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PAPERS

Conceptualising Global Cities: Analysing the Role of Global Cities in International Affairs

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Abstract

International relations (IR) as a discipline is state centric, but in the era of globalization cities have become significant. The rise of global cities as key nodes or command points of power have become fulcrum of political-economic activities, playing an important role in global economy, information industry, global governance thereby becoming an important economic, political and social entity, poses a challenge to the conventional state centric international system. It enables us to revisit the process of destabilization, de-nationalisation, de-territorialisation in age of globalization reincarnating the role and position of cities in international system and market society. The core research agenda delves into vital issues of the emergence of global cities in transforming the logic of international system and the role they play in global political order. The key concern is that no single definition of global cities can be formulated, since have evolved over time and have taken new shape and functions. The global cities are culturally, politically and economically are open ended as a concept which has given new dimension to international politics. The paper aims to theoretically analyse the origins of global cities, linkages with globalisation and its role in multi-scalar political order, engaging in new governance role at national and international level bringing about a shift in global political order and international political dynamics.

Keywords*: global cities, international politics, globalisation.*

Introduction:

Cities as a topic of research have failed to gain the required attention in field of international politics. International relation as a discipline is state centric, but in the era of globalisation, the analyses of cities have become significant. The rise of global cities poses a challenge to the conventional state centric international system. It enables us to revisit the process of destabilisation, de-nationalisation, de-territorialisation in age of globalisation. The phenomenon of globalisation has reincarnated the role and position of cities in international system. The process of contemporary globalisation has revived the interest in study of cities and their changing relations with states (Alderson, 2004). Cities are now treated as the key nodes or command points of power (Sassen, 2002). Global city can be considered as an anchor for studying the growth of transnational network, social polarisation and inequalities along with the social, cultural and relational aspect prevalent within the domain of globalisation process. The concept of global cities by Sassen (1991) has been an important contribution as to how cities are central to globalisation. It is not just the nodes of international trade and bounding system but goes beyond that making them qualitatively new historical development.

Methodology:

The study seeks to explore the concept of global/world city in inter-state system and explore their relation with states, their negotiation with each other and re scaling of both the entities. The

World city/ Global city are the standpoint for studying the state structures in the epoch of globalisation. The theoretical paper looks into the role of cities in global arena through pages of history; the concept of global cities and the significance of global cities in international affairs through a qualitative methodology. It has taken recourse to several secondary resources and looked into the gaps present in the literature and aimed to come out of the rigid determinism.

Exploring Theoretical Approaches:

Cities have become vital to the understanding of these epochal changes and global cities of today reflect the dynamic relation between the globalization and cities; globalization and urban development (Brenner and Keil, 2006). Being a product of particular historical context; the cities have been the backbone of infrastructure, economy, decentralization and development (Curtis, 2010). There have been several ways in which authors have looked at global cities mainly focusing on the economic aspects and the interconnectivity or the linked networks. Sassen (2001) clarifies that the term "global cities" had been coined by her was done purposely to distinguish from the "world cities" of Friedmann and "global – city regions" of Allen Scott. Defining global cities has been a daunting task since there has been no definite criterion to understand them. However efforts have been made to refine and rework the definition by different scholars each emphasizing a particular interpretation of the concept. The *world city* concept can be drawn from the papers of Wolff (1982) and Friedmann (1986) which looked at the cities as growth of global urban networks at the background of geographical transformation of capitalist world economy. According to Friedmann (1986:70) a city is a "spatially integrated economic and spatial system at a given location or metropolitan region…" Cities are seen as anchors for global capital and they differ from each other in terms of mode of integration with global economy, historical background, national policies, and cultural impact. The world cities have been identified as a joint between globalization and urbanization process.

Sassen (1991) distinguishes global city from world city and looks afresh at the functionality and centrality of the cities in global economy and the services that provides valuable knowledge, skills and technology which enables to create suitable environment for economic and financial activities to thrive in the cities. The transnational environment brings a myriad connection between the services that provides the formation of transnational urban system (Sassen, 2001).Global cities are sites of production services, crucial command points and nodes of international economies.

Taylor (2004) on other hand laments the lack of robust research to understand global cities which includes confusion in defining the global cities a term often collaborated or interchangeably used with world cities. He recognizes the fact that the development of information technology and the emergence of digital age have allowed to reinforce in today's world as global cities. From the economic point of view the global cities constitute wide range of attributes such as attractive centre of employment, business transaction, and coordination of economic activities, specialization of banking and insurance, education and cultural hub, centre of innovation, creativity and knowledge. Such wide is the range of processes comprising global cities. At

present scenario it is the production services, entertainment, culture, consumption that characterizes global city more and are making them competitive also.

Understanding global city in context of territorial rescaling has given rise to *global city regions.* It is a term popularized by Allen Scott (2001) who comprehends global city region as new territorial key units in post Fordist global economy. Most of the literatures on cities look at economic standpoint rather than socio-political aspects. These different starting points and variables gives a diverge perspective on the city as the node in transnational network-its role and function as key agent in the urban network. These networking are cutting across the core periphery divide where we find semi peripheral cities like Mexico city, Mumbai, Dubai are well connected to global services (global city) but not simply a centre of power and dominance in the world economy (world cities). They however influence the economy of the nation, region and are affected by the ups and downs of global economy.

Global Cities in International Affairs:

Based on the research findings it can be said that the global cities are the product of the globalisation world touching upon not only the economic aspect but painting the canvas of identity, culture and society. It has redesigned the role of state since the states aid in attracting capital flows and realises that it can no longer engage in capital accumulation, giving space global cities. Cities though are vital and have carved a space for themselves; the states continue to play a significant role in policy making. In fact the future of the cities and urban development rests on the good policies of the state which facilitates growth and vibrancy in the economy and society. In case of states they are defined in terms of power, accumulation, coordination, maintenance of national trust. Global cities are vital in rescaling the national territorial state system and understand the process of economic-socio-cultural and political engagements at three levels-units, state and international.

The linkages between globalization and cities have been the starting point for studying various sociological, economic and political transformation as well as power configuration. Globalisation is a multidimensional process which not only divides but also integrates fully. Cities are pro active in the globalized economy. Anything that happens in the global economy is bound to effect cities since the cities are centres of world economy. Today cities are worth studying because world economy is integrating. The interdependence in the global economy is strengthened by the intercity networking. Globalization as a process has touched the cities in some way or the other and this wave of globalization has unfolded the new patterns of polarization, exploitation and people are affected by the development process positively as well as negatively.

The conceptualization of global cities will be broadened with new indices rather than simply taking the number of corporate, headquarters, stock exchange, presence of international banks, workforce percentage we need to also look at the cultural and institutional settings. Understanding global city and the evolution of the concept catches the moments for the creation of theories and ideas pertaining to global city. There has been questioning and criticisms of the

stagnancy of global city thesis. There needs to be a conscious move to include larger number of cities and bring the understanding of the concept out of the biasness towards only few cities since these new cities of the south broadens the concept of global cities with their own nuances (Robinson 2006).

The new global network of cities has become a terrain for politics and engagement of several facets of social and economic activities. Many cities have emerged as a strategic site for global capital, transnational migration, identities and communities. These networked cities become the mechanism for the coordination of the global economy. The economic globalization breaks down the nation state into several components which are significant in understanding of the cities. There has been a change in the traditional urban networks and this has led to the emergence of new global cities such as Shanghai, Rio De Janerio, Mumbai, Sao Paulo which are capturing businesses, interacting with new institutions and specialized services.

Global cities are strategic not only from the economic point of view but also from the political, and cultural view point. They constitute a different cultural agglomeration, corporate culture, multiple identities. (Sassen, 2005).Cities cannot be studied as a singular product of one event but rather as a complex interaction of urban with the global engagements. Global cities reflect fundamental changes in territorial state which had often been missed by the eminent scholars working on global cities. Global cities also enable us to focus on agent- structure debate. The emergence of global city in developing countries opens the door for new role of state vis a vis the cities which calls for changing dynamics in the state- city relations. The contemporary intertwining of the cities and states is a complex fusion of centralisation and decentralisation (Sassen 2000).

Conclusion:

On the basis of the research findings it can be concluded that globalisation networks of inter linkages leading to the emergence of the global cities enabling us to rethink the role of state at the backdrop of the rising powerful cities that have become the nodes of economy, information technology, and political, economic and social activities thereby becoming an important entity in international politics. The role of cities varies widely across the regions in fields of economy, politics and social – cultural milieu.

There has been a massive restructuring within the countries enabling the shifting of commerce away from many traditional urban centres towards the cities which demonstrates market advantage. This has changed the role of state which is now refocusing to facilitate markets, accelerate economic process, social stability, and to ensure equity. The state has been a key agent facilitating global processes and has emerged altered in the process. Yet sovereignty and territory remain the key features of the international system (Robinson, 2009).

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**The article is a version of my M.Phil dissertation entitled, "Global' Cities in the Inter-State System: Analysing Systemic Transformation" under the supervision of Prof. Jayati Srivastava submitted in year 2014.*

Reformation and Protection of Juvenile – Multidimensional Analysis

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Abstract

Children are hope and aspiration of any state, they are the builder of our future but at the same time juvenile delinquency has become a very imperative multidimensional issue which calls for immediate attention to reform and protect juvenile. This paper is in two parts, first part analyses the causes and factors for delinquency in children as the circumstances and situations through which a child goes plays a very intrinsic role in determining their behavioral output, while traversing through adolescence to adulthood which is the most important transitional phase, delinquent children manifest element of criminality, the roots of which can be traced back to the inception of childhood which may be very difficult to identify at an alpha stage. Element of criminality in children is nothing but a high degree of complexity which needs to be handle with due care and sensitiveness. The Second part of the paper examines the laws enacted and institution established for reformation and protection of the delinquent children, further, it scans the contemporary legal framework protecting the interest of juvenile and various measure and approaches taken to prevent juvenile delinquency focusing on the Indian states from the operational point of view of juvenile legislation. The criminality in juvenile is indeed a complex issue but it is preventable with the perfect blend of psychology and criminal justice system.

Keywords: *Theories and Factors of Delinquency Psychological Dimension of Delinquency Indian Juvenile Justice System.*

Juvenile delinquency refers to the behavior by youths under the age of 18 years of age which is not acceptable to the society and is generally regarded as calling for some kind of admonishment, punishment or corrective action[1]. Juvenile delinquent means a minor guilty of criminal behavior which is punished by special laws not pertaining to adults[2]. Differing from the legal definition of juvenile delinquency psychologists lay much emphasis on upon the causes of the juvenile delinquency in defining it.[3] Most importantly, the problem of youth violence cannot be viewed in isolation.[4] Many theories have been put forth for juvenile delinquency. Such as, *scientific theory* which may be defined as a set of two or more related empirically testable assertion.[5] According to *classical school*, people were thought to behave according to rational calculations of pleasure and pain they are expected to receive as a product of their

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actions.[6] *Rational-Choice Theory/postclassical theory* of the 20th century also involve the notion that before people commit crimes, they rationally consider the risks and rewards. [7] *Deterrence Theory* states that the way to prevent future delinquent acts is to adjust the risk (pain) of the act so it outweighs its rewards (pleasure).[8] *Developmental Psychopathology* gives the broad perspective for understanding and addressing criminal offences during the transition from adolescence to adulthood. [9] Factors contributing to delinquency are thus to be found not only in the mental and physical make-up of the individual, but also in his present and past environments. [10] Research has documented the magnitude of youth violence and the trends in that violence over time. But what do we know about *why* young people become involved in violence? Why do some youths get caught up in violence while others do not? There is no simple answer to these questions, but scientists have identified a number of things that put children and adolescents at risk of violent behavior and some things that seem to protect them from the effects of risk. [11] *Risk factors* have been broadly defined as those characteristics, variables, or hazards that, if present for a given individual, make it more likely that this individual, rather than someone selected from the general population, will develop a disorder. [12] To determine whether a risk factor is a predictor or possible cause of violence, the risk factor needs to be measured before the violence occurs.[13] *Protective Factors* appears as an alternative or a complementary approach for the risk behavior prevention [14] and the *protective*

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factors buffer the effect of *risk factors*.[15] Tracing the history of juvenile legislation, laws and legal procedures relating to juvenile offenders have a long history, dating back thousands of years. *The Code of Hammurabi (2270 B.C.), Roman civil law and canon (church) law* 2,000 years ago distinguished between juveniles and adults based upon the idea of "age of responsibility."[16] The first legislation on juvenile justice in India came in *1850* with the *Apprentice Act*.[17] The next landmark legislation was the *Reformatory School Act, 1876 and 1897*.[18] The *Reformatory School Act of 1876* which had a provision to empower the government to establish reformatory schools and to keep young criminals there till they found employment.[19] Another significant development in Indian Juvenile Justice came after the release of the *1919-20* report by the *Indian Jail Committee* following its recommendations Madras became the first state in India to pass the first *Children Act of 1920*, the example of Madras was followed Bengal and Bombay in 1922 and 1924 respectively and Children's Acts for these states were passed. More States followed suit in the years to follow and passed their Children's Act. [20] Further which, the Government of India duly ratified the *U.N. Convention on the Rights of the Child, 1989* and as a sequel to the *U.N. Rules of 1985* the first Central law on the subject, the *Juvenile Justice Act, 1986* [21] was passed in pursuance of the *Beijing Rules 1985*. Further which the Government of India ratified the *United Nations Convention on the Rights of the Child in 1992*. Hence, the *1986 JJ* Act had to be reviewed and changes had to be made. Subsequently, it was repealed and the *Juvenile Justice (Care and Protection of Children) Act 2000* was passed taking into consideration all the International standards prescribed as per the Convention on the *Rights of the Child, the Standard Minimum Rules for the Administration of Juvenile Justice, 1985 (Beijing Rules)*, The *UN Guidelines for the Prevention of Juvenile Delinquency* called the *Riyadh Guidelines, 1990* and the *United Nations Rules for the Protection of Juveniles Deprived of their Liberty (1990)*. [22] The *Juvenile Justice (Care and Protection of Children) Act, 2000* has been amended twice in *2006* and in *2011*. The Government of India is now contemplating re-enacting a new *Juvenile Justice*

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Act, 2014. [23] Henceforth, tracing the causes and factors of juvenile delinquency, laws have been enacted and amended for the care and protection of children and prevent delinquency.

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A Proposed Study of Algebraic Content and Pedagogical Knowledge of Sixth Grade Mathematics Teachers

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Abstract
Algebra test scores of the primary through higher secondary students are the lowest compared to any other area of mathematics in the Maldives. Algebra is a fundamental topic in mathematics. Strengthening algebra instruction could improve student achievement as research indicates effective instruction improves student performance significantly. To strengthen algebra instruction it is important to identify the algebraic content and pedagogical knowledge strengths and weaknesses of mathematics teachers as ability to teach algebra is highly influenced by these forms of knowledge. Specifically, sixth grade mathematics teachers are the ones who lay the foundation on which students can later construct more sophisticated algebraic understanding. This proposed concurrent mixed methods study is guided by Shulman's Major Categories of Teacher Knowledge and Ball's Domains of Mathematical Knowledge for Teaching. This study aims to understand algebraic content and pedagogical knowledge of sixth grade mathematics teachers across the Maldives. Quantitative data will be collected through Diagnostic Teacher Assessments of Mathematics and Science whereas qualitative data will be gathered through lesson observations, interviews, and analysis of lesson plans and notes. Quantitative data will be analyzed for algebraic content and pedagogical knowledge while qualitative data will be analyzed for themes and patterns, allowing for an in-depth understanding of teacher's algebraic content and pedagogical knowledge. This study is expected to contribute positively towards improving algebra instruction, thereby improving student achievement nationally and internationally.

Keywords *Learning algebra, teacher knowledge, teaching algebra*

Introduction

A teacher's ability to teach mathematics content is subjective to the mathematical content and pedagogical knowledge of the teacher (26; 30). Shulman (1987) discussed categories of teacher knowledge that included content and pedagogical knowledge. In 2008, Ball and her colleagues refined Shulman's Major Categories of Teacher Knowledge and developed a model called "Domains of Mathematical Knowledge for Teaching", which also included mathematical content and pedagogical knowledge. Content knowledge was defined as the subject matter knowledge whereas pedagogical knowledge referred to the unique knowledge required to teach the subject specific content (3; 28).

Mathematical content and pedagogical knowledge of teachers had been linked to students' ability and performance in subjects including algebra (16; 30; 31; 32). Algebra is a fundamental topic in mathematics that serves as a gateway to a journey that gives students the skills necessary for mathematical reasoning and complex problem solving (12; 30). Research indicated that algebra is a topic students find difficult. Many students fail to achieve basic algebraic literacy that can prove to be a barrier to entry into careers in the sciences, engineering, technology, and business (8; 23; 30; 35). Research indicated that students face numerous difficulties in understanding algebra due to lack of understanding of symbols and letters, and of manipulation of algebraic expressions and equations (4; 30). Welder (2012) pointed out that these difficulties could be due to the existing knowledge students have that may be incomplete or misunderstood. A baseline study conducted in the Maldives between 2012 and 2013 indicated students scored the lowest in algebra compared to any other topics in mathematics (34). The study reported that students lacked conceptual understanding (34).

It is widely believed that teachers who have a deep understanding of the content and pedagogy lead to better student performance as they will have better instructional practices than teachers who lack an in-depth understanding of the content and pedagogy (1; 8; 15; 25; 27). Brown and colleagues (2011)

reported that students taught by teachers equipped with the ability and knowledge to teach mathematics effectively produced six times better results compared to the students taught by teachers who lacked the ability and knowledge to teach mathematics effectively. Though it is unclear whether it is content knowledge, or pedagogical knowledge, or both content and pedagogical knowledge that lead to better student performance, it is obvious from the literature that the ability to teach mathematics depends on the mathematical content and pedagogical knowledge of the teachers (6; 26; 30).

Research on teacher knowledge and student performance have produced mixed results (1; 9; 17; 27). Some studies showed teacher knowledge had a positive effect on student performance while other studies showed that teacher knowledge had a negative effect on student performance (6; 27; 30; 33). According to Thames (2006) these inconsistent results led researchers to ponder whether there was a problem in the way teacher knowledge was measured as the number of mathematics courses taken at university was used to as a measure of teacher knowledge in many of those studies. Use of variables such as number of mathematics courses taken at university, or grade point average to measure teacher knowledge was seen as inappropriate due to the complexity in measuring such variables and its poor approximation of teacher knowledge (6; 9; 17; 33).These mixed results led researchers to explore what types of knowledge teachers should really have in order to teach mathematics (6; 33).

Teachers who introduce algebra to students are responsible for building a solid foundation on which students can later construct more sophisticated algebraic understanding (30). Numerous studies have been conducted to identify the difficulties and misconceptions students have in learning algebra (5; 7; 10; 22; 29; 35). Research indicated that at times students incorrectly interpreted letters as objects (22; 29; 35). Tennant and Colloff (2014) linked this incorrect interpretation of letters to the approach used by teachers in introducing early simplification of algebra that is influenced by the algebraic content and pedagogical knowledge of the teacher (2; 13). Understanding the algebraic content and pedagogical knowledge strengths and weaknesses of mathematics teachers would contribute positively towards improving mathematics education in general and strengthening algebra instruction in particular. Therefore, the purpose of this study is to examine the algebraic content and pedagogical knowledge of sixth grade mathematics teachers in the Maldives to determine their relative strengths and weaknesses to serve as the foundation for the development of teacher professional development curriculum.

Theoretical Frameworks

This study is guided by two theoretical frameworks, namely, Shulman's Major Categories of Teacher Knowledge (1987) and the Domains of Mathematical Knowledge for Teaching proposed by Ball, Thames, and Phelps (2008). Lee Shulman outlined the categories of knowledge required by a teacher to teach, and for the first time pedagogical content knowledge was mentioned in education. Ball and her colleagues developed Shulman's idea of pedagogical content knowledge and linked that to content knowledge. In addition, Ball and her colleagues developed a model that focused specifically on the knowledge required to teach mathematics.

Shulman's Major Categories of Teacher Knowledge

The first is the Shulman's Major Categories of Teacher Knowledge. In 1987 Shulman outlined seven categories of teacher knowledge required for a teacher to teach. According to Shulman (1987, p. 8) they are:

Content knowledge;

General pedagogical knowledge, with special reference to those broad principles and strategies of classroom management and organization that appear to transcend subject matter;

Curriculum knowledge, with particular grasp of the materials and programs that serve as "tools of the trade" for teachers;

Pedagogical content knowledge, that special amalgam of content and pedagogy that is uniquely the province of teachers, their own special form of professional understanding;

Knowledge of learners and their characteristics;

Knowledge of educational contexts, ranging from the workings of the group or classroom, the governance and financing of school districts, to the character of communities and cultures; and
Knowledge of educational ends, purposes, and values, and their philosophical and historical grounds.

Domains of Mathematical Knowledge for Teaching

The second theoretical framework that guides this study is the "Domains of Mathematical Knowledge for Teaching" proposed by Ball, Thames, and Phelps (2008). The "Domains of Mathematical Knowledge for Teaching" was built on Shulman's theoretical framework connecting content knowledge to practice of teaching (3). According to Ball et al. (2008), in 1986 Lee Shulman and his colleagues put forward a domain of teacher knowledge which linked content knowledge and teaching, and they called it pedagogical content knowledge. Since then, this domain has gained the popularity and Shulman's idea has been cited in more than 1,200 refereed journal articles in 125 different journals in "professions ranging from law to nursing to business, and regarding knowledge for teaching students preschool through doctoral studies" (3, p. 392).

Ball (2008) and her colleagues refined Shulman's categories and proposed the model in Figure 1. Figure 1 shows the Domains of Mathematical Knowledge for Teaching. This has been cited 2,029 times since then.

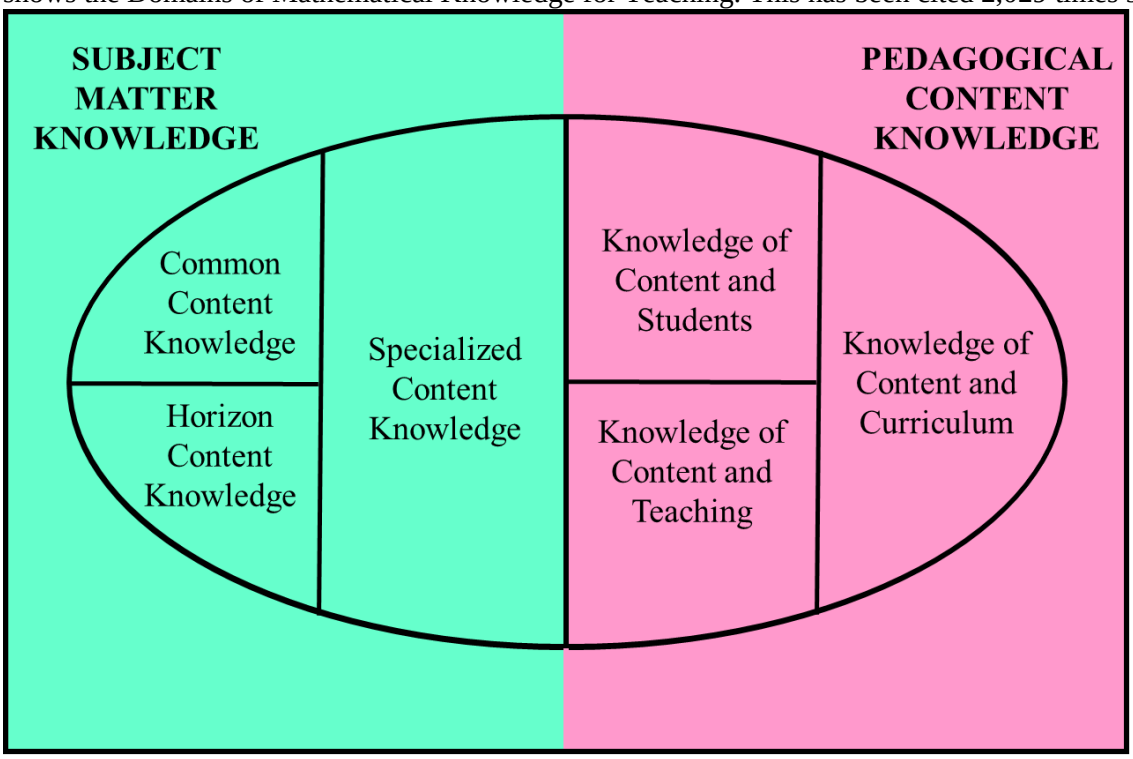

Figure 1. Domains of Mathematical Knowledge for Teaching (Ball, et al., 2008).

Ball (2008) and her colleagues proposed six domains, namely, common content knowledge; horizon content knowledge; specialized content knowledge; knowledge of content and students; knowledge of content and teaching; and knowledge of content and curriculum (as shown in Figure 1). These six domains come under two main categories – subject matter knowledge and pedagogical content knowledge. Mathematical content knowledge which is also referred to as subject-matter knowledge is a critical aspect of teacher knowledge as teaching requires helping others to learn, and therefore, understanding what is to be taught is fundamental to teaching (2; 3). Pedagogical knowledge covers the knowledge required to teach the subject specific content which include understanding students' misconceptions and knowing how to remedy those misconceptions (3; 13; 35).

Methods

This study aims to examine the algebraic content and pedagogical knowledge of sixth grade mathematics teachers in the Maldives using a concurrent mixed methods multi case study approach. The main reason

for selecting a mixed methods approach is the increasing use of the approach in mathematics education research to gain an in-depth understanding of the problem under study. Mixed methods research is found to complement the results obtained through either quantitative or qualitative approach only, making the results more meaningful in terms of what could be done in future to address the issue studied (11; 14; 21). Fourteen sixth grade algebra teachers employed in the selected schools are eligible to take part in the study. These teachers will be approached and those who consent to take part in the study will be selected. As this is an in-depth study, a study of a few cases would suffice (14, 18). All data collected will be kept confidential to prevent the participants from any harm or negative impact that may come due to the findings of the study. Qualitative data will be collected through observations of algebra lessons, analysis of algebra lesson plans and notes, and interviews with the sixth grade algebra teachers while quantitative data will be collected using Diagnostic Teacher Assessments of Mathematics and Science. Collecting both qualitative and quantitative data will not only help to gain an in-depth understanding of the problem but also it would help to triangulate the findings (24). Content of the qualitative data collected will be analyzed for themes and patterns (20) while quantitative data will be sent to Center for Research in Mathematics and Science Teacher Development staff for a detailed analysis of the algebraic content and pedagogical knolwege of the sixth grade mathematics teachers in the Maldives.

Discussion

Educational leaders are concerned about the growing problem of teachers not possessing the content knowledge required to teach mathematics (25). Mathematics education researchers have been calling for the better preparation of mathematics teachers (19; 25; 31). Education researchers advocate that professional development activities should be planned to address these issues and in-service mathematics teachers should be encouraged to take part in these professional development activities (25).

As this is the first study of its kind in the Republic of Maldives, this study could contribute to the improvement in algebra instruction as a result of what is learned about the algebraic content and pedagogical knowledge strengths and weaknesses of sixth grade mathematics teachers. Firstly, the results of this study could contribute to the improvement in algebra instruction by suggesting ways teachers could modify their instruction of algebraic concepts to ensure students build conceptual understanding of the subject. Secondly, the results from this this study could be used to inform the pre-service teacher training curriculum. Thirdly, the findings of this study could also be used to tailor professional development curriculum for in-service teachers. Lastly, the strengths and weaknesses of teacher content and pedagogical knowledge could be communicated to teacher education institutions to strengthen the teacher education programs thereby contributing positively towards the betterment and enhancement of mathematics education.

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Between Arrival and Departure: Narrating boundaries and Experiences from Transit Spaces

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Abstract

In the14th century, a group of pilgrims set forth in the sweet showers of April to the Canterbury festival. En route they stopped at an inn and the inn keeper came up with the idea that each of them would tell stories on their way to and back from Canterbury. The Tabard inn was their transit point from where they shared tales reflecting their experiences of the world which were written by Geoffrey Chaucer in The Canterbury Tales.

Centuries after Chaucer's work, when global travellers criss -cross the world, their transit spaces are airport terminals, visa offices, duty free shopping areas, bus ride tour of cities during stopovers. Transit spaces are also refugee camps, border fences, mid-seas. These momentary locations through ever shifting physical spaces dissolve boundaries. These spaces which provide a state of borderline and liminality are associated with contemporary geographical, economical and political questions.

Transit points provide spaces of passage linking departure and arrival. The modern airport stands as a prime example with its forced multiculturalism. This space is based on the idea that everyone is from different places. So are the other spaces where there is always a 'coming and going' and a moving back to home and nation. Narrations from transit spaces explore themes of feeling lost, finding a sense of purpose, coming together with strangers with the comfort of anonymity and moving forward on life's long journey ahead.

This paper is an attempt at understanding space boundaries and experiences from writings in English (selected writers) to see how narrations from temporary locations create lasting stories of the global soul's endless quest for life's meaning.

Keywords: *transit space, liminality, journey*

Between Arrival and Departure: Narrating Boundaries and Experiences from Transit Spaces

So important have stories been to mankind that they are not restricted

to accounts of initial creation but will be found following human

societies as they recreate themselves through vicissitudes of their

history, validating their social organizations, their political systems, their

moral attitudes and religious beliefs, even their prejudices... but they

also serve to sanction change when it can no longer be denied. At such

critical moments new versions of old stories or entirely fresh ones tend

to be brought into being to mediate the changes and sometimes to

consecrate opportunistic defections into more honourable rites of

passage.

-Chinua Acheb *(Hopes and Impediments,163)*

The words arrival and departure draw attention to travel time with both being pre-decided points in travelling. All journeys begin with a departure and end at an arrival, where both may not be the same place always. This apparently very simple concept of going and coming takes on deeper and richer meanings in human journeys, where the experiences gained help to interpret and form our views of the world. And if these experiences are documented, they contribute to a literary genre named travel writing.

Travel writing is an interdisciplinary genre, which in recent times has become an important area of study. It is closely linked to issues of imperialism, diaspora, multiculturalism, nationalism, identity, gender, globalisation, colonialism and postcolonialism. It brings into play ideas of transculturalism, centre/margin, border crossings, hybridity, location and displacement.

There are also experiences which are not written or cannot be written – the endless stream of humanity termed refugees struggling to enter lands not their own, leaving behind homes to which they may never return; journeys ending mid seas with death, left to the mercy of the waves to wash the human remains to some shore. The previous year presented us with stories of human journeys, where spaces between departure and arrival have been filled with despair, uncertainty, fear of death, starvation, and rejection of human dignity. People have stood at the threshold, between death and hope for a better life; between war and peace, waiting in constant transit at points such as refugee camps, no man's land, border fences, mid seas.

These mid points of journeys present a liminal state where human beings are stripped of anything that might differentiate them from their fellow humans. Liminal, derived from the Latin word *limen*, meaning threshold refers to a transitory, in-between state or space which is characterised by indeterminacy, ambiguity, hybridity, potential for subversion and change. As a transitory space it foregrounds the temporal border. It also constitutes a border zone which not only becomes productive of new meanings, social relations and identities, but also disrupts and subverts established entities, and is associated with contemporary geographical, economical and political questions.

In literary and cultural studies the concept has been successfully adopted to circumscribe a being on the border, or on the threshold, dividing distinct spheres, identities or discourses. Homi Bhabha writes, "This interstitial passage between fixed identifications open up the possibility of a cultural hybridity that entertains differences without an assumed or imposed hierarchy.*"(The Location of Culture, 5)* This space according to Bhabha is characterised by disorder, asymmetry and instability. These ever shifting physical and emotional spaces call for an understanding of space, boundaries and experiences through a reading of selected writings in English from transit spaces. A reading which will lead to an understanding of how transit points in travelling have changed with time; how important are they as locations for discourses; how do they influence the course of the longer journey; and what stories emerge from such spaces. Narrations from transit spaces need to be read to understand how momentary locations create lasting stories of human's endless quest for life's meaning.

In the fourteenth century, a group of pilgrims set forth in the sweet showers of April to the Canterbury festival. En route they stopped at an inn and the inn keeper suggested that each of them would tell stories on their way to and back from Canterbury.

...I prey yow, in desdeyn.

This is the poynt, to speken short and pleyn,

That ech of yow, to shorte with oure weye,

In this viage shal telle tales tweye,

To Caunterbury-ward, I mene it so...

(The Prologue to the Canterbury Tales, 147)

The Tabard Inn was their transit point from where they shared tales reflecting their views of the world. Geoffrey Chaucer's characters express vastly different views of the world. The concept of liminality figures prominently within the Canterbury Tales. Norma J. Bishop writes that a lliminal space which can be both geographical as well as metaphorical or spiritual, is the transitional or transformational space between a real (secure, known, limited) world and an unknown or imaginary space of both risk and possibility. *(Liminal Space in Travellers' Tales, Web)* The notion of a pilgrimage is itself a liminal experience, because it centres on travel between destinations and because pilgrims undertake it hoping to gain something in the process.

Each character gives different readings of the world – operations of God at the expense of physical reality, sermons insisting on prudential or orthodox morality, romances privileging human emotions. Liminality is evident in the individual tales of love, marriage, interpretations of dreams, medieval medicine or corruption in religious institutions. The Friar's Tale is an example where the yeoman devil is a liminal figure because of his transitory nature and function. It is his work to issue souls from their current existence to hell. The Franklin's Tale invokes both the interaction of the supernatural and the mortal, between the present and the imagined past. Jean E. Jost summarises the function of liminality in The Canterbury Tales as:

Both appropriately and ironically in this raucous and subversive liminal space, a ragtag assembly gather together and tell their equally unconventional tales. In this unruly place, the rules of tale telling are established, themselves to be both disordered and broken, here tales of game and earnest...will be set and interrupted. Here, the sacred and profane adventure begins, but does not end. Here, the condition of peril is as prominent as that of protection. The act of pilgrimaging itself consists of moving from one urban space, through liminal rural space to the next urban space with an ever fluctuating series of events and narratives punctuating those spaces. The goal of pilgrimage may well be a religious or spiritual space at its conclusion, or reflect a psychological progression of the spirit, in yet another kind of emotional space. (Fundamentals of Medieval and Early Modern Culture, 375)

Centuries after Chaucer's work, when global travellers criss-cross the world, their transit spaces are now airport terminals, visa offices, duty free shopping zones, bus ride tour of cities during long stopovers. The modern airport stands as a prime example with its forced multiculturalism based on the idea that everyone is from different places. Here people arrive with the conviction of knowing where they are going. This space gives a sense of freedom, anonymity, escape, and eradicates boundaries. In the midst of constant coming and going lies the joy of moving back to home and nation. But not all travellers share this joy – the stateless ones who do not have a nation to go back to, nor can enter another space.

Let us begin the modern stories from transit spaces with them – stories of people who are in legal immigration limbo and not technically allowed into any country. Cases of statelessness have been brought to wide public attention in airports due to their status as ports of entry. The first story is of Mehran Karimi Nasseri, an Iranian refugee who lived in the departure lounge of terminal one in Charles de Gaulle airport in Paris for eighteen years from 1988-2006. Having no country to return to, he spent these long years waiting after which he was shifted to a shelter home. Similar is the story of Zahra Kamalfar, another Iranian Refugee who lived for ten months at Sheremtyevo International Airport, Moscow with her son and daughter till they were granted asylum in Canada in 2007. It was from the airport that she appealed to the world to help her and her children with basic human needs and to find them a home.

The stories of the real world are stranger than those in fiction. The creative art of writing allows fancy and imagination to take over the story. Rana Dasgupta's *Tokyo Cancelled* (2005) narrates thirteen stories by passengers stranded at an airport when their flight to Tokyo is cancelled due to bad weather. The passengers form a huddle by the silent baggage carousels to tell each other stories. Read by critics as the Canterbury tales of our times, the stories combine modern urban landscape with the timelessness of fairy tale ethos, bringing to life a cast of extraordinary individuals. Their stories are robust enough to incorporate all with equal dignity – industrialists, film stars, shadowy characters, illegal immigrants and migrant labours. Each story is set in a different contemporary city – New York, Istanbul, New Delhi, Tokyo, Lagos, Frankfurt, London. They are stories without borders, narrating global spaces, told by global citizens who are lost, confused, happy in a world that remains ineffable, inexplicable and yet wonderful. Rana Dasgupta believes that , " The airport is an obvious meeting place for a group of contemporary travellers. But it is also a cold and intimidating space to spend a night in, and it seems to demand of stranded travellers that they fill it with stories in order to make it habitable. The airport can therefore be a place to stage storytelling as the most primordial communication between human beings and the unknown*." (Tokyo Cancelled, 3)* Told by people on a journey, these stories are about life in transit, stories that grow into an epic cycle about the hopes, dreams, disappointments which connect people everywhere -story tellers/ listeners/ readers.

The Rendezvous in Istanbul is the story of a merchant who is led by a wingless bird back to a lost lover. Set in New York, *The Store on Madison Avenue* is the story of Robert De Niro's son who masters the transubstantiation of matter and turns it against his enemies. *The Memory Editor* is the story of a man who manipulates other people's memories and finally has to confront his own past. *The Doll* is the story of a Japanese entrepreneur who risks losing everything in his obsession with a doll. *The House of the Frankfurt Mapmaker* is the story of a Turkish girl who is left in the house of a German who is mapping the world.

Rana Dasgupta's narration weaves magical elements into the stories, providing an escape from human greed, misdeeds, imbalances and shortfalls. The magical world reminds one of the thousand and one stories told by Scheherazade. Also known as the *Arabian Nights*, the stories are narrated from a transit space between life and death. The princess, though aware of an impending death at dawn does not let its fear creep into her tales. Instead she fills her stories with magic lamps, flying carpets, secret treasures, wish fulfilling agents, endless fountains of joy, unfading flowers, beauty and youthfulness. She also creates suspense to hold the interest of the king to allow her to continue her stories to the next night, thereby postponing death.

There is also the story of one who could not postpone her death, but narrated the story of her life before her execution. Nawal El Saadawi's *Woman at Point Zero (1975)* is the first person account of Firdaus from Qanatir Prison in Egypt. She had been convicted for murder and made no efforts to save herself. Her story is of one who lived in the margins of society facing poverty which led her to prostitution, exposing society's brutal treatment of women. Firdaus's story reaches everyone regardless of border and gender. Nawal el Saadawi wrote:

Firdaus is the story of a woman driven by despair to the darkest ends. This woman, despite her misery and despair, evoked in all those who, like me, witnessed the final moments of her life, a need to challenge and to overcome those forces that deprive human beings of their right to live, to love and to real freedom.(Woman at Point Zero, xii)

Shifting the narration from prison houses to visa offices, the atmosphere is one of hope and promises of visiting another country. Chimamanda Ngozi Adichie's short story *The American Embassy* narrates the story of a Nigerian woman who watches the long wait for a US visa, but when her turn comes for the interview, she is unable to leave behind the memories of her dead son, or prove to the interviewer that her life was not safe in Nigeria and would therefore seek asylum in a country which promised her a new life.

Chitra Banerjee Divakaruni's *One Amazing Thing* (2010) is set in an Indian Consulate. In an unnamed American city the persons waiting for an Indian visa include a teenager, an upper class Caucasian couple whose relationship is disintegrating, a young Muslim man struggling with the fallout of 9/11, a graduate student, an African –American ex-soldier searching for redemption, a Chinese grandmother with a secret past. There are also the office workers. An earthquake traps these characters together in their collective efforts to survive. With little food and the office beginning to flood, psychological and emotional stress, the young graduate student suggests that each tell a personal tale – one amazing thing from their lives which they have never told anyone before.

Surprising stories of romance, marriage, family, political upheaval and self-discovery unfold against the urgency of their circumstance. The transitory nature of the space provides a sense of anonymity, a certain belief that they may never meet again and so from the comfort of that feeling deep secrets, lies, confessions and sorrows emerge. Jiang is a Chinese from Calcutta who was forced into a marriage and sent to the United States during India's 1962 war with China. She now wants to return to her old city to meet her brother, and narrates her story of a long lost love. Uma, a young graduate tells how a lie comforted her friend during her dying moments. Chitra Banerjee's stories reflect the powerful art of storytelling, how it can envelop us all with a blanket of comfort, giving warmth to our wishes and desires to share the beautiful and pleasant thoughts. At the same time, stories also help to unburden the pain, sufferings, unbearable truths, trauma and sorrows, revealing what it means to be human.

To go back to Achebe's quote, stories are indeed powerful and can create lasting impressions on our minds. Fictional accounts from transit spaces like airport terminals or visa office have the luxury of being light hearted, unreal, and unbelievable and may end with the next announcement for departure. They may be worth remembering for the rest of the journey or may even be remembered and retold a long time after. But how would the world remember the stories of those who do not reach anywhere, those incomplete journeys which end before arriving?

Would only the images of a little boy lying lifeless on the shores of death suffice for the stories of countless Syrian children fighting their own battle with the world to find a safe place? Would the media coverage of watery deaths from capsized overcrowded boats tell the stories of people who risk their lives to be called illegal immigrants? Would the pleading look on the faces of Rohingyas quenching their thirst with the rain survive to tell their stories of what it meant to have been floating mid sea, waiting for a friendly shore to welcome them? Would the accounts of the Tibetans waiting in a long transit for freedom be told only through their non-violent protests?

The answers to all these questions lie in the stories which are yet to be told. The untold, unwritten and lost stories should find a way to seep into our readings, our engagements with the affairs of the world, our concerns for the future, and the documentation of human history. Transit spaces would then become locations for new discourses and meaning, agencies for change, not only of narrations but would also help to shape, review and recreate policies on issues related to immigration, refugee crises, asylum, and above all human rights.

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Use of mobile phone for agricultural knowledge mobilization: Exploring the case of "subsistence farmers in the bottom-of-the-pyramid" in Batticaloa, Sri Lanka

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Abstract

A critical challenge facing the information and communication technology for agriculture development (ICT4AD) arena at present is promoting a sustainable approach for mobilization of scientific and indigenous knowledge. Mobile phone, a commonly available, easily assessable and relatively affordable technology complemented with diverse uses, can play an important role in advancing knowledge sharing starting from the lowest socio-economic category – referred to as the base-of-the-pyramid (BoP) – in farming communities. On this rationale, this paper explores the current status of use of mobile communication for information sharing by subsistence farmers in the Batticaloa district of Sri Lanka who play a key role in the ongoing partnership development initiative from Sri Lanka and Canada to establish local capacity for inclusive innovation using low cost ICTs that can support knowledge mobilization within agricultural communities of practice. Baseline survey data gathered by means of personal interviews carried out with a cross section of "Janathakshan Beneficiary Farmers" (n=98) from three Grama Niladhari Divisions (i.e. Vaharai, Kathiraveli and Kirankulam North) during April to September 2014 with the support of a pre-tested structured questionnaire prepared based on the 'LIRNEasia Teleuse@BOP4' instrument were subjected to Regression Analysis and ANOVA tests. The outcome of analysis highlights that over three fourth of farmers utilize mobile phone as a main source of information sharing in their farm and off-farm livelihood, and the level of education did not act a significant barrier in this respect. This accentuates the fact that mobile phone can be fostered as an effective mode of knowledge creation, acquisition, absorption and distribution amongst the farmers in the base-of-the-pyramid population to exploit various opportunities to develop their farm-based livelihood, if it is enriched with a right mix of facilitative/market-based and regulatory/public incentives to augment its sustainable use.

***Keywords**: ICT4AD, Inclusive innovation, Knowledge mobilization*

Introduction

The Information and Communication Technologies (ICTs) such as Mobile communication, Internet communication, Television and Radio etc. are extensively used for information sharing in agriculture in developed countries. Recently, mobile communication has experienced an exponential growth in all over the world and it serves as a cost-effective platform for communication, especially in agricultural sector (Kang et al., 2012). The estimates from International Telecommunication Union highlight that there are more than 7 billion mobile phone subscribers globally, and in Sri Lanka this number has reached about

22 million by the mid of year 2015. Mobile technology includes in particular the mobile phones, smart phones, tablets and the technologies that surround them. At present, mobile phone has been emerged as a popular technology amongst the farmers in many countries. It has become the subject of intense focus within the information communication technology for development (ICT4D) in community, mainly because it is seen as a low cost and widely available communication tool that can be used conveniently for knowledge sharing in the agriculture sector. In fact, mobile phone can be considered the first and the single most modern technology personally owned by the poor or the lowest socio-economic category – referred to as the *base-of-the-pyramid* (BoP) – in communities (Adamides *et al*., 2013; Qiang *et al*., 2011).

Several previous studies concluded that mobile communication is capable of making a significant impact on agricultural development and knowledge sharing. Aker (2010), shows that the use of mobile phones, together with allied services, can provide new opportunities for farmers to obtain access to agricultural information such as market prices, weather reports and agricultural techniques in various formats, i.e. voice, video and text. De Silva *et al.* (2011) and Duncombe (2012), shows that the mobile phones can play an important role in advancing knowledge sharing approach, particularly in an agricultural context where collaborative work is commonplace across the value chain. Qiang (2011), shows that in ICT4D concept, mobile communication act as a low cost and widely available communication tool which holds considerable promise for knowledge mobilization in the agriculture sector. According to the Heeks *et al.* (2013), attention in the ICT4D community has turned toward the importance of promoting change at the grassroots level with direct participation of technology users, which is commonly referred to as 'inclusive innovation'. This process empowers users to participate directly in the conceptualization and implementation of new ICT initiatives (Gurstein, 2003).

Yet, the real situation of Sri Lanka on this phenomenon is mostly unknown. There is a paucity of literature pertaining to the uses, level of adoption, and implications of mobile communication in rural agricultural communities in particular. Jayathilake *et al*. (2015) and De Silva *et al.* (2008) studied on the interventions of low cost ICTs to the agricultural sector in Sri Lanka have found that the level of information provided to its stakeholders has increased to a greater extent that help to diminish the transaction costs associated with provision of information in the process of mobilization of knowledge. In this shed of light, this study was aimed to explore the current status of use of mobile communication for information sharing by subsistence farmers in the Batticaloa district of Sri Lanka who play a key role in the ongoing partnership development initiative from Sri Lanka and Canada to establish local capacity for inclusive innovation using low cost ICTs that can support knowledge mobilization within agricultural communities of practice.

Materials and Methods

As a co-event of an ongoing 'Canada – Sri Lanka Partnership Development Project' (CSLPDP) funded by the Social Sciences and Humanities Research Council (SSHRC) of Canada, a national workshop was planned and conducted by the Wayamba University of Sri Lanka (WUSL) in collaboration with University of Alberta and University of Guelph in Canada and the LIRNEasia under the theme of 'Agriculture Knowledge Mobilization' in 2013 with the view of assessing the use of low cost communication technologies for knowledge mobilization in agricultural communities in Sri Lanka, and in

turn, to recommend how ICT tools use in agricultural knowledge sharing in the rural farming communities.

Through this, "Janathakshan", a Non-Governmental Organization, was identified as one of the eight agricultural communities identified to work with the CSLPDP. A series of key-informant discussions were held with relevant authorities in the Janathakshan and the communities closely associated with them, i.e. from three Grama Niladhari Divisions, including Vaharai, Kathiraveli and Kirankulam North. At the end of these activities, the research team was in a position to identify the key problems faced by respective communities in relation of use of ICT, and to furnish quick solutions to such problems by configuring ICTs and testing with the community, referred to as a 'Rapid Prototyping' exercise.

The data for this particular study were from the farmers benefitted through this particular expertise, i.e. "Janathakshan Beneficiary Farmers" (n=98) attached to three Grama Niladhari Divisions mentioned above, which were gathered from April to September 2014. The sample was designed in particular to represent the BoP in the Batticaloa district. The 'LIRNEasia Teleuse@BOP4' (LIRNEasia, 2012) instrument was adopted in particularly for the purpose of preparation of questionnaire to gather information pertaining to the socio-economic and demographic data of the respondents as well as their behavior with regard to agriculture information seeking, The survey provided insights as to how, when, and why mobile phone was used in their daily lives, for example.

Both descriptive and inferential statistical methods were used to analyze data using the 'Statistical Analysis System' (SAS) software. A "scoring system" was applied to facilitate selection of specific survey questions to create MINDEX to represent the use of 'Short Message Service' (SMS) in mobile communication (Fredrickson, 1984). One-way ANOVA tests were carried out assess the potential relationship between the level of education and annual income versus usage of mobile phones by farmers.

Results and Discussions

All the farmers included in the sample (n=98) were Tamils by nationality and the most of them were Hindus followed by Catholics by religion. Further, about 83 percent of farmers were Males, and the mean age of a farmer was 49 years. It was found that more than 92 percent of farmers in the community used at least one of any modes of phone to take or receive a telephone call in the recent past, and nearly 62 percent use their own mobile phone/s for this purpose, in particular. Nearly 81 percent of farmers own a 'single active SIM' and 75 percent use at least a one "pre-paid connection". While, more than 90 percent use a mobile phone to take and/or receive phone calls regularly for various purposes, there were only about 16 percent were familiar with and/or use SMS facility in the phone.

The types of agriculture related information expected from the surveyed community was illustrated in Figure 1.

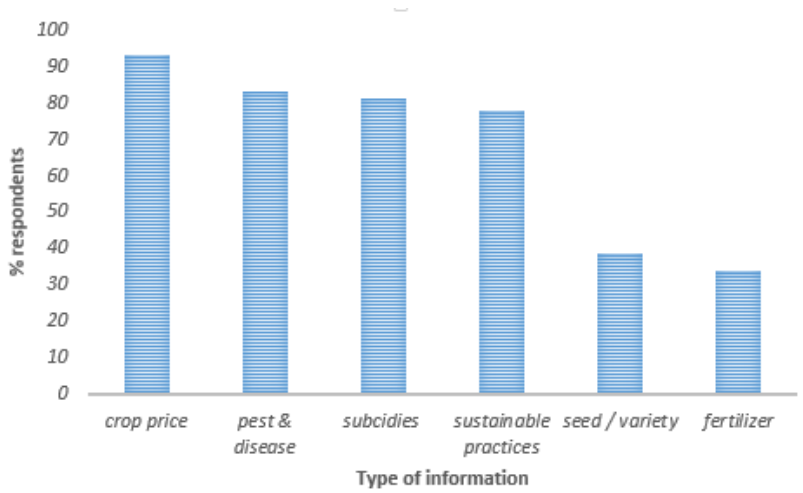

Figure 1. Type of information communities expected

Figure 1 highlights that farmers were concerned about an accurate and timely information about the prices of the crops that they cultivate, methods that can be used to control pests and diseases, sustainable crop management practices, and subsidiary schemes available for them. They used to collect such information from various sources such as government officers and non-governmental organizations work in the respective areas, family members and fellow farmers, farmer organizations and market venders etc.

Figure 2 shows the sources of agricultural information seek by the communities in concern. Farmers use various sources for getting valid and reliable information, and in fact, about 69 percent rely on the government officers in the respective areas, mainly the Regional Development Officer, for this purpose.

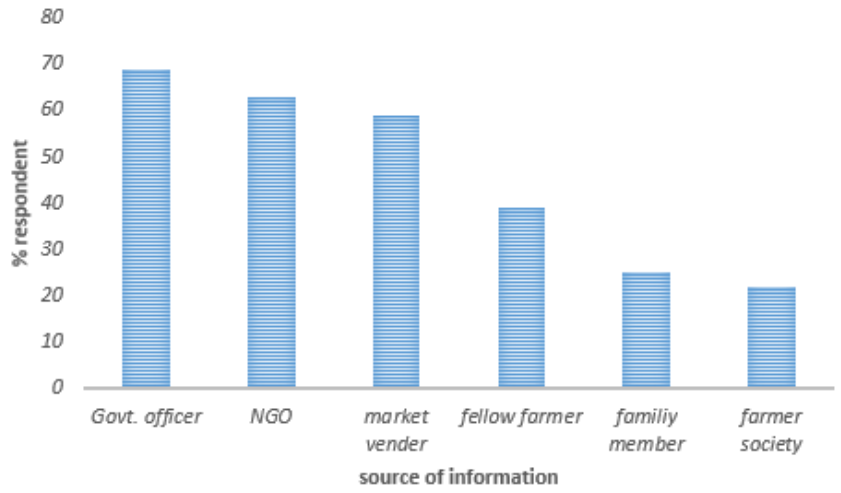

Figure 2. Source of agricultural information

Although the offices of these government officials are located far away from the farmland, relatively high proportion of farmers in the community were used to have regular visits to these for various needs.

Interestingly, around 63 percent of farmers rely on a NGO, especially on the Janathakshan, because those officers used to visit regularly the farmland of their beneficiaries and discuss the matters related to their agricultural activities. It was found that all these attempts were relatively costly and the transaction costs (i.e. search, negotiation and verification) associated with such contracts was also considerably high.

Although farmers obtain 'information in need' from the fellow farmers and market venders (i.e. 39 and 59 percent in the sample, respectively), they were not seen as reliable as the information from officials. There were many concerns amongst and queries from the farmers that, as they try to obtain such information related to production and marketing from the market venders, they were cheated for mere advantage of 'selling the products in their shop', including seeds, herbicides and fertilizer etc.

One of the key objectives of CSLPDP was to educate and train farmers to use SMS in their agricultural activities to get valid and reliable information on related farming practices. To fulfil this, the relationship between the 'value of MINDEX' of, and the 'constraints' faced by, a farmer was assessed by employing a Regression Analysis in which the following constraints were specified as explanatory variables, in particular: "Don't know what it is" [*dntsms*]; "using SMS is confusing to me" [*consms*]; "difficult to go through menu and open it" [*difmnu*]; "too difficult for me to type" [*diftyp*], "too expensive for me" [*tooexp*], and "don't see any benefits of using it" [*dntbef*]. The outcome of analysis is summarized in Table 1.

The results show that the variables "*dntsms*", "*consms*" and "*difmnu*" possess a significant positive relationship with the dependent variable. The outcome of One-way ANOVA test used to assess extent to which the level of knowledge and know-how of farmers effect on this behavior show that the three levels of education used in the analysis (i.e. Grade 0 to 4 = 38%; Grade 5 to 9 = 43%; Grade 10 to 12 = 19%) were not statistically significant ($p=0.2104$, $\alpha=0.05$). This implies that farmers, irrespective of their level of education, use mobile phone to share information. Similarly, the two categories used to assess the effect of annual income in this respect (i.e. < Rs. 180,000 per annum = 69%; > Rs. 180,000 per annum = 31%) were not statistically significant ($p=0.1031$, $\alpha=0.05$) implying that farmers, irrespective of their wealth, use mobile phone to the same extent.

Table 1. Parameter values in Regression for Scored Index

Variable	MINDEX	
	Coefficient	Probability
dntsms	13.50*	0.012
consms	9.56*	0.031
difmnu	8.07*	0.048
diftyp	2.38	0.067
tooexp	0.88	0.125
dntbef	0.81	0.162
R^2	0.613	
Adj. R^2	0.591	
F	13.32	0.001

* denotes significant @ p=0.05

Conclusions

The outcome of analysis shows that more than 90 percent of farmers in the Batticaloa district, in general, use mobile phone as a source of information sharing in their day-to-day life. Further, the results suggest that the different levels of education and annual household income were not affecting on this behavior significantly, or in other words, their status of 'knowledge' and 'wealth' did not act as significant barriers to use mobile phones. This highlights that mobile phone, especially its SMS facility, can be promoted with appropriate training to disseminate vital information on farming practices to the farmers on time.

This accentuates the fact that mobile phone can be fostered as an effective mode of knowledge creation, acquisition, absorption and distribution amongst the farmers in the base-of-the-pyramid population to exploit various opportunities to develop their farm-based livelihood, if it is enriched with a right mix of facilitative/market-based and regulatory/public incentives to augment its sustainable use. The stakeholders work on these criteria, thus, may come up with appropriate user-friendly packages targeting specific farming communities work on different agricultural products, which shall be regulated by relevant line Ministries working for agriculture to make sure 'right information is shared' and facilitated with various market-based incentives to 'augment the level of usage'.

Acknowledgment

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A CFD approach for determination of Electric Field Variables for Metal Arc Welding process

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Abstract

In this study an arc welding process is computationally studied for the electric field variables responsible for the formation of metal arc droplets using the corresponding conservation equations. A two dimensional axisymmetric model is prepared to reduce computational time. The computation is carried out as a transient fluid flow process subjected to relevant initial electric field conditions. An interactive coupling between welding arc, plasma, current and temperature were considered. The assumed steady state and laminar gas flow in traditional models studied so for does not reflect the real distributions in the welding process. Hence influence of the welding arc on the shielding gas flow and vice versa was taken up for study. From the study it is found that as the arc struck, the shielding gas is accelerated towards axis. The shielding gas also carries current from electrode to work piece which helps in reducing spatter of arc and concentrated arc is obtained. There are two distinct regions of electric potential contour observed. One is around electrode with upside contour showing current diverges from centre and another is at cathode with downside contour showing current converges to centre. The electric current density is concentrated at the tip of electrode causing large amount of heat generation.

Keywords: *Metal Arc Welding, Electric Field, Shielding Gas, Current.*

Introduction

The problem being taken up for the computational analysis pertains to GMAW process. GMAW is a welding process where an electrode wire is continuously fed from an automatic wire feeder through a conduit and welding gun to the base metal, where a weld pool is created. GMAW is a common welding process used in conditions where air current is not too severe to be detrimental to the external shielding gas used to protect the weld pool.

This domain is a two phase domain consisting of mixture of molten metal and shielding gas. The numerical computation will explore the fluid flow and heat transfer characteristics of molten metal in the presence of shielding gas. The phenomenon of GMAW is assumed to be steady state and laminar gas flow in traditional models where as in real process gas flow is highly turbulent and transient. The need for determining the effect of nozzle geometry on shielding gas flow and consequently on welding bead characteristics is felt much in actual GMAW process and therefore the problem will be solved covering both.

Many researches have attempted to study the Gas meal arc welding. In most of the researches done to study GMAW, they have assumed a theoretical model of the welding rod without considering actual geometry parameters of the nozzle which will affect the inert gas flow and the weld quality. Also the gas flow is assumed to be laminar whereas in actual process gas flow is highly turbulent. Some research has also been done to study the transient effect of welding parameters in the arc plasma. No specific research has been observed in the area of effect of geometry of nozzle parameters on the shielding gas flow in GMAW process.

Anthony B. Murphy [1] studied the transport properties of the arc plasma. The calculation of plasma arc properties can provide valuable information regarding behavior of the welding arc. T.W. Eagar et. al [2] studied the droplet size produced during GMAW both theoretically and experimentally. Study is carried out basically on static force imbalance theory and their application in GMAW process. P.G. Jonsson et. al. [3] studied the arc parameters and the metal transfer in GMAW process using mild steel and helium and argon gases as shielding gases. A two dimensional steady state model has been prepared to study the

arc parameters such as temperature, electric potential, and velocity. J. Hu, H.L. Tsai [4] prepared a unified comprehensive model to simulate transient phenomenon occurring during the GMAW process. Based on the unified model, a thorough investigation of the plasma arc characteristics during the gas metal arc welding process was conducted. H.G. Fan et.al. [5] prepared a theoretical model describing globular transfer in GMAW process. The heat and mass transfer in the electrode, arc plasma and molten pool are considered in one unified model. Using the volume of fluid method, the transport phenomenon is dynamically studied. The current density distribution is calculated with an electrode-arc-work-piece system. G. Wang et.al [6], proposed a method to pulsate current in GMAW to achieve a specific type of desirable and repeatable metal transfer mode. This method uses a peak current lower than the transition current to prevent accidental detachment and takes advantage of downward momentum of the droplet to enhance the detachment. U. Fussel et.al [7], studied the shielding gas flow inside the welding torch and free jet between the gas nozzle and the work-piece. The arc model includes a MHD model and a LTE assumption near the electrode region. Takehiko TOH, Jun TANAKA et.al [8] studied the behavior of DC arc plasma under a magnetic field imposed perpendicular to the plasma current. The behavior is studied both theoretically and experimentally by changing various parameters such as plasma electric current, nozzle diameter, argon flow rate and magnetic flux density.

Modelling Parameters for Geometry

There are various parameters to be considered while preparing a computational model representing a complex GMAW process. Fig. 1 shows parameters to be considered for modeling.

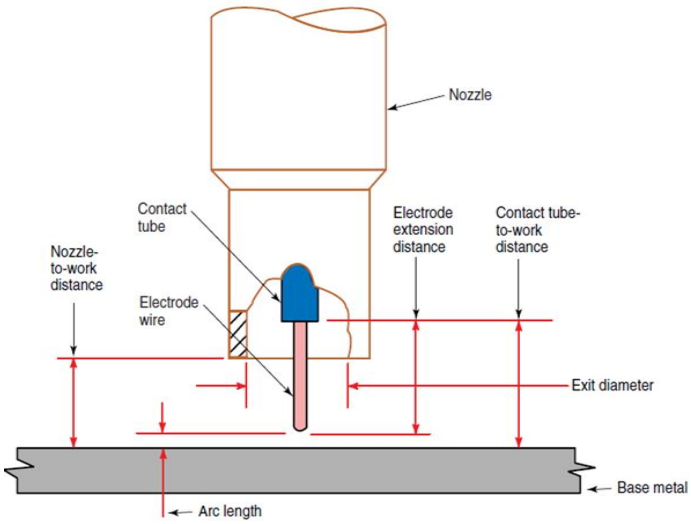

Fig.1 Parameters to be considered for geometry [10]

Numerical Modelling

An axisymmetric model is used so as to reduce computational time. Angle for the nozzle is 60^0. There are two zones assigned namely solid and fluid. Electrode is assigned as solid while all other remaining zones are assigned as fluid region. Velocity inlet boundary condition is employed where gases enter into domain and outlet vent is assigned from where gases come out. All other boundaries are assigned as wall boundary condition.

Fig 2 shows meshing of the domain. For meshing of solid domain quad mesh with map scheme is utilised, whereas for meshing of fluid domain quad mesh with pave scheme is utilised. Total numbers of elements are found to be 89,553 and corresponding nodes are 90,104.

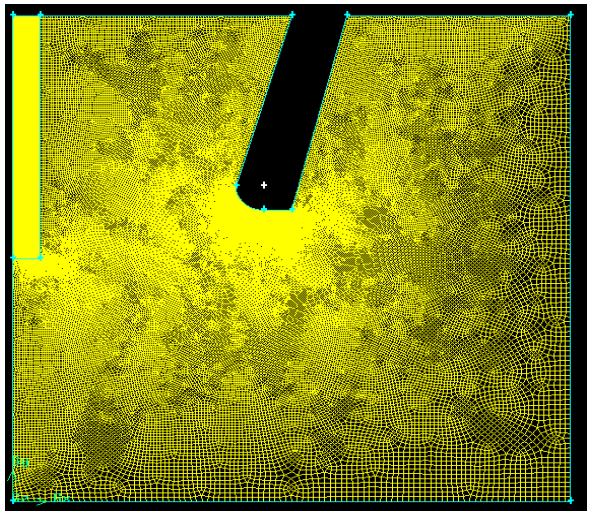

Fig.2 Meshing of domain

After several trials, a model with optimum mesh quality of 0.37519 is selected. As there are two fluids present one, molten metal and the other, mixture of gases (argon and oxygen), VOF technique is used. Energy equation is also solved for getting temperature distribution. To account for turbulence, viscous model with standard k-ε is used in the analysis. Finally MHD model, which is available as an add-on model, is brought to the solution procedure at the end. Magneto Hydro Dynamics (MHD) is the science of predicting flow of electrically conducting plasma. MHD model with electric potential method is used. Electric potential method is used whenever there is high current density involved. Since GMAW is low voltage and high current process, use of Electric potential method is justified.

The pressure based, axisymmetric, transient solver is used. The pressure based solver is used for low speed incompressible flows. In this approach pressure field is extracted by solving pressure or pressure correction equation which is obtained by manipulating and continuity and momentum equation. The inlet velocity of 74.8 m/s is set as velocity inlet boundary condition. In the electrode zone, voltage is given as 25 V and current is set to 275 A. In the work-piece zone voltage is set to zero volts. The general ambient temperature is set at 300K. The outlet vent is given zero gauge pressure so that pressure gradient is created and gases flow in desired direction. SIMPLE algorithm [9] is used for solving mass, momentum and energy equation. The discretization scheme used for gradient and pressure are LEAST SQUARE cell based and PRESTO respectively. For all other parameters such as momentum, energy, turbulent energy, electric potential second order upwind discretization scheme is used. For transient formulation first order implicit scheme is utilised. All residuals are set to 10^{-5}. The solution is initialised with prescribed boundary conditions from all zones. Time step size is chosen as 0.0001 s to get true transient output.

Results and Discussion

4.1 Electric Potential and Current Density

Fig. 3 to Fig 5 shows contours of electric potential in the region between electrode and work-piece. There are two distinct regions are observed where dense electric potential contours are observed. One is around electrode with upside contour and another is at cathode with downside contour. The gradient of electrical potential is current density. Fig 6 to Fig 8 shows contours of electric current density. The electric potential contours are denser where the current density is higher. The upside contour shows current diverges from the centre and downside contour shows current converges to centre. The current flow pattern determines the inward and downward electromagnetic force around the droplet and work-piece. As the gas flow increases more amount of current starts to flow between electrode and work-piece. When the arc is struck between electrode and work-piece, gases start ionizing and start carrying current. Thus arc is confined

mainly in the arc column and very little current flows outside the hot arc plasma column. Outside the arc column, gases get mixed with atmospheric gases and hence electrical conductivity of the gas decreases, reducing current flow.

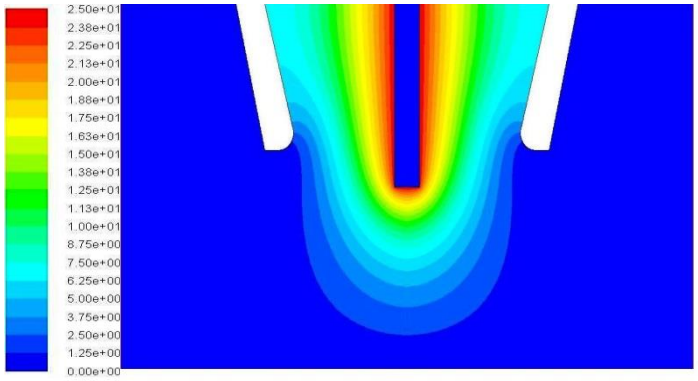

Fig. 3 Contours of electric potential in V at t= 100 ms

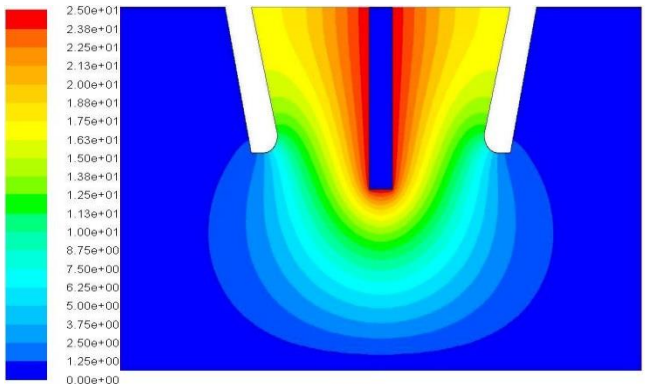

Fig. 4 Contours of electric potential in V at t=400ms

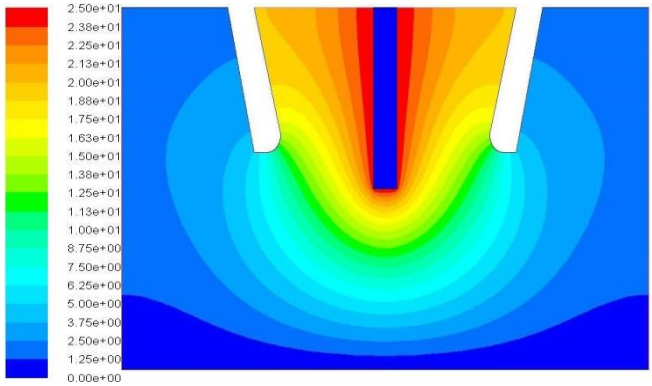

Fig. 5 Contours of electric potential in V at t=800 ms

The current density at the tip of electrode is 3.75e10 A/m^2. This high amount current density causes very high amount of heat, which results in melting of the electrode. Current density is higher at the tip of electrode and reduces away from the tip.

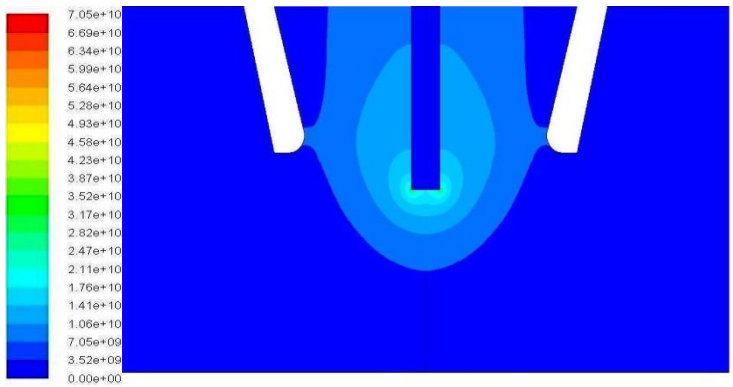

Fig. 6 Contours of electric current density in A/m^2 at t=100ms

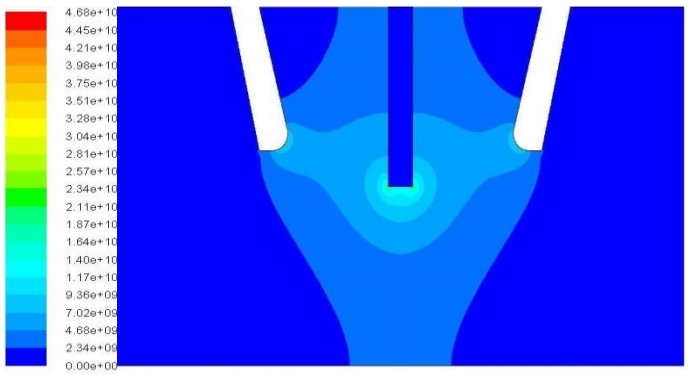

Fig. 7 Contours of electric current density in A/m^2 at t= 400 ms

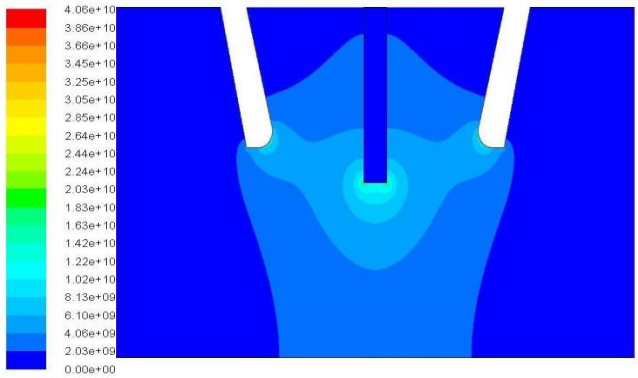

Fig. 8 Contours of electric current density in A/m2 at t=800ms

4.2 Joule Heat

Fig 9 to Fig 11 shows graph of joule heat versus length of electrode. From these graphs it can be clearly be seen that the joule heat increases as we go towards the tip of electrode. There is steep increase in heat generated at the tip of the electrode as the current density is higher at the tip. At t = 100ms, the value of

joule heat generated is 6e15 W/m^3. This enormous amount of heat is generated since the value of current applied is very high in a small region. At steady state amount of heat generated is 1.8e15 W/m^3. There is reduction in the amount of heat generated at start and steady state. As gases start carrying current the current density starts deviating from the tip of electrode to the work-piece. Thus there is a lack of current at electrode for generation of heat.

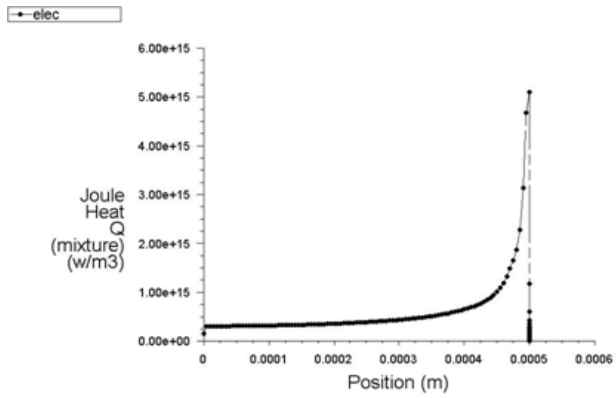

Fig. 9 Graph of joule heat versus distance at t=100ms

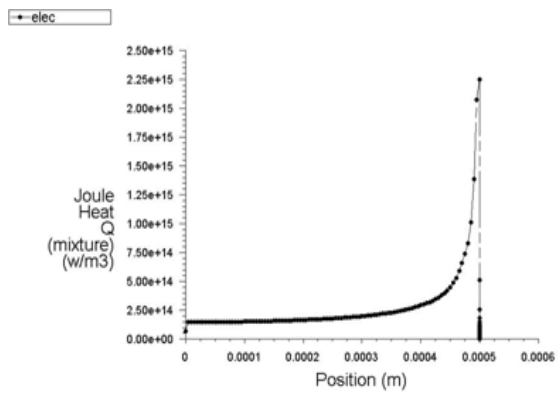

Fig. 10 Graph of joule heat versus distance at t=400ms

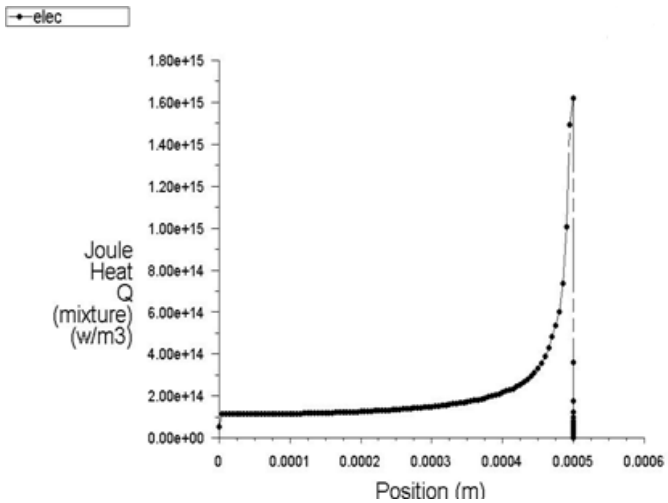

Fig. 11 Graph of joule heat versus distance at t=800ms

CONCLUSION

A numerical model has been developed to simulate the complex transport phenomenon in Gas Metal Arc Welding. The heat transfer and fluid flow in the arc column were studied based on the transient distributions of voltage, current density and joule heat . An interactive coupling between welding arc, plasma, current and temperature were considered. The assumed steady state and laminar gas flow in traditional models were found to be not real distributions in the welding process. The influence of the welding arc on the shielding gas flow and vice versa was analyzed. The arc stabilizes the shielding gas flow. The shielding gas also carries current from electrode to work-piece which helps in reducing spatter of arc and concentrated arc is obtained.

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Numerical Analysis of Flat Plate Solar Air Heater with Transverse Notched Rib Turbulators for Heat Transfer Enhancement

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Abstract:

Solar air heaters are widely used for drying and space heating applications and usually have flat absorber plate for solar energy collection which makes it simple in construction and hence requires little maintenance. However, they generally exhibit low thermal performance owing to high thermal losses from the absorber plate and poor heat carrying capacity of air, which is the working fluid. Hence, there is a dire need to develop an efficient flat plate solar air heater. In this paper a two dimensional numerical analysis is conducted to evaluate the effect of notched ribs on the heat transfer augmentation of solar air heater. The design parameters that influence the performance of collector in the presence of ribs are the longitudinal pitch, geometry and dimensions of the ribs. The relative roughness pitch of is varied as 8, 10, 12 and 14 and the rib height is fixed at 1.4mm. The analysis is carried out at a constant heat flux input of 1000W/m^2 for different Reynolds number conditions ranging from 8000 to 24000. The maximum increase in the Nusselt number was found to be about 1.88 times as compared to the smooth duct. The increase in thermal enhancement factor which indicates the thermohydraulic performance of the collector in the presence of ribs is found to be in the range of 1.27–1.45.

Keywords: *Notched Ribs, Solar Air Heater, Nusselt number, Thermal enhancement factor*

Introduction

Solar air heaters with flat absorber plate are typically associated with high heat losses owing to poor heat transfer characteristics of air and high thermal loss from the absorber plate. Enhancement of thermal efficiency of flat plate solar air heaters has been the focus of many researchers in the last few decades and various techniques for heat transfer enhancement have been developed. Use of turbulators or artificial roughness is a widely used technique to achieve improved heat transfer by promoting turbulence in the air flow close to the absorber plate surface. In addition, turbulators cause local flow acceleration and also provide increased surface area for heat transfer. Various turbulator designs have been reported in the past. Alam et al. [1] has shown that the use of V-shaped perforated blocks provide significant improvement in thermal performance. The maximum increase in the Nusselt number is found to be 6.96 while the friction factor increased by 28.84 times the smooth duct. Skulllong et al. [2] has shown that rib-groove turbulators are capable of providing considerable increase in heat transfer. Satta et al [3] used angled ribs to create complex secondary flow which provide intense mixing and hence improved heat transfer. Xinyi and Dongsheng [4] conducted a numerical analysis using discontinuous crossed ribs and grooves and found that the thermal performance was enhanced by about 13.6% while the thermo-hydraulic performance was improved by 36%. Bhagoria et al. [5] have shown that the transverse wedge shaped rib turbulators improve the heat transfer by about 2.3 times higher than the smooth duct. The highest improvement in thermal efficiency was found to occur at a wedge angle of 10°.They have also shown that the friction factor is directly proportional to the wedge angle. Yadav and Bhagoria [6] carried out a numerical analysis using square sectioned rib turbulator. They found that the RNG k-e turbulence model was appropriate for their analysis. The flow and roughness parameters that affect the performance were

optimized based on constant pumping power requirement. The effect of various designs of turbulators such as Multi-v shaped ribs and Multi-v shaped ribs with gaps were evaluated through Computational Fluid Dynamics (CFD) simulation by Anil Kumar [7]. The CFD model was validated by comparing the Nusselt number of smooth duct with that of Dittus-Boelter equation and found that the CFD results were in close agreement with the correlation at all Reynolds number of the flow. They adopted RNG k-e model as the turbulence model to solve the turbulence equations.

From the literature it is found that various designs of turbulators have been proposed for performance enhancement and different designs offer varied levels of performance enhancement and pressure losses in the air flow. However, the concept of providing notch on the rib to increase the turbulence level and hence heat transfer has not been reported. In the present work a two dimensional CFD is carried out to evaluate the effect of transverse notched rib turbulators on the heat transfer and thermo-hydraulic performance of flat plate solar air heater.

Nomenclature

u,v	Velocity components in x and y direction, m/s
T	Temperature, K
p	Pressure, N/m^2
e	Rib height, mm
P	Pitch, mm
P/e	Relative roughness pitch
Re	Reynolds number of the flow
Nu	Nusselt number
α	Thermal diffusivity, m^2/s
ρ	Density, kg/m^3
ϑ	Kinematic viscosity, m^2/s

CFD Model

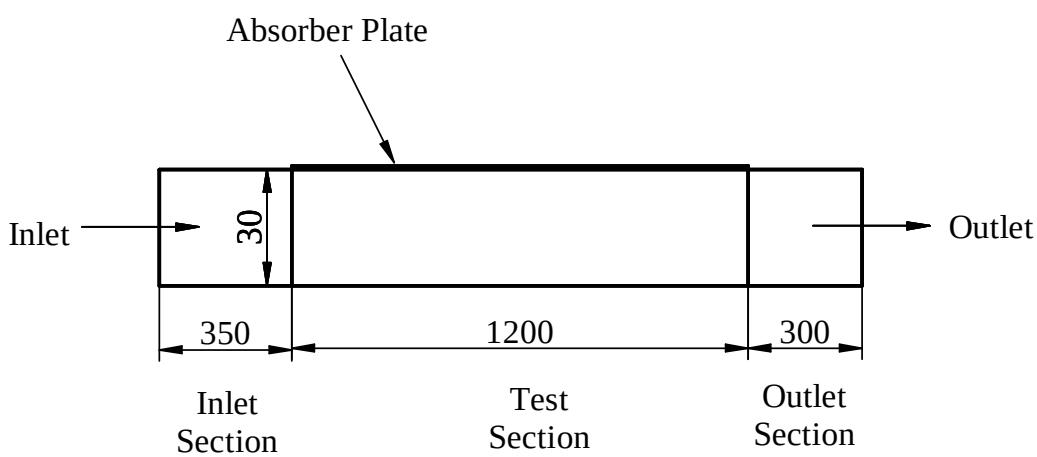

Fig.1(a). Schematic diagram of flat plate solar air heater (All dimensions are in mm).

The two dimensional computational model of the smooth duct without turbulators is shown in Fig.1(a). The length of the inlet section is 350mm, length of test section is 1200mm and that of exit section is

300mm in accordance with the ASHRAE guidelines [5,7] for fully developed turbulent flow. The geometrical parameters of the notched rib turbulator is as shown in Fig.1(b).

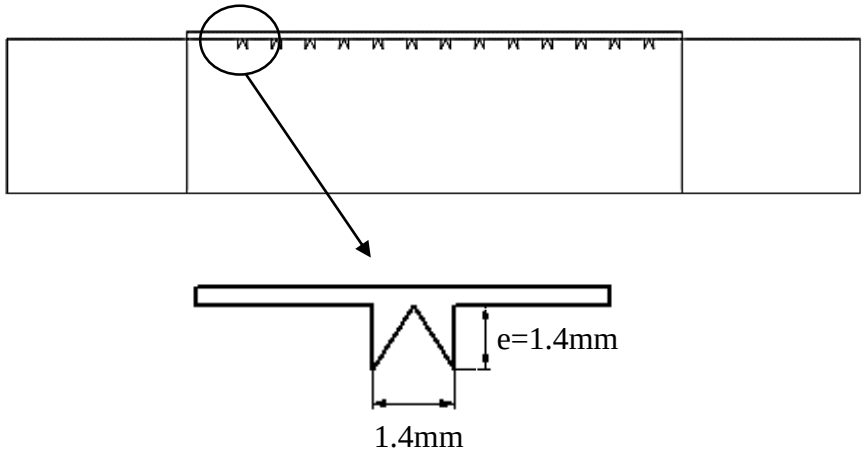

Fig.1(b). Schematic diagram of flat plate solar air heater with notched turbulators

Numerical Scheme and Boundary Conditions

At the inlet of the CFD model, a known 'mass flow rate' input is specified and at the exit 'pressure outlet' boundary condition is used. The mass flow rate is varied as 0.0933kg/s, 0.1533kg/s, 0.2kg/s and 0.27kg/s which corresponds to the Reynolds number of 8150, 13470, 17613 and 23529 respectively. A constant heat flux input of 1000W/m^2 is specified on the top surface of the absorber plate. No-slip condition is adopted at the solid-fluid interface. SIMPLE algorithm is used for coupling the pressure and velocity while second order upwind schemes were used for discretization purposes for better accuracy. The RNG k-e model is used to solve the turbulence equations [6,7].The fluid medium is air and the absorber plate is made of aluminium.

Governing Equations

The equations governing the flow and heat transfer in the present analysis is give below:

$$\frac{\partial u}{\partial x} + \frac{\partial v}{\partial x} = 0 \tag{1}$$

$$u\frac{\partial u}{\partial x} + v\frac{\partial u}{\partial y} = -\frac{\partial p}{\rho \partial x} + \vartheta\left(\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2}\right) \tag{2}$$

$$u\frac{\partial v}{\partial x} + v\frac{\partial v}{\partial y} = -\frac{\partial p}{\rho \partial y} + \vartheta\left(\frac{\partial^2 v}{\partial x^2} + \frac{\partial^2 v}{\partial y^2}\right) \tag{3}$$

$$u\frac{\partial T}{\partial x} + v\frac{\partial T}{\partial y} = \propto\left(\frac{\partial^2 T}{\partial x^2} + \frac{\partial^2 T}{\partial y^2}\right) \tag{4}$$

Grid Independence Test

The grid independence study is carries out by varying the number of elements in the computational domain of the base model. The number of elements is varies as 55,345, 1,05,066, 2,67,175 and 4,23,743. It is found that the change in Nusselt number as the number of elements increases from 2,67,175 to 4,23,743 is less than 1%. Hence, the computational domain consisting of 150000 elements is taken as the optimal mesh and all the computational models used in the analysis were built with at least 2,67,175 elements.

Validation of CFD model

Fig.2 shows the variation of Nusselt number for smooth duct obtained from CFD simulation against that of Dittus-Boelter equation [6,7] at various Reynolds number conditions. It is found that the CFD results agree very closely with the Nusselt number values obtained from the Dittus-Boelter equation which is given by,

$$Nu = 0.024Re^{0.8}Pr^{0.4} \quad (5)$$

The maximum deviation in the Nusselt number obtained from CFD simulation as compared to the correlation was found to be about 5.16%.

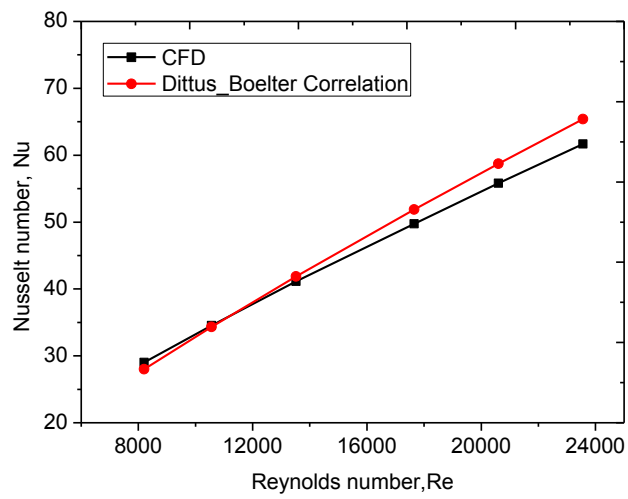

Fig. 2. Validation of CFD model

Results and Discussions

A two dimensional CFD simulation is carried out on a flat plate solar air heater fitted with transverse notched rib turbulators to evaluate the effect of notched rib turbulators on thermal performance as compared to the smooth duct. The analysis is carried out at a constant heat flux input of 1000W/m^2 and various Reynolds number conditions. Fig. 3(a) depicts the effect of varying relative roughness pitch on the Nusselt number at different flow rate conditions. The relative roughness pitch is varied from 8 to 14. In general, the Nusselt number is found to increase with increasing Reynolds number of the flow for all the models. This is due to increased heat transfer at higher flow rate conditions. Further, the Nusselt number values in the presence of transverse notched ribs are found to be considerably higher than the smooth duct at all Reynolds number conditions. This can be due to the presence of ribs which breaks the laminar sub-layer that exists close to the absorber plate surface by creating flow separation on the upstream of the rib as shown in Fig. 3(b). The flow separation results in better mixing and hence turbulence in the flow near the rib region. The flow reattachment brings the relatively colder fluid in the core region of the flow closer to the absorber plate resulting in improved heat transfer.

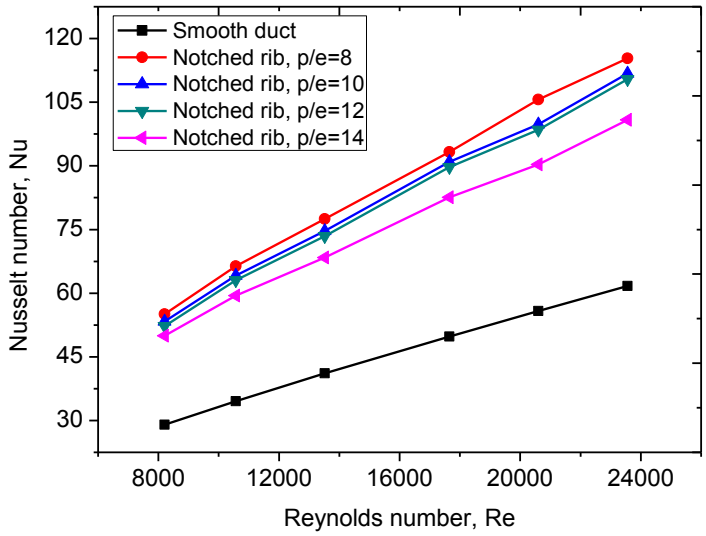

Fig.3(a). Effect of relative roughness pitch on Nusselt number

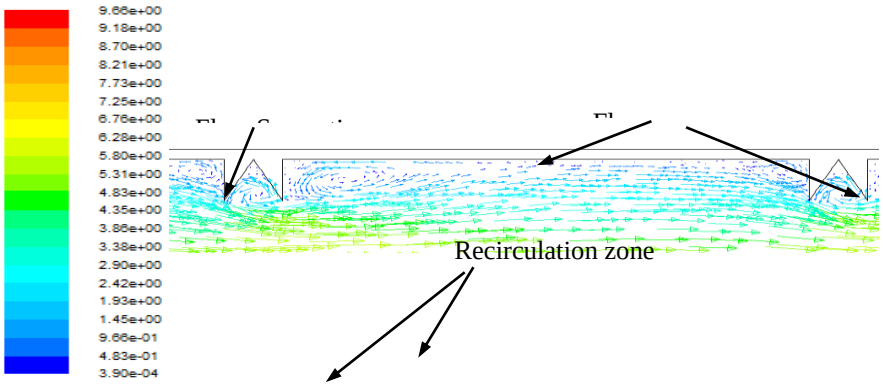

Fig.3(b). Flow behaviour in the presence of notched ribs.

In addition to this, flow recirculation zones are formed in the immediate upstream and downstream of the rib as shown in Fig.3(b). Further, part of the separated flow enters the notch and reattaches on the inner surface of the notch and forms an extra recirculation zone. Due to reattachment of the flow in the notch, the heat exchange between the rib and the recirculating flow in the notch region increases [5,6,7]. Also, the recirculating flow in the notch region create intense mixing thereby promoting turbulence and hence increased heat energy exchange in the flowing air stream around the rib region.

As the relative roughness pitch increases, the number of such instances reduces resulting in lower values of Nusselt number as shown in Fig.3(a). Also, at lower p/e values, the flow reattachment occurs far behind the succeeding ribs in the downstream leading to the formation of boundary layer which reduces the heat transfer.

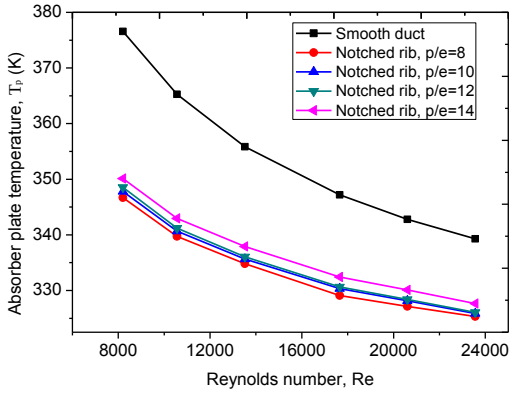

Fig.4. Variation of absorber plate temperature for various p/e values.

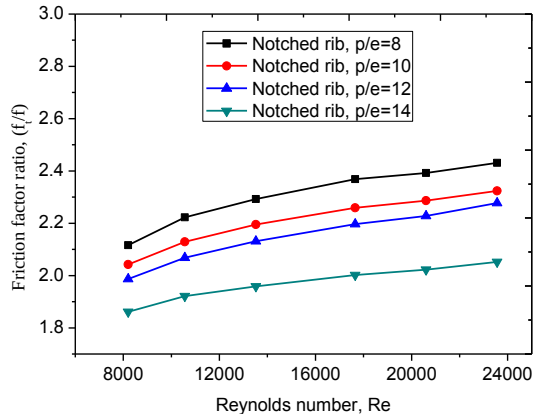

Fig.5. Effect of relative roughness pitch on friction factor ratio.

This can be further verified from Fig.4 which shows that the absorber plate temperature decreases with decreasing relative roughness pitch at all Reynolds number of the flow. As the Nusselt number is high at lower p/e value, the absorber plate temperature is also lower owing to relatively higher heat transfer from the absorber plate. It can also be noted that the absorber plate temperature in the presence of ribs is considerably lower than the smooth duct at all p/e values. The maximum increase in the Nusselt number was found to be about 1.88 times as compared to the smooth duct for p/e=8. Fig.5 shows the variation of friction factor ratio for all p/e values. It is found that the friction factor ratio increases with increasing Reynolds number. This can be due to relatively higher friction losses in the presence of ribs at higher flow rate conditions. It is also interesting to note that the maximum friction factor ratio occurs at p/e=8 at which the Nusselt number values are found to be maximum at all flow rate conditions. Therefore, in order to evaluate the true performance enhancement of the collector in the presence of transverse notched rib turbulator which is associated with increased frictional losses, a parameter called Thermal Enhancement Factor (TEF) which indicates the thermohydraulic performance needs to be determined and is given by [5,6,7],

$$TEF = \frac{(Nu_r/Nu)}{(f_r/f)^{1/3}} \tag{6}$$

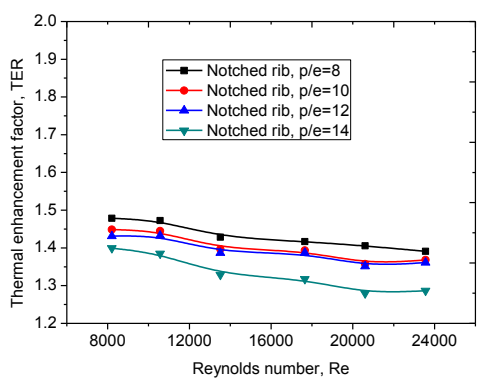

Fig.6. Thermohydraulic performance of the collector at various relative roughness pitch values.
Where, Nu_r and f_r refers to the Nusselt number and friction factor for the duct with ribs and Nu and f refer to the Nusselt number and friction factor for smooth duct.

From Fig.6, it is seen that the TEF >1 for all p/e values at all Reynolds number of the flow. This shows that the use of transverse notched rib is truly beneficial as performance enhancement device for all the p/e value considered in the analysis. The increase in TEF is found to be in the range of 1.27–1.45.

Conclusions

A two dimensional CFD simulation of flat plate solar air heater is carried out to determine the effect of notched rib turbulator on heat transfer enhancement. The major conclusions from the above analysis are as follows-

The Nusselt number values in the presence of transverse notched ribs are found to be considerably higher than the smooth duct at all Reynolds number conditions. The highest increase in the Nusselt number was found to be about 1.88 times as compared to the smooth duct for p/e=8.

The increase in thermal enhancement factor which indicates the thermohydraulic performance of the collector in the presence of ribs is found to be in the range of 1.27–1.45.

The presence of notch in the rib provides improved heat transfer through flow impingement and recirculation in the notch region.

Acknowledgments

The authors wish to express their sincere gratitude to the Department of Mechanical & Mfg. engg, Manipal Institute of Technology, Manipal University, Manipal for providing the computational facilities to carry out the simulation work.

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CFD Analysis of a Solar Air Heater with Deflector Plate for Heat Transfer Enhancement

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Abstract:
In this paper a two dimensional Computational Fluid Dynamics (CFD) analysis is carried out to study the effect of deflector plates on the thermal performance and friction factor in a solar air heater. The deflector plate provides high velocity jet of air close to the absorber plate and results in increased heat transfer to the air flow. The design parameters that influence the performance of the collector in the presence of deflector plate are the pitch, deflector plate angle, length and clearance spacing between the absorber plate and the deflector. The pitch of the deflector is varied as 20, 50, 70, 80 and 160mm and the deflector length is fixed at 14mm with a deflector angle of 45°. The clearance spacing is fixed at 5mm.The analysis is carried out at a constant heat flux input of 1000W/m^2 for different Reynolds number conditions ranging from 8000 to 24000. An average increase in the Nusselt number was found to be about 81% as compared to the smooth duct whiles the friction factor increased by 25 times.

Keywords: *Deflector Plate, CFD, Solar Air Heater, Nusselt number, Friction factor*

Introduction

Enhancement of thermal efficiency of flat plate solar air heaters has been the focus of many researchers in the last few decades and various techniques for heat transfer enhancement have been developed. Use of turbulators or artificial roughness is a widely used technique to achieve improved heat transfer by promoting turbulence in the air flow close to the absorber plate surface. In addition, turbulators cause local flow acceleration and also provide increased surface area for heat transfer. Various turbulator designs have been reported in the past. Anil Singh Yadav and Bhagoria [1] carried out a numerical analysis using square sectioned rib turbulator. They found that the RNG k-e turbulence model was appropriate for their analysis. The flow and roughness parameters that affect the performance were optimised by considering the thermohydraulic performance parameter based on constant pumping power requirement. The effect of various designs of turbulators such as V-shaped, Multi v-shaped ribs and Multi v-shaped ribs with gaps was evaluated through CFD simulation by Anil Kumar [2]. The CFD model was validated by comparing the Nusselt number of smooth duct with that of Dittus-Boelter equation and found that the CFD results were in close agreement with the correlation at all Reynolds number of the flow. RNG k-e model was used to solve the turbulence equations. Parkpoom Sriromreun et al [3] has proposed the technique of using baffle plate below the absorber which could create intense mixing in the fluid flow thereby providing increased heat transfer. However, pressure losses in the air flow were found to be very high. The highest thermal enhancement factor was found to be about 2.2. Eiamsa-ard and Promvonge et al [5] experimentally determined the effect of rectangular-rib and triangular-groove, triangular-rib and rectangular-groove on the performance enhancement and have reported that the maximum increase in heat transfer was about 80% while friction factor increased by about 6.9 time as compared to the smooth duct. The same authors have proposed the use of V-nozzle turbulators in a circular tube to create accelerated air flow and hence achieve higher heat transfer coefficients. And the maximum increase in heat transfer was found to be about 270% as compared to the smooth duct [6]. Akpinar and Kocyigit [7] have shown that the use of obstacles in the air flow can provide significant improvement in heat transfer though are aslo associated with pressure losses.

From the literature it is found that various designs of turbulators and obstacles in the air flow to provide intense mixing have been proposed for performance enhancement. However, the concept of providing deflectors in the air flow to deflect and accelerate the core fluid towards the absorber plate to achieve higher heat transfer has not been reported. In the present work a two dimensional Computational Fluid Dynamics (CFD) is carried out to evaluate the effect of deflector plate on the heat transfer of flat plate solar air heater.

Nomenclature

u,v	Velocity components in x and y direction, m/s
T	Temperature, K
p	Pressure, N/m^2
α	Thermal diffusivity, m^2/s
ρ	Density, kg/m^3
ϑ	Kinematic viscosity, m^2/s

Computational Domain

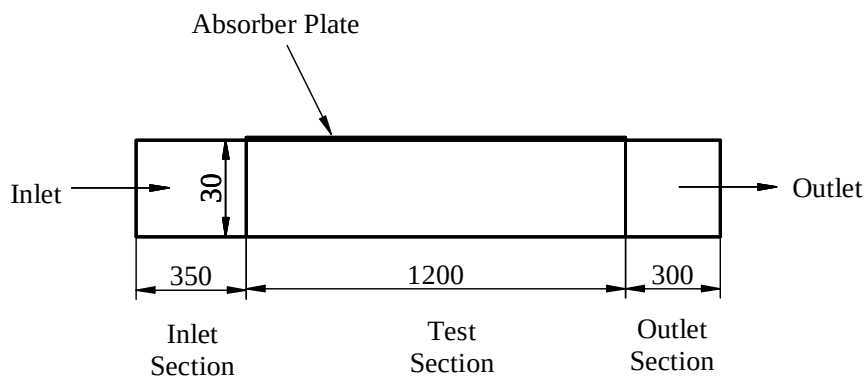

Fig.1(a). Smooth duct (All dimensions are in mm)

The two dimensional computational model is shown in Fig.1(a) and Fig.1(b). The length of the inlet section, test section and exit section are fixed as per the ASHRAE guidelines for fully developed turbulent flow [1,2]. The design parameters that influence the performance of the collector in the presence of deflector plate are the pitch, deflector plate angle, length and clearance spacing between the absorber plate and the deflector. The pitch of the deflector is varied as 20, 50, 70, 80 and 160mm and the deflector length is fixed at 14mm with a deflector angle of 45°. The clearance spacing is fixed at 5mm.

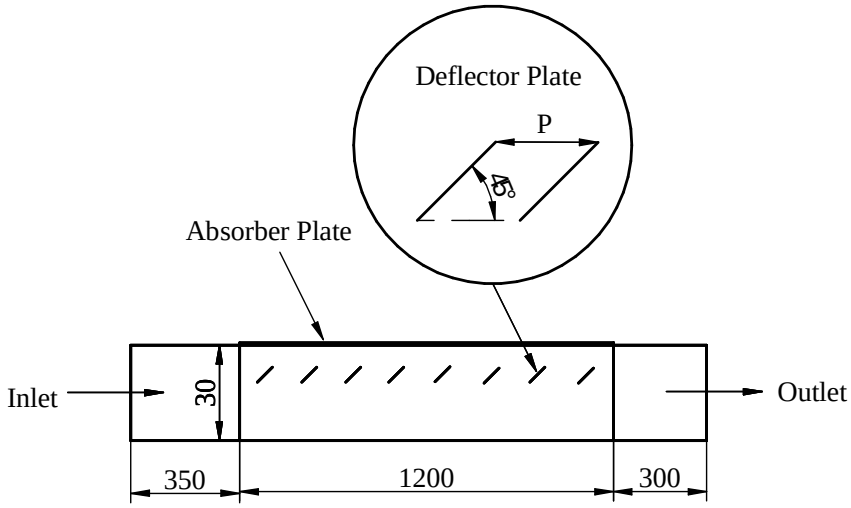

Fig.1(b). Solar air heater model with deflector plates (All dimensions in mm)

Numerical Scheme and Boundary Conditions

At the inlet of the CFD model, a known 'mass flow rate' input is specified and at the exit 'pressure outlet' boundary condition is used. The mass flow rate is varied as 0.0933kg/s, 0.1533kg/s, 0.2kg/s and 0.27kg/s which corresponds to the Reynolds number of 8150, 13470, 17,613 and 23,529 respectively. A constant heat flux input of 1000W/m^2 is specified on the top surface of the absorber plate. No-slip condition is adopted at the solid-fluid interface. SIMPLE algorithm is used for coupling the pressure and velocity while second order upwind schemes were used for discretization purposes for better accuracy. The RNG k-e model is used to solve the turbulence equations [1,2].The fluid medium is air and the absorber plate is made of aluminium and the material properties are listed in Table 1.

Table 1. Material Properties

Parameters	Air	Aluminium
Density	1.15 kg/m^3	2719 kg/m^3
Viscosity	0.001003 kg/(m-s)	---
Specific heat	1007 J/kg-K	840 J/kg-K
Thermal conductivity	0.0262 W/m-K	202 W/m-K

Governing Equations

The equations governing the flow and heat transfer in the present analysis is give below-

$$\frac{\partial u}{\partial x} + \frac{\partial v}{\partial x} = 0 \tag{1}$$

$$u\frac{\partial u}{\partial x} + v\frac{\partial u}{\partial y} = -\frac{\partial p}{\rho \partial x} + \vartheta\left(\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2}\right) \tag{2}$$

$$u\frac{\partial v}{\partial x} + v\frac{\partial v}{\partial y} = -\frac{\partial p}{\rho \partial y} + \vartheta\left(\frac{\partial^2 v}{\partial x^2} + \frac{\partial^2 v}{\partial y^2}\right) \tag{3}$$

$$u\frac{\partial T}{\partial x} + v\frac{\partial T}{\partial y} = \propto\left(\frac{\partial^2 T}{\partial x^2} + \frac{\partial^2 T}{\partial y^2}\right) \tag{4}$$

Grid Independence Test

The grid independence study is carries out by varying the number of elements in the computational domain of the base model. The number of elements is varies as 55,345, 1,05,066, 2,67,175 and 4,23,743. It is found that the change in Nusselt number as the number of elements increases from 2,67,175 to 4,23,743 is less than 1%. Hence, the computational domain consisting of 150000 elements is taken as the optimal mesh and all the computational models used in the analysis were built with at least 2,67,175 elements.

Validation of CFD model

Fig.2 shows the variation of Nusselt number for smooth duct obtained from CFD simulation against that of Dittus-Boelter equation [1,2] at various Reynolds number conditions. It is seen that the CFD results are in close agreement with the Dittus-Boelter equation which is given by,

$$Nu = 0.024Re^{0.8}Pr^{0.4} \tag{5}$$

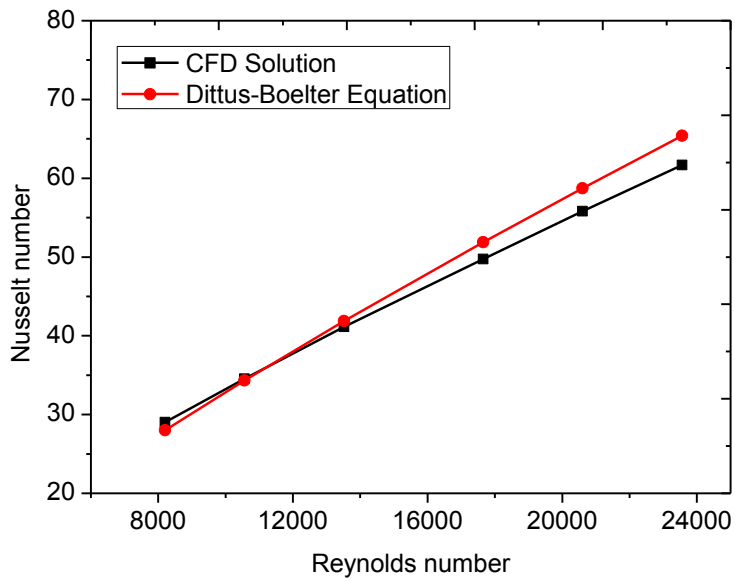

Fig. 2. Validation of CFD model

Results and Discussions

Fig.4 shows the variation of Nusselt number at various pitch conditions. In general, it is observed that the presence of deflector plates have significant effect on heat transfer enhancement from the absorber plate to the flowing air stream as is evident from higher Nusselt number values at all Reynolds number of the flow. This can be due to the fact that the deflectors divert the core flow towards the heated absorber plate and creates intense mixing of the relatively hot near wall flow and the colder core fluid leading to increased heat energy exchange. Further, the air stream is made to flow through the narrow gap between the absorber plate and the deflector plate as shown in Fig.5 thereby accelerating the flow close to the absorber plate surface.

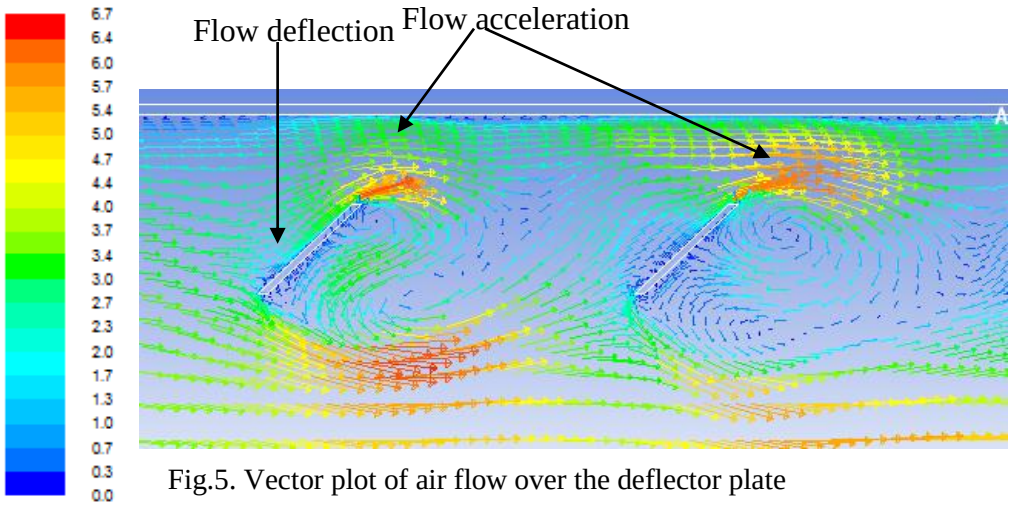

Fig.5. Vector plot of air flow over the deflector plate

Thus, the deflector plate creates intense turbulence and flow acceleration close to the absorber plate. As a consequence, the heat transfer coefficient increases and hence the Nusselt number as depicted in Fig.4. Also, it is observed that the Nusselt number reduces with increasing pitch values of the deflector plate. This can be due to reduction in the number of deflector plates with increasing pitch which leads to reduced instances of accelerated flow and mixing in the air flow stream. This can be further validated from Fig. 6 which shows the variation of absorber plate temperature at various pitch values. From Fig.6 it is clear that in general the absorber plate temperature with deflector plate is lower than the smooth duct at all Reynolds number conditions. This is due to higher heat transfer from the absorber plate in the presence of deflector plate. As the pitch value increases, the heat transfer enhancement also reduces gradually and hence the absorber plate temperature increases as depicted in Fig.6. An average increase in the Nusselt number was found to be about 81% as compared to the smooth duct for the pitch value of 20mm.

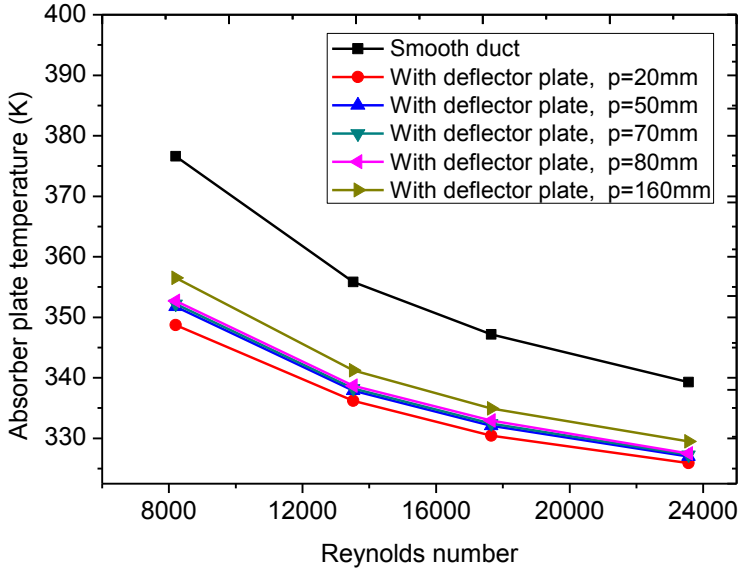

Fig.6. Variation of absorber plate temperature for various pitch values.

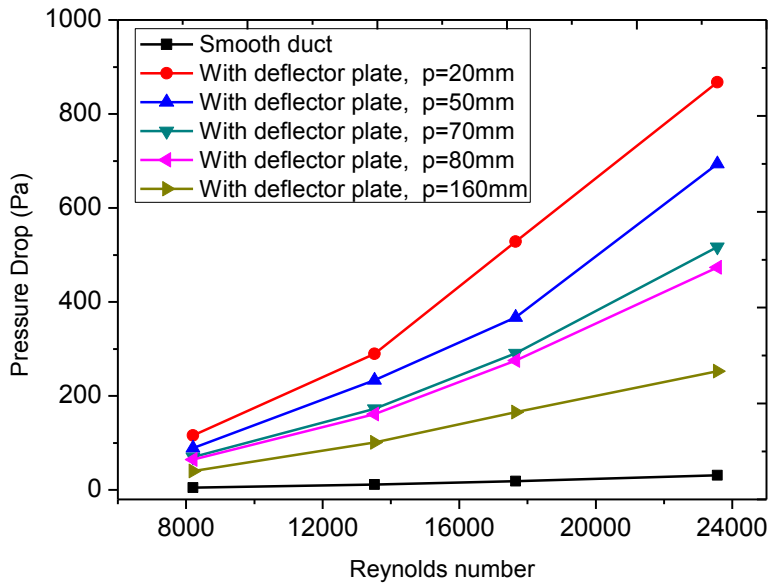

Fig.7. Pressure drop for various pitch values.

Fig.7 shows the variation of pressure drop for various pitch values of the deflector plate. It is seen that the presence of deflector plate results in increased pressure drop across the duct due to obstruction in the air flow path which offers resistance to the air flow. As the pitch increases, the number of deflector plates decreases and hence the resistance to the air flow thereby leading to reduced pressure drop across the duct. The maximum pressure drop is found to be about 23 times higher as compared to the smooth duct.

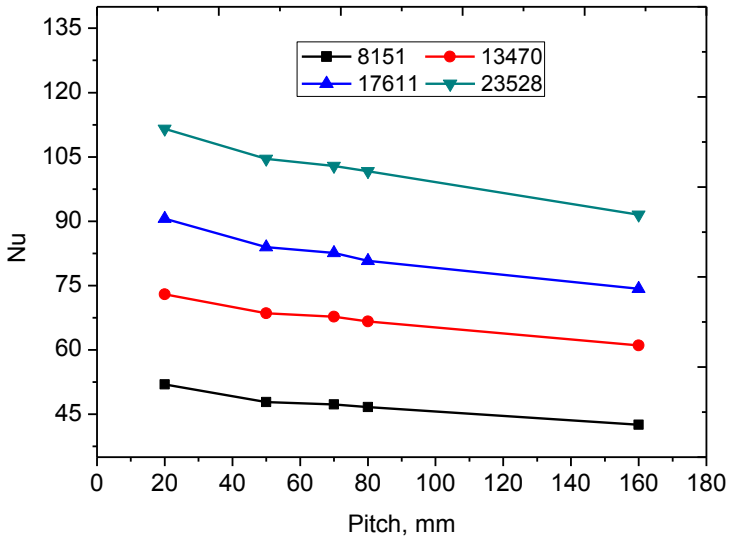

Fig.8. Nusselt number variation for different pitch values

From Fig.8 it is observed that at lower Reynolds number conditions, the variation in the Nusselt number with varying pitch values is small. This can be used to our advantage where higher pitch values that produce relatively lower pressure drop can be adopted at lower flow rate conditions. However, at higher

Reynolds number of the flow, the variation in the Nusselt number is significant and is found to decrease with increasing pitch values.

VIII. Conclusions

A two dimensional CFD simulation was carried out on a flat plate solar air heater to evaluate the effect of deflector plate on thermal performance enhancement at various pitch values and flow rate conditions for a given heat flux input. The following conclusions can be drawn from the above analysis-

The presences of deflector plates have significant effect on heat transfer enhancement.
An average increase in the Nusselt number was found to be about 81% as compared to the smooth duct for the pitch value of 20mm.
The absorber plate temperature with deflector plate is lower than the smooth duct at all Reynolds number conditions.
At lower Reynolds number conditions, the variation in the Nusselt number with varying pitch values is small which can be used to our advantage to produce higher thermal performance at relatively lower pressure drop.
At higher Reynolds number of the flow, the variation in the Nusselt number with varying pitch values is significant and is found to decrease with increasing pitch values.
The maximum pressure drop is found to be about 23 times higher as compared to the smooth duct.

Acknowledgments
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System Dynamics Simulation of Overall Equipment Efficiency with Equipment Defects, Process Quality and Throughput

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Introduction: In order to become productive and being competitive it is required to embrace a continuous innovation in modern manufacturing systems. The global marketplace has necessitated many organizations to implement proactive lean manufacturing programs and reviving the organizational structures so as to enhance their competitiveness (Bonavia, and Marin-Garcia, 2006). One approach of improving the performance in the maintenance activities is to develop and implement strategic Total Productive Maintenance (TPM) programs (Ahuja and Khamba, 2007). The TPM is an amalgamation of American preventive maintenance and Japanese concepts of Total Quality Management (TQM) moderated by total employee involvement. Therefore it is vital to identify disturbances in manufacturing processes in other words identifying the losses due to improper equipment maintenance policy and use of matrices such as Overall Equipment Effectiveness in identifying the production losses. The reason to measure the losses in an enterprise is to identify the cause for the major losses and use this information to find a suitable remedy (Ljungberg, 1998).

The TPM is a methodological approach to lean manufacturing system and also a proven manufacturing competitive strategy and is successfully employed globally for achieving the organizational objectives through integrating the employee's core competence in the organisation working environment. The TPM is a proactive action higher than the preventive maintenance so that it becomes the productive maintenance. In principle, the TPM is an innovative approach to plant maintenance that is complementary with TQM, JIT, Continuous Performance Improvement (CPI), and other world-class strategies (Cua et al., 2006). The pillars of TPM are Jishu Hozen, Kobetsu Kaizen, Planned Maintenance, Quality Maintenance, Safety and Environment, Early management, Office TPM. The 5s strategy focuses on: Seiri-Sort, Clearing, Classify; Seiton-Straighten, Simplify, Set in order, Configure; Seiso-Sweep, shine, Scrub, Clean and Check; Seiketsu-Standardize, stabilize, Conformity; Shitsuke- Sustain, self-discipline, custom and practice. In order to understand the concept research supporting evidences the next section deals with literature.

Literature Survey:

One of the empirical metric of measuring and identifying the effect of TPM is through Overall Equipment Effectiveness (OEE) that easily measures the throughput of equipment. OEE metrics is a hierarchical tool used to measure efficiency, productivity, performance, maintainability, quality output of the system and manufacturing equipment. The direct measure and indirect measures are commonly influenced by quality, production loss, and delivery commitments (Singh and Singh, 2013).

Overall Equipment Effectiveness:

One of the most commonly used measures of performance against capability of the equipment is the Overall Equipment Effectiveness (OEE). This is a effective metric to the equipment in producing what is intended to produce in a set time frame. The three components of OEE are: Availability (A), Performance Efficiency (P) and Quality (Q). Each component points to an aspect of the process that is targeted for improvement (Eq.1).

$$OEE = AxPxQ \quad (1)$$

The Availability (A) is measured in terms of operating time to that of planned production. The Performance (P) efficiency is a ratio of net operating time to that of operating Time. The Quality (Q) is a proportion of fully productive time to the net operating time. It is significant to know the other reasons for lower operational performance, they are identified as six big losses in OEE that influence are

categorized under availability, performance and quality (Table 1). This research has limited its study to six big losses accounted by OEE.

Table1: Six big losses to OEE

Availability	*Performance*	*Quality*
Planned Downtime	Minor stops	Production Rejects
Unplanned Downtime	Speed loss	Rejects on start up

The reasons for identifying the losses are to know which loss is contributing more so that countermeasures can be taken to improve the operational performance. The yield from the equipment is a measure of operational efficiency of the manufacturing unit. Any production unit purchasing low cost equipment would end up in spending more time in planned downtime and also unplanned downtime. Thus this research focuses on how OEE is influenced by a decision on purchasing low cost defective equipment's attributes to loss in quality, productivity and drop in throughput.

Total Productive Maintenance

It is a system of maintaining and improving the integrity of production and quality systems through the machines, equipment, processes, and employees that add business value to the organization. One of the main objectives of TPM is to increase the productivity of plant and equipment with a modest investment in maintenance. Total quality management (TQM) and total productive maintenance (TPM) are considered as the key operational activities of the quality management system. The Eight Pillars of TPM are autonomous maintenance, planned Maintenance, quality Maintenance, focused Improvement, early equipment management, training and education, safety health environment, and TPM as an administration tool. The implementing and adopting TPM is achieved through teams, the members in the team need to be motivated so as to improve the quality and to attain higher OEE.

The TPM is gradually implemented and executed by several organizations across the globe to improve their equipment efficiency and to obtain the competitive advantage in the global market in terms of cost and quality (Attri, et al., 2007). Small improvements in quality, production (Kaizen) add up to major benefits, resulting; faster delivery, lower costs, and greater customer satisfaction (Imai, 2012). According to Venkatesh (2005) the objectives of TPM are aimed at; avoid wastage in a quickly changing economic environment by producing goods without reducing product quality with a focus on cost reduction so as to produce the product of low batch quantity at the earliest possible time in order to ensure goods delivered to the customers are non-defective.To implement the producers should adhere to certain operating conditions, as well as fixed-cycle planned preventive maintenance (Borkowski and Selejdak 2007).

Planned Downtime

Means that worker waits until equipment fails and then repairs it. Such a thing used when the equipment failure does not significantly affect the production operation and that does not generate any significant loss other than repair cost. It is also known as corrective maintenance.Corrective maintenance often is of an emergency nature requiring immediate performance; hence, it is usually more costly than planned downtime and often requires workmen of special skills and possibly special tools.

Planned Maintenance

The primary goal of maintenance is to avoid or mitigate the consequences of failure of equipment. Planned maintenance activities include partial or complete overhauls at specified periods, oil changes, lubrication and so on. In addition, workers can record equipment deterioration so they know to replace or repair worn parts before they cause system failure.

Unplanned Downtime

The downtime that is unplanned may cost the company heavily; it stops the work-in-process but also the losses due to labour productivity, material, replacement of components. Research reports that 80% of the unplanned downtime is because of the failures that are caused by the worker and the process (Young,

2005). Elaborating on the influence of unplanned downtime thus root cause analysis reveals factors like lack of equipment observation by the worker, variation in the equipment noise, detection of abnormal speed, overrunning/overloading the equipment against designed capacity, critical components malfunctioning. In order to diminish the unplanned downtime the workers are be motivated and held responsible through TPM, as a contributor to the OEE with an incentive strategy. The unplanned downtime is the largest manufacturing loses, as it brings halt to all relative process. The efficiency of the production equipment designed is dependent on the reliability of the components used in the equipment building.

Research Description:

This study is an exploratory research wherein a pre-designed System Dynamics (SD) model of TPM is developed as shown in Fig. 2. The basis for the developed mode is from a research paper on TPM by Shahanaghi & Yazdian (2009). Along with this from the other literature survey the identified gap are being addressed by adding new variables which are very relevant for attaining the desired research objectives. The important new variables added in this paper is Overall equipment Efficiency and Total Productive Maintenance. A model formulation and its validation is carried out as a iterative process for the developed model (Sterman, 2000).

System Dynamic Model:

System dynamics model is drawn with conceptualising the problem and drawing the Stock and Flow diagram (Forester,1994). The SD methodology follows a step by step approach to get the projective solutions (Fig. 1).

Fig.1. Steps in system dynamic methodology (Sushil, 1993)

While the base model was designed care was taken to structure relationships between breakdown maintenance and throughput of unplanned downtime on equipment reliability and process quality with the additional variable of OEE. The methodlogy followed is formulation of the model and few equations are added as appendix at the end of the paper.

This reserach focuses on studying the effect of OEE on the importantant variables of the system like equipment defects, process quality and net throughput. As stated above (Eq.1) OEE is dependent on availability, performance efficiency and quality rate, after the Stock and Flow diagram is drawn the model was tested for the understanding the effect of OEE on equipment defects, process quality and net throughput. The value of availability, performance efficiency and quality rate was hypothetically assumed (Table 2) the product of which represents the OEE. Thus varying these factors for simulation represensts different conditions of OEE in a system and studying its impact on other parameters is of significant use for making effective decision for overall improvement of the system.

Table 2: The hypothetical data used for analysis

Run and corresponding line number	Availability (A) (%)	Quality(Q) (%)	Performance Efficiency (P) (%)
1 (ideal case)	90	99	95
2	50	90	50
3	80	50	50
4	70	70	50
5	60	50	50
6	50	50	50

Now for different values of availability (A) and quality (Q) keeping performance efficiency (P) constant simulations were carried out and the influence of these variables over the time is studied except Run 1 (table 2) where values are kept at high percentages which can be considered as an ideal case. The purpose of keeping performance efficiency constant is to reduce the complexity of the analysis.

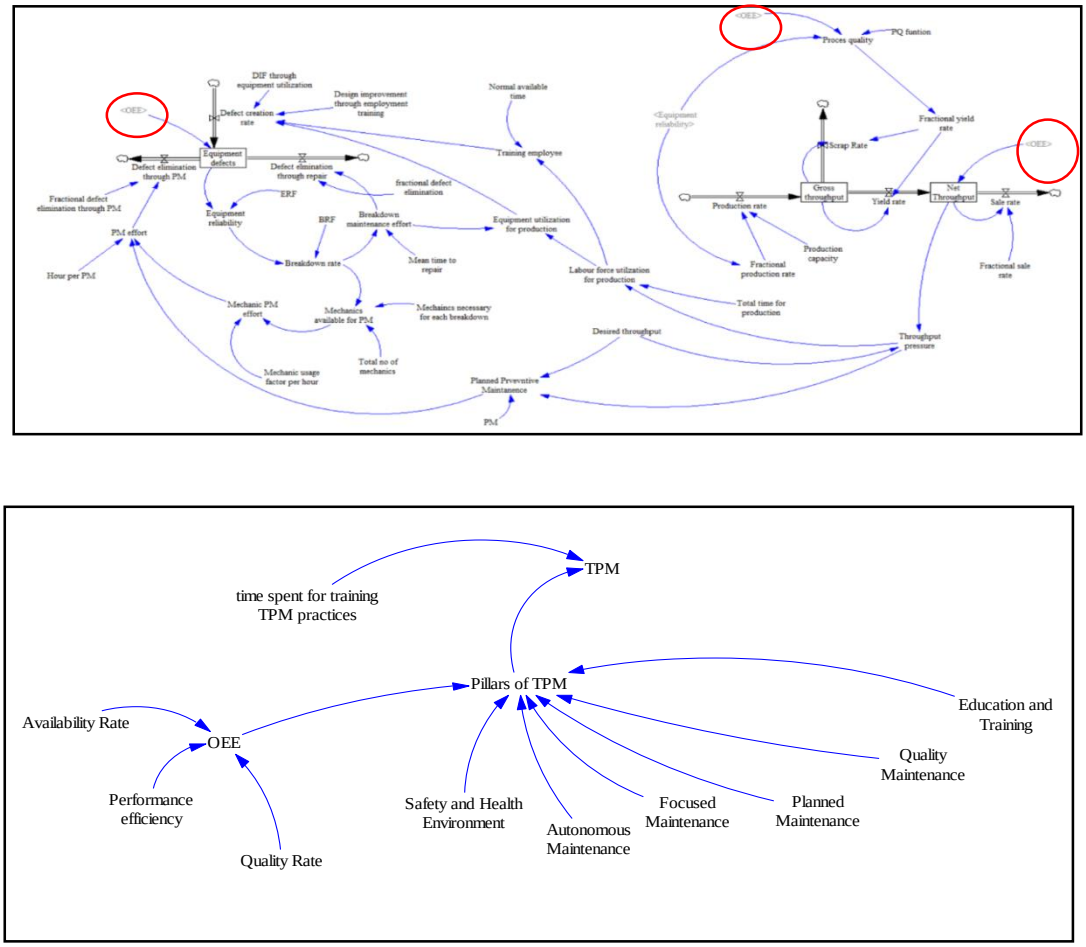

Fig. 3. Effect of OEE on TPM

Simulation Results:

Effect of OEE on Equipment Defects

The secondary data is used in the formulation of the model and for the purpose of simulation the hypothetical values framed in the table 2 was used. It can be clearly seen that for the Run 1 which is an ideal case (A-90,Q-99,P-95) there is greater reduction in the Equipment Defects (Fig. 4). But achieving this might not be realsistic or cost effective. Its is very important to observe that there is greater reduction in equipment defects for Run I, 2,3, and 4 when compared with Run 5 and 6. It sis to be noted that for the lower values of A and Q there are higher defects but also when either of the factors are increased to a greater value keeping the other low there is no significant influence of the reduction in the defects. But for an equal weightage of 70 per cent each on the variables there is significant drop in the defects (Run 4). Thus it is very important to consider that both the variables are having a singnificant influence and should be considered together for a greater benefits. The simulated result shows that Equipment defects were reducing with the implementation of TPM from 43 defects to about 15 defects (i.e. 43% reduction) during

the initial years after which the system stablizes at around 30th month (Fig. 4). Also, it takes lesser time for the system to stabilize during the simulation Run 4, 3, and 1.

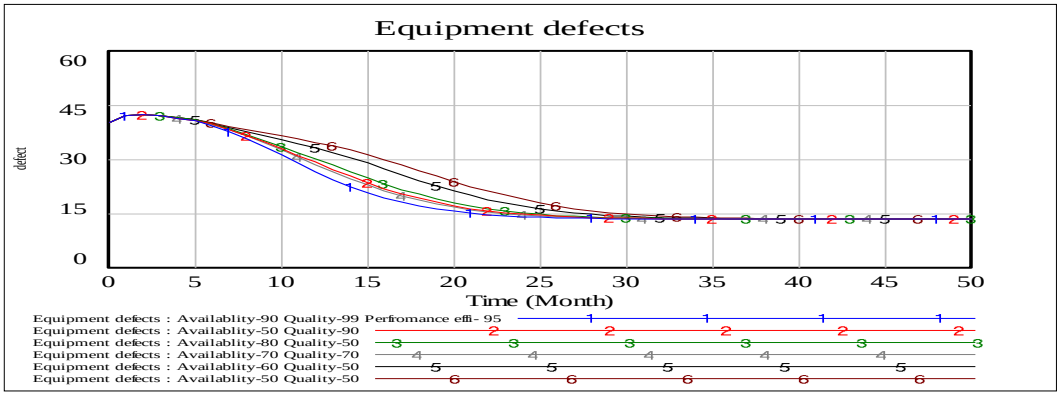

Fig. 4. Effect of OEE on equipment defects

Effect of OEE on Process Quality

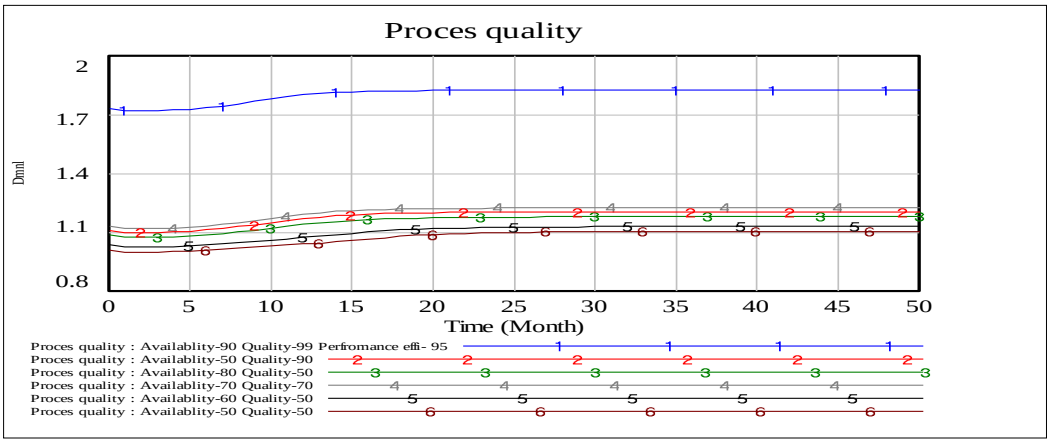

Fig. 5. Effect of OEE on process quality

The process quality initially reduces for the copuple of months after which there is a gradually increase in the quality for around 15 months after which it becomes stable (Fig. 5). But it is very important to note that the quality level is higher for 70% value of A and Q which is desirable (excluding the ideal case – Run 1). But it can also be observed that there is sudden increase in the quality when simulation run 5 and 6 is compared with run 3, 2 and 4 which implies that achieving 3, 2 or 4 OEE conditions will yield greater improvement in the system which now can be the optimum level of improvement to gain maximum benefits with the most desirable one to be run 4.

Effect of OEE on Net Throughput

Similarly the net throughput (Fig. 6) shows significant effect on OEE. It is seen that when equal weightage was given to availability and quality rate (70 and 70) the net throughput was higher. It can be observed that during the 15th month there is around 20% increase in the net troughput when simulation run 6 is compared with run 4. Again it is desirable to attain the level of OEE as in run 2, 3 or 4 so as to gain the higher throughput which thus becomes the optimum range and run 4 being the optimum level for attaining the greater benefits.

This indicates that giving equal weightage to availability and quality may give either best result or the worst but should ensure that Availability and Quality will not go below 50%. Because, it is evident that

the net throughput is increasing from zero to about 900 with the implementation of OEE (Fig. 6) for any condition of simulation carried

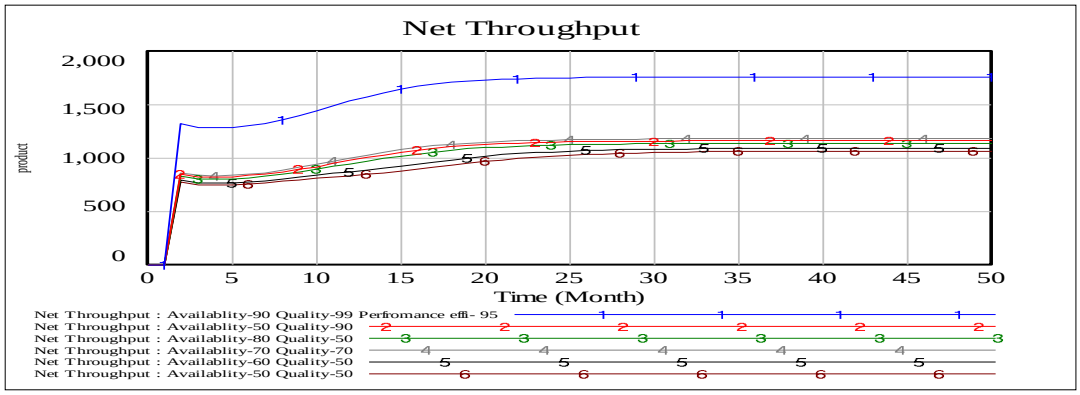

Fig. 6. Net throughput v/s OEE

Discussion and Conclusion:

The simulation and analysis conducted in this research paper suggests that OEE helps in reducing the equipment defects and thus improving the process quality, and net throughput. Hence, equipment reliability naturally increases as result of reduced equipment defects. So, if the machines are maintained properly using TPM activities then there are chances of getting more profit as result of increase in operational efficiency of work.

Therefore by using system dynamics, as a tool for system thinking, effect of OEE and hence TPM on independent variables such as equipment defects, process quality and net throughput was analysed. As Nakajima (1988) recommends the ideal values for OEE are availability of 90%, performance efficiency of 95% and quality 99% (refer: Dal, Tugwell, and Greatbanks, 2000), in this study the minimum optimum level was identified which is to be 70% for the factors A and Q which would result in gerater benefits with lesser effort. Thus even though the ideal condition is difficult to attain company should try to achieve a level of around 70% atleast to gain the maximum benefits even though Kotze (1993) states that an OEE of 50% or more is realistic and acceptable target which is shown as a summary(see Table 3).

Table 3: Summary of results and conclusions

Simulation Run	Availability (A) (%)	Quality(Q) (%)	Performance Efficiency (P) (%)	Conclusion based on simulation
1	90	99	95	Ideal condition may be difficult to achieve
2	50	90	50	Desirable has a drastic improvement in system when compared with run 5 & 6 so can be thought as an optimum range. But Run 4 is the most desirable thus the optimum level.
3	80	50	50	
4*	70	70	50	
5	60	50	50	Not desirable lower benefits
6	50	50	50	

Future Scope:

In this research the simulations were carried with a hypothetical values which forms a conceptual model which can be used in real system with definitie values for the analysis based on which decision can be taken by a decision maker. Also, in this study the focus was mainly on the two factors Availability (A) and Quality (Q) keeping Performance Efficiency (P) constant. The results of which is just not sufficient for decision making thus other iterations with the three factors has to be carried out and also study of the

influence of each factor on the system is necessary so as to arrive at a optimum values of the three factors which would give a better results thus leaving a higher scope of the future research.

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Appendix:

Autonomous Maintenance= 1; Units: Dmnl

Availability Rate= 0.8; Units: Dmnl

Breakdown maintenance effort= Breakdown rate*Mean time to repair; Units: hour/Month

Breakdown rate= BRF (Equipment reliability); Units: breakdown/Month

BRF([(0,0)(1,50)],(0,50),(0.0489297,38.5965),(0.0917431,31.5789),(0.134557,25),(0.21101,17.3246),(0.311927,12.2807),(0.415902,8.55263),(0.538226,6.14035),(0.614679,4.16667),(0.672783,3.07018),(0.749235,1.9738),(0.825688,1.31579),(0.932722,0.6),(1,0)); Units: breakdown/Month

Defect creation rate= SMOOTH3 (Design improvement through employment training (Training employee), 8) +SMOOTH (DIF through equipment utilization (Equipment utilization for production), 5);Units: defect/Month

Defect elimination through PM= PM effort*Fractional defect elimination through PM; Units: defect/Month

Defect elimination through repair= Breakdown maintenance effort*fractional defect elimination; Units: defect/Month

Design improvement through employment training([(0,0)-(20,25)],(0,21.2),(1.11927,21.1184),(2.14067,20.9868),(3.79205,20.65),(5.5,19.7368),(7.155,17.9605),(8.50153,15.7895),(9.7247,13.75),(11.2538,12.1053),(13.45,11.0526,(15.841,10.592),(18.0428,10.5263),(19.8165,10.4605)); Units: defect/hour

Desired throughput= 1000; Units: product

DIF through equipment utilization [(0,0)-(400,200)],(150,0),(150,0),(170,1),(190,3),(210,5),(250,7)); Units: defect/hour

Education and Training= 1; Units: Dmnl

Performance Enhancement of Refrigerator with De-Superheater

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Abstract:

In a world with constantly growing energy needs, energy saving and energy efficiency are gaining prominence in all Engineering applications. Refrigeration systems with considerable cooling requirements consume a large amount of electricity and thereby contribute greatly to the running costs. Slight modifications in the technical elements of the modern refrigeration systems have the potential to reduce the energy consumption, and improvements in simple operational practices can have beneficial impact on Coefficient of Performance (COP) of the system. Thus, the challenge is to determine the changes that can be made in a refrigeration system in order to improve its performance, reduce operating costs and power requirement, and achieve a higher COP. The opportunity here will be to incorporate modifications in conventional refrigeration systems for saving energy.The present work aims at fabricating a working model of a refrigerator that will provide for effective heat recovery from superheated refrigerant with the help of an efficient de-superheater. The temperature of the refrigerant and water in the de-super heater at different intervals of time are measured to determine the quantity of waste heat recovered. It is found that the COP of the system improves by about 6% with the de-superheater and the power input to the compressor decreases by 4 % and also the refrigeration capacity increases by about 4%.

Key words: *Coefficient of Performance, De-Superheater, Heat recovery, Vapor compression refrigeration system (VCRS), Refrigerant*

1. Introduction:

Refrigeration process generates considerable quantities of heat, and this energy simply becomes waste heat if not utilized. In a refrigerator, for instance, the heat absorbed in the evaporator and during the compression must be released again in the condenser in the form of heat. Instead of dissipating this heat quantity to the environment through air cooled condensers, appropriate measures can be implemented in order to put this heat flow to meaningful use for heating purposes because of its temperature level. This can be done by incorporating a De-super heater after the compressor, in series with the main condenser unit. The heat recovered in the "De-super heater-Condenser" unit this way will in turn improve the cycle efficiency and the system COP. Energy efficiency, in addition to improvement of COP, can deliver a range of savings such as reduced operation and maintenance costs, improved system reliability, improved safety, increased productivity, better matching of refrigeration load and equipment capacity, reduced resource consumption and greenhouse gas emissions, better working environment, and reduced energy costs.

Chao Zhu et al [1] proposed a novel domestic cooling and heating unit which is the integration air conditioner, refrigerator and water heater. This system was used for both heat recovery and energy saving with multiple working modes. Emin Yilmaz [2] carried out experimentation on air condition unit. Concentric tube type heat exchanger was used for heat recovery. The main finding is that, when entering water temperature is less than ambient air temperature, efficiency of air conditioning unit is improved. Milind Rane et al [3] developed sensible heat recovery unit and carried out experiments. Waste heat recovered is utilized for water heating. From their findings, chiller cooling capacity enhanced by 30% and COP by 20%. The Reduction in CO2 Emissions is also estimated in their study Robert Clark et al [4] carried out experimentation on domestic refrigerator. They used water cooled condenser and regular air

cooled condenser in parallel. They estimated the rise in temperature of cooling water 35^0 C in 100 hours of continuing operation. They also obtained 18% - 20% energy savings for hot water.
Stinson et al [5] conducted research in dairy refrigeration by recovering the heat from condenser. They found out that by using the water cooled condenser COP of the system is enhanced by 10% to 18%. They also found that increase in condenser pressure reduces COP, and inclusion of heat recovery heat exchanger reduces heat loss. Walawade et al [6] conducted testing of an integrated heat recovery system which was designed both to enhance the performance of a domestic refrigerator and simultaneously to recover heat from heat exchanger.This condenser operates in parallel with the air cooled condenser of the refrigerator so that either one of them is active when the refrigerator is running. Yu et al [7] made an attempt to recover waste heat from the condenser of a domestic refrigerator. They selected a common house hold appliance known as hot case and its energization is replaced from high quality electrical power to low grade waste heat of hot refrigerant vapors keeping in view the likelihood of more effective cooling of high pressure hot refrigerant vapors from the compressor.

It is found from the literature review that most of the research carried out is for recovery and utilization of heat from condenser of the refrigerator using a heat exchanger. The recovery of heat before the refrigerant goes to the condenser is essential because this contains super heat. The recovery of this super heat is more complex than recovery of heat from condenser as it requires the design of a de-superheater separately.
The objective here is to build a prototype of a refrigerator which incorporates direct utilization of waste heat, and which can provide exact, demand-controlled heat recovery. High grade heat comes from 'de-superheating' the refrigerant between the compressor and the condenser. A shell and tube heat exchanger (de-super heater) is installed, with the refrigerant on one side and the fluid to be heated on the other. Not only will this de-superheat the refrigerant, it will reduce the cooling water or air needed in the condenser. The design of the de-super heater is carried out to meet hot water demand.

2. Methodology:

The "De- super heater - condenser unit" is completely insulated, and the heat recovered is measured with respect to the increase in temperature of water flowing through the heat exchanger. A two way valve is used at the entry to the De-super heater, and another two way valve is incorporated at the exit of the De-super heater.

First, the system is made to run normally, by-passing the De-super heater, and allowing complete heat rejection in the condenser. The observations taken for the temperature and pressure is used to calculate the enthalpies and the useful heat available at the exit of the compressor. Then the refrigerant from compressor discharge is allowed to go to the De-superheater-condenser unit in sequence. The observations taken is used to compare the COP of the system, Power input and refrigeration capacity with and without De-superheater.

Figure 1 shows the experimental setup with a 230 Litre refrigerator and a De-superheater The refrigerant used is R-134a, which is the common refrigerant used in domestic refrigerators. The condensation of the hot refrigerant vapour takes place in several stages. In the initial phase ,heat is extracted from the hot compressed gas from the compressor. The extracted heat amounts to 10-20 % of the total condenser capacity. Even though, the superheat portion is only 10-20% of total heat rejected, the quality of this heat is much higher than the heat available at condenser temperature. It is particularly suitable for heat recovery if the required heating media temperature is higher than the condenser temperature, and the extracted heat alone can cover the heat demand. The actual condensation then occurs in a second phase . The temperature of the recoverable heat then corresponds to the condensation temperature Tc. In the final phase the sub cooling of the condensed refrigerant takes place in the condenser. Due to the low temperature and energy content, the heat recovery is difficult in this phase.

Figure 1. Whirlpool – Ice Magic 230L DLX Refrigerator with De-superheater

Technical specifications of the refrigerator:
Compressor : Power Input = 91 Watts, Current = 0.8 Amperes
Condenser : Condensing Temperature = 38 C
Evaporator **:** Coil Temperature = -18 C
The condenser and the evaporator coil temperature are measured using thermocouples at the surface of condenser tubes and the evaporator coil under steady state.
In addition to this, other temperatures in the working cycle of the refrigerator are measured using thermocouples at different locations in the refrigerator.
Compressor Inlet/Evaporator outlet temperature : -1.8 C
Compressor Outlet Temperature : 73 C
The corresponding evaporator and condenser pressures are obtained from the thermodynamic property tables for R-134a refrigerant corresponding to condenser and the evaporator temperature.
Condenser pressure : 9.6301 bar , Evaporator Pressure : 1.4454 bar

2.1 COP of the system:
Using the thermodynamic property tables for refrigerant R134a, enthalpies at various state points were determined.
At the compressor inlet, h_1 = 389.221 kJ/kg (superheated)
At the compressor exit, h_2 = 458.157 kJ/kg
Specific work of compressor = $h_2 - h_1$ = 56.936 kJ/kg
Enthalpy at condenser outlet = 253.37 kJ/kg (Throttling) (h_3=h_4)
Refrigeration effect in the evaporator = 135.85 kJ/kg
Refrigerant mass flow = ($\dot{m}$) = Power input / Specific work = 91/ (56936) = 0.001598 kg/sec
Refrigeration Capacity = mass flow rate x (h1' – h4) = 217.02 W
C.O.P = (h1' – h4)/(h2 – h1) = 2.36

2.2 De-super heater Design:

The De-super heater unit is a plastic container of square cross section containing water. The spiral shaped tubes where the superheated refrigerant flows inside the de-superheater enhances the heat transfer from the refrigerant to water. Both the De-super heater and the top lid are properly insulated. Two hose nipples are fitted at the same level in opposite faces of the De-super heater for maintaining a constant level of water in the De-super heater. One of the hose nipple is connected to a water pipe for making inlet of water into the De-super heater, while the other hose nipple at the opposite face provides for outlet of water into the drain when the desired level (1.5 litre) of water is reached in the De-super heater.

2.3 Overall heat transfer coefficient (U):

Outer diameter of the refrigerant tubes (Do) = 6 mm, Thickness (t) = 1 mm

Material = Copper (Thermal conductivity, k = 380 W/mK)

Fouling factor for refrigerant side (Fr) = 0.00017

Fouling factor for water side (Fw) = .00017

To find out the heat transfer coefficient, Diltus–Boelter correlation for refrigerant is used.

$Nu = 0.023 \times Re^{0.8} \times Pr^{n}$ where: n=0.3 for cooling (Tw < Tf) , Nusselt Number, Nu = hD/k, Reynold Number, Re = ρV D/μ and Prandtl Number, Pr = μ Cp/k

Mean Temperature of refrigerant = (73 + 38)/2 = 55.5 C

Mass flow rate of refrigerant $(\dot{m})$ = 0.001597 kg/sec

For 55.5 C and 9.6301 bar, the thermodynamic and physical properties of R134a is found out from data tables, and are listed below:

$\rho = 47.3277$ kg/m^{3,} $v = 2.7105 \times 10^{-6}$ m^2/s, $\mu = 12.7825 \times 10^{-6}$ Pa-s, $k = 15.9378 \times 10^{-3}$ W/m.K, C_p = 1127.63 J/kg.K

Velocity of refrigerant can be found out by using the mass flow rate as follows; $(\dot{m}) = 0.001597 = \rho \times A \times u = 47.3277 \times \pi \times .25 \times (6 \times 10^{-3})^2 \times u$

which gives, **u = 1.1934 m/s**

$R_e = (\rho \times u \times D_o)/\mu = (47.3277 \times 1.1934 \times 6 \times 10^{-3})/(12.7825 \times 10^{-6}) = 26511.657$

$P_r = (\mu \times C_p)/k = (12.7825 \times 10^{-6} \times 1127.63)/ 15.9378 \times 10^{-3} = 0.9043$

$Nu = 0.023 \times Re^{0.8} \times Pr^{n}$ gives,

$Nu = 77.1306 = (h_r \times D_o)/k = (h_r \times 6 \times 10^{-3})/(15.9378 \times 10^{-3})$

$h_r = 204.88$ W/m^2.K

$1/U = 1/h_r + Fr + Fw + t/k_{Cu} = (1/238.09) + (2x.00017) + (10^{-3}/380)$

U = 191.441 W/m^2.K

2.4 Length of De-superheater tubes:

The heat available for recovery, $Q = mCp\Delta T$ where Q = Heat available from De- super heating = 63.028 W

m = mass flow rate of water = .1 kg/min, Cp = 4187 J/kg.K

ΔT = Difference in water temperature at outlet and inlet

Substituting these values in the equation;

$\Delta T = Q/mCp = 63.028/(.1/60) \times 4187) = 9.051$ C

To = 30 + 9.051 = 39.051 C

Now, ΔT_m = LMTD

ΔT_1 = Refrigerant temperature difference = 35 ℃

ΔT_2 = Water temperature difference = 9.051℃ $(approx)$

$\Delta T_m = \frac{\Delta T_1 - \Delta T_2}{\ln(\Delta T_1/\Delta T_2)}$ = (35-9.051)/(ln (35/9.051)) = 19.186 C

Now, Area of heat exchanger (A) will be;

Q = UA ΔT_m

A= Q/(U ΔT_m) = 63.028/(191.441 x 19.186) = **0.0171 m^2**

A = $\pi\ Do\ L$, **L** = A/ ($\pi\ Do$) = .0171 / (π x 6 x 10^{-3}) = **0.91035 m = 91.035 cm**

3. Results and Discussion:

Table 1.Temperature Readings for calculating C.O.P, Power Input, Cooling Capacity

Configuration	**11:00-12:00**	**2:00 – 3:00**	**4:00 – 5:00**
Without De-super heater	Te = -18^0 C Teo = -1.8 Tco = 73 Tcs = 38	Te = -22^{0}C Teo = -5.1 Tco = 72 Tcs = 38	Te = -22^{0}C Teo = -4.2 Tco = 74 Tcs = 38
With De-super heater	Te = -20 Teo = -4.8 Tco = 69 Tcs = 38	Te = -18 Teo = -2 Tco = 71 Tcs = 36	Te = -20 Teo = -2.2 Tco = 69 Tcs = 36

3.1 With De-super heater:

From the thermodynamic P-h diagram, and using the thermodynamic property tables for refrigerant R134a, enthalpies at various state points were determined –

At Compressor inlet, h_1 = 401.092 kJ/kg

At Compressor outlet h_2 = 453.64 kJ/kg

$h_3 = h_4$ = 253.37 kJ/kg (Throttling)

C.O.P = (h1' – h4)/(h2 – h1) = 2.44

Mass flow rate (m) = 0.001598 kg/sec

Power Input = mass flow rate x ($h_2 - h_1$) = 87.11 W

Refrigeration Capacity = mass flow rate x (h1' – h4) = 217.02 W

Maximum Recoverable Heat = mass flow rate x (h2 – h2') = 55.79 W

Actual heat Recovered = mass flow rate of water xC_p x ΔT for water= 48.59 W

Table 2. C.O.P, Power Input , Cooling Capacity at different times of the day

Configuration	**11:00-12:00**	**2:00 – 3:00**	**4:00 – 5:00**	**Average**
Without De-super heater	C.O.P = 2.36 Pin = 90.89W R.C =214.82W	C.O.P = 2.2801 Pin = 92.49W R.C = 208.89W	C.O.P = 2.211 Pin = 94.94W R.C = 205.59W	2.2837 92.60W 209.77W
With De-super heater	C.O.P = 2.44 Pin = 87.113W R.C = 217.02W	C.O.P = 2.474 Pin = 88.8069W R.C = 221.55W	C.O.P = 2.55 Pin = 85.06W R.C = 218.59W	2.4236 88.553W 219.01W

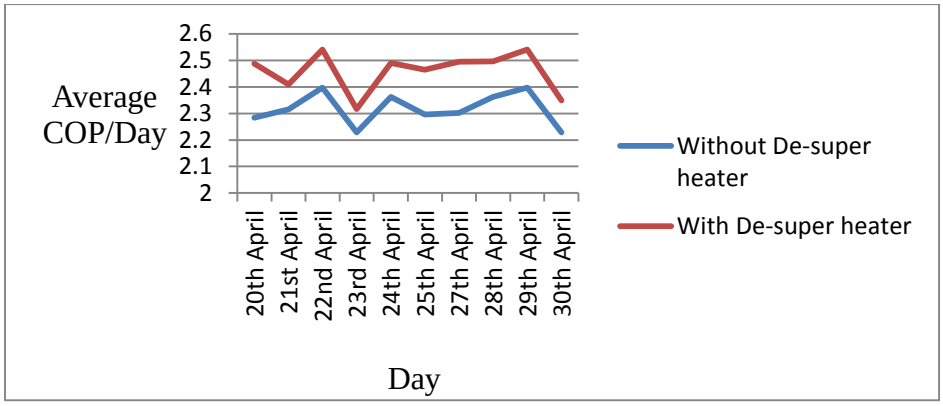

Figure 2. COP comparison with and without De-Superheater

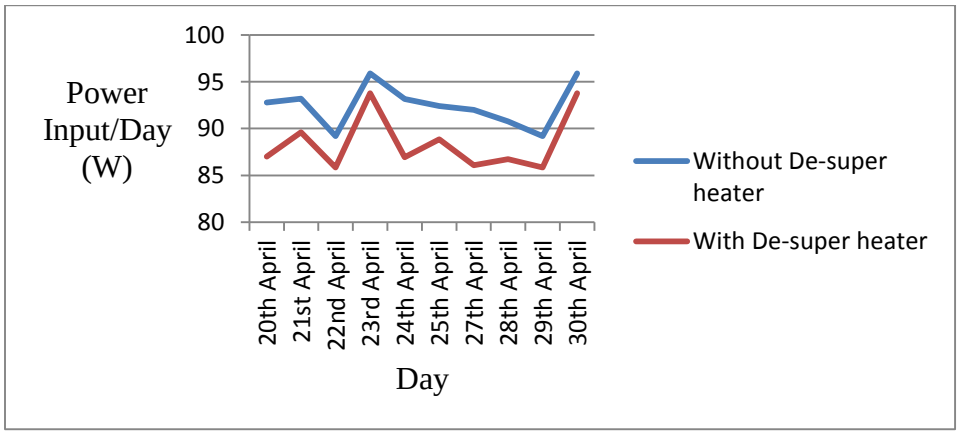

Figure 3. Power input comparison with and without De-Superheater

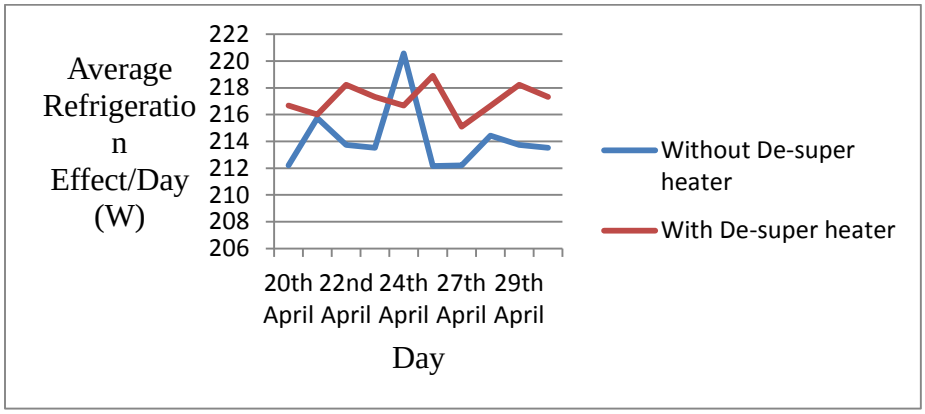

Figure 4. Refrigeration capacity with and without De-Superheater

Overall percentage increase in C.O.P = 6.125 %
Overall percentage decrease in Power Input = 4.32 %
Overall percentage increase in Refrigeration Capacity = 4.4 %
Average Maximum Heat Recoverable = 55.79 W
Average Actual Heat Recovered = 48.59 W
Percentage Actual Heat Recovered = 87 %

4. Conclusions:

1. Use of de-superheater for recovery of superheat is beneficial in refrigerator.
2. The recovered heat can be used for hot water requirements.
3. Since the heat at the end of compression is recovered completely in each cycle, the system runs smoothly.
4. Quantity of air/water to be circulated in condenser reduces thereby reducing its size.

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Hayavadana: A woman's deft freedom or a suffocating plight?

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Abstract:

Girish Karnad, an Indian English playwright deals with social concerns of the modern world creating the base of mythology. Hayavadana (1972) is one such play that deals with the theme of incompleteness woven in the love-triangle of Devadatta, Padmini and Kapila.Through the central character of Padmini, Karnad challenges the social gender norms prevailing in society. A woman's identity is judged according to the socio-sexual norms than her intellectual capacity wherein she ultimately becomes a subaltern. Elaine Showalters' term "feminist critique" further reinforces the stereotyped image of women portrayed in literature. In reference to Hayavadana, on one hand, when Padmini transgresses the socio-cultural boundaries created by the patriarchal society, it becomes a challenge for Devadatta and Kapila to accept the free-will of a woman. On the other hand, Padmini herself performs the act of self-immolation when she looses her husband, Devadatta, which portrays a woman's compliance to the traditional norms. Such events in the play open up possibilities to explore whether the reasons for Padmini's actions to consciously submit herself to patriarchal notions were to save herself from the social stigma or was she actually a victim of inhuman customs against women.
This paper is an attempt to explore all these possibilities from the gender lens.

Keywords: *Subaltern, Socio-cultural boundaries, Patriarchal.*

The Sita and Draupadi myth proclaims an ongoing tradition of long-suffering women whose significance is overlaid with the message of devotion and service to their husbands. These qualities have been glorified since ages and have been considered as preferable and imperative. Tradition has only emphasized women's self- immolation and the concept of ―*pativrata*– the idealized one which has been romanticized through legends, myths, folklores, folksongs and reaffirmed through ceremonies of different kinds.

Girish Karnad, in his plays, skilfully pictures the condition of a 'typical' Indian women governed by the aforesaid patriarchal norms who is bound by the tradition of marriage but whose spirit remains unbound. With an eye of concern for the oppressed and the downtrodden he has depicted women enthused with feminism, fighting against the unjust norms of the patriarchal order.

Introduction:

When the play begins,Devadatta and Kapila, the two male characters , are the closest friends- one mind, one heart, as the narrator- Bhagvata describes them.

Kapila says;

" Don't you know I would do anything for you?Jump into a well-or walk into fire? Even my parents aren't as close to me as you are. I would leave them this minute you asked me to." (Karnad, 12)

Devdatta is a man of intellect; the only son of the revered Brahmin, Vidyasagar. He is comely in appearance, fair in colour, unrivalled in intelligence and the greatest poets of the world with his poetry

and wit. Kapila, is the only son of the ironsmith; dark and plain by looks but with physical skills and strength which has no competitor.(Karnad, P2)

The strands of their friendship start to loosen when Devadatta marries Padmini.
Kapila gradually falls for Padmini. Eventually, Padmini also starts falling for Kapila. The friends kill themselves in a scene, which has been very hilariously described but infused with a lot of drama. Padmini, consciously or unconsciously, transposes their heads, giving Devadatta Kapila's body and Kapila Devadatta's. After this, she is illusioned by the fact that she has the best of both the men and over a period of time, she understands the fact that of the three, she has the capacity for complete experience but things have already become beyond her control now. A duel leading to the death of both the friends and Padmini's tragic act of *sati* ends the play.
The play is a mirror to the contemporary society wherein women have to succumb to the age old traditions blindly, making themselves fit in a frame of what their husbands expect them to be.

Deft freedom or suffocating plight?
The play begins with an invocation to Lord Ganesha in which Bhagavata, the narrator, describes him as the single tusked destroyer of incompleteness. He further says:

"How indeed can one fathom the mystery that this very Vakratunda-Mahakaya, with his crooked face and distorted body , is the Lord and Master of Success and Perfection? Could it be that this Image of Purity and Holiness , this Mangalmoorty, intends to signify by his very appearance that the completeness of God is something no poor mortal can comprehend?

These lines give the reader an idea about the one of the major themes of the play which deals with incompleteness of the human being.

Hayavadana or the horse headed man, is one such character of the play constantly struggling to establish an identity.

The mother of Hayavadana is the female character who strives to achieve her right in male-dominated society. When she was asked to select her husband, she decided to marry with white stallion. Her father deeply tried to convince her but she strictly stood on her decision. As Hayavadana describes:

"No one could dissuade her. So ultimately she was married off to the white stallion. She lived with him for fifteen years." (Karnad, 29)

Here, it is important to note that mother of Hayavadana broke the shackles of male- dominated society. Also, she could not be convinced by anyone. She became despair when she came to know that the white stallion turned into *gandharva*. Also, she firmly denied when her husband asked to come with him in the Heavenly Abode. Her husband was a symbol of patriarchal person who cursed her when she denied his company. Therefore, she ran away lonely without thinking about her child, Hayavadana leaving him alone in the worldly affairs without any knowledge, struggling to establish his identity.

There is a covert suggestion that women are mainfestations of 'divine energy' or 'life force' and it is they who hold the centre stage. Into the basic fabric of the stories which he has taken from myths, Karnad weaves new patterns. In Hayavadana, the thrust is made more psychological, and thereby the mythic content of the transposed heads is given a turn of the screw.

On the superficial level, it is the tale of three lovers, Devadatta- Padmini-Kapila. Padmini who is initially very happy after her marriage with Devadatta, is gradually attracted by Kapila's strong physique. However, her inner urge must remain repressed and her fidelity as a good Hindu wife must never be in question. The irony lies in the fact that neither dramatis has ever taken strides beyond the basic story material.

Girish Karnad has also glorified the extra- marital relationship through his dramatic art, while he knows that it is for sensual fulfilment. Padmini, though a beautiful woman, wages a war against the patriarchal order of command and ultimately she too becomes a prey to the tyranny of the patriarchal society. It is the undeniable reality that Indian culture considers marriage to be the supreme blessing for a woman, because it offers her salvation through her service to her husband. For her, chastity is superior and preferable to life itself. But, she denied love, enjoyment, entertainment and freedom, which are indispensable to the growth of her personality. Padmini, on seeing both the men dead, prays to Goddess Kali to save her. She says to herself:

" And what shall I say when I get there? What shall I say happened? And who'll believe me? They'll all say the two fought and died for this whore. They're bound to say it. Then what'll happen to me?" (Karnad , 31).

The above mentioned lines clearly indicates the constant fear that a women lives under when it comes to shaping her character in front of the society. But at the same time , Padmini is wise enough to think for herself as well when she says: Then what'll happen to me.

When Padmini realised the fact that she could not get out of the complex codes of the society and openly express her admiration for Kapila, she thought to make things go in her favour at the Kali temple by transposing the heads.This gesture reflects her smartness in trying to shape things as per her whims and fancies thereby trying to aim for a completeness in her life. For a brief period she does feel that she has achieved that but over a period of time, she realises the fact it is all temporary. Finally, Kapila and Devadutta who are unable to live together with Padmini kill themselves in a duel and Padmini performs *sati*. Padmini due to the impact of male hegemonic power prevalent in the society dare not live with two males whom she is fascinated with and without them is unable to make her life happy. Padmini stands out as a strong exponent of women's liberation through her own choice in the sense that she tried her best to make choices based on free will but ultimately loosing out against the social order prevalent in the society.

John Stuart Mill says:

"the legal subordination of one sex to the other . . . is wrong in itself, and now one of the chief hindrances to human improvement' is 'an opinion which I have held from the very earliest period when I had formed any opinion at all on social or political matters, and which . . . has been constantly growing stronger by the progress of reflection and the experience of life" (Mill, Subjection of Women).

The protagonist of the play, Padmini is beautiful, energetic and shrewd (in the manner that she tactfully knew how to get the best out of both the men). Her constant attraction to Kapila because of his attractive physique disturbs Devadutta, eventually causing an unrest in their married life. But Padmini, very cleverly acts as a rescuer when her husband holds his best friend responsible for the same. When Devadutta complains about Kapila's constant interaction with Padmini during his reading of Bhasa (the earliest and most celebrated Indian playwrights in Sanskrit) , she says:

"Don't blame him. It's my fault. He learnt a bit about poetry from you and I thought he might enjoy Bhasa. So I asked him to come...He didn't want to –but I insisted." (Karnad, P20).

The idea of Padmini preforming *sati* becomes humorous and ironic because the comment of Bhagvata specifies the act of *sati* as:

Bhagavata: Padmini became a sati. India is known for its *pativrata*- wives who dedicated their whole existence to the service of their husbands -but it would not be an exaggeration to say that no "*pativrata*" went in the way Padmini did. And no one knows the spot where she went sati. (Karnad, 63)

As a lady, Padmini wants that Devadutta should pay attention to her desire but he is always busy in poetry and plays. Therefore, she looks for a man who can admire her beauty and fulfil her desire and Padmini sees the trip to Ujjain as an opportunity to spend more time with Kapila. As they move ahead for the journey, she projects her passion for the "iron-black-body' when she sees Kapila. She breaks the moral social code and conducts in her life.The scene where she performs *sati* becomes comic and ironic. Before performing *sati* , she gives out the hidden and mysterious speaks of human relationship when she tells Bhagvata, the narrator , about her child as:

Padmini: Yes, Please. My son is sleeping in the hut. Take him under your care. Give him to the hunters who live in this forest and tell them it's Kapila's son. They loved Kapila and will bring the child up. Let the child grow up in the forest with the rivers and the trees. When he's five take him to the revered Brahmin Vidyasagara of Dharmapura. Tell him it's Devadatta's son. (Karnad, 62)

Gayatri Chakravorty accentuates that the ideological construction of gender keeps the male dominant and the female in the "shadow" which leads to "double colonisation" of women- that is, in the first instance , in the domestic sphere , the patriarchy of men, and then in the public sphere, the patriarchy of colonial power. This has led to increasing companionship being made between patriarchy and colonialism. Therefore, "female emancipation" femmes to disappear from public agenda.

Girish Karnad has presented their subalternity and fused energy in to them to speak; moving them from the "margin" to "centre". Padmini, who had been initially confined to the walls of the house after the

marriage with Devaduta gradually became the centre of the world for both the men by shaping her desires according to her own will.

The literature is fully filled with the examples of women who were oppressed because they tried to cross the threshold in the male dominated social strata . The male has voice, presence and power, whereas the female is silent, absent and powerless. Taught to repress her own desires and train to practice self-effacement, she has taken birth to aciculate a male constructed definition which she has to internalise. Therefore, when she speaks , it is patriarchy that speaks through her. Women slavery leaves men free to pursue their wishes. The solitary confinement of women in the plays of Girish Karnad symbolises the chastity belt of middle ages, the reduction of women's talents to housework and the exclusion of women from enlightenment and enjoyment.In this respect, Padmini not only tries to free herself from forces and shackles of marriage life but also boldly expresses her commitment to her love for Kapila. The image of the free independent and self-respecting modern woman is evident in Padmini. Though she does not fight patriarchal domination in the true sense, she merely marks a beginning in the long process of reform in the existing social system in the Indian context. Here the comment of Jaya Kapoor, a South-Indian film actress, is significant to quote: Karnad finds a special interest in the rich wealth of Indian mythology which offers him ample threads to weave his stories where he is not just narrating a tale but constructing and exploring narratives at various levels. The richest in these multilayered narrative explorations is his play 'Hayavadana'. (2006:98)

Thus, it is concluded with the views of Showalter that "we have seen our fore mothers as mindless, down-trodden souls, accepting century after century the fetters of their lot with passivity unheeding or incapable of perceiving their exclusion from society. Women's relationships to themselves and society have been essentially static, as fixed as to render women of the past mute and dumb, unable to write, speak or even see the truth".

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Jailed Rights - An approach to carve out the rights crisis in democratic set up though Indian Illustration and European inspiration

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ABSTARCT-

Adversarial legal system envisages in itself the innocence of an accused until proven otherwise. This paper would enshrine in itself the infringement of second generation democratic rights of such under trial prisoners in the Indian prisons. **Right to Vote**, a second generation right, which a denizen of a democratic country enjoys at liberty without any non-rational restrictions. Albeit such rights have been considered as equivalent to human rights by European commission of human right; but still in parts of world, such rights have been kept at bay with some **"special citizens**" There are these who are not given the liberty of Right to Vote. Through the medium of this paper, herein we declassify the distinction between an ordinary citizen, a prisoner and a person sandwich between the two. the paper discussed the article 326 of Indian Constitution with reference to International Covenant on civil and political rights and Human rights. The European Human Right Commission has been cognoscenti with its next generation recognition of Voting Right for prisoners. this has, also, been obstreperous to current approach of such rights. The paper through jurisprudential analysis of rights crisis subsumes case laws and various dictum set under various other legal system of the world. The paper analyses Austin, Locke, and Pound with due consideration towards the School of jurisprudential thoughts.

Keywords: adult franchise, social engineering, grundnorm

The case was an appeal under Art. 136[24] through special leave petition in Supreme Court, challenging the judgement of Patna High Court[25], regarding the right of universal adult franchise to under trial prisoners. Section 62(5)[26] condemns under trials to vote; in order to de-criminalise political sphere[27]. In the judgement, the two judges' bench of Supreme Court had illustrated various provisions in Representation of People act, 1951; which sets criteria for disqualification for electors, on the ground of confinement in a prison or under police custody[28]. Supreme Court in case of PUCL[29] in 1997, had dismissed the petition on

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[24] INDIA CONST. art. 136
[25] Jan Chaukidar (Peoples Watch) through its convenor Basant Kumar Chaudhary vs. Union of India (UOI) and Ors. 2004 (2) BLJR 988, (India)
[26] Representation of People act of 1951, INDIA CODE,
[27] *Id.* at 1
[28] *Id.* at 1
[29] A.C. Pradhan v. Union of India, AIR 1997 S.C. 2814 (India).

the same grounds stating the reason that voting rights are not such, that without which a man cannot survive and such rights are only eclipsed for a time being. The same dictum was followed in the present case and Supreme Court relied upon observation of Patna High Court and dismissed the appeal.

Right to vote, being enlisted as statuary right under Indian constitution, draws its applicability from the United Nation convention on political and civil rights[30]. Such statutory rights are differentiated from fundamental rights[31] for the reason that former are specially created under a statute for extra ordinary or special purposes and are also subject to limitation imposed upon it from the statute itself[32].

POSITIVE SCHOOL OF THOUGHT

This judgement shows more characteristics of positive school of thought than any other school of jurisprudence. Under positive school, while defining the law, it is argued that it should be understood scientific and analytical and free from normative approach of law *i.e. ought to be*. In this school of thought, the subject of moral, political, ethical or religious shall be annulled for characterising the law, until the law serves the purpose of its composition. But it shall not be understood that positivist defends value and moral less law, for the reason that some of its jurists were themselves utilitarian in their approach. Jeremy Bentham, being a utilitarian, believed that the good of majority shall be advanced over interest of minority. In the present case, the voting rights of under trials was abrogated while on the same instance, another Supreme court judgement on voting rights for Non- resident Indian[33], gave such rights to NRI's who out numbers the under trial in Indian prisons. Another perspective could also be that the under trial prisoners who are bailed out, during the trial, can vote; but under trial below poverty line, who can't pay their bail, cannot vote. For Bentham, happiness shall be the greatest good, without considering the natural school ideas of morals, ethics or other qualities. Bentham would justify the Supreme Court instance on the judgement as it adopted by sovereign and drives the conduct of a section of society, which consists of under trial prisoners, and they are subject to the power of such sovereign. Bentham would justify the law on the basis of its source as it comes from the legislation, subject and extent as it applies to population in prison, object as Supreme Court states that objective of such law is to avoid criminality in politics, corroborative appendage would law itself be, as it is a punishment for being charged under the

[30] International Covenant on Civil and Political Rights, (Dec 16, 1966)
[31] INDIA CONST. art. 14 – 32
[32] N.P Ponnuswami V. Returing Officer, Namakkal constituency, A.I.R. 1952 S.C. 64 (India)
[33] Nagender Chindam v. Union of India; Writ PetitionsCivil No. 80/2013 W.P.C No. 1010/2013 W.P.C No. 265/2014

law and remedial appendages as election commission of India has an electoral handbook which provides clarifies the principle law.

But Bentham would only satisfy the peripheral understanding of positivism in the present case, John Austin would further elaborate upon it through his self-coined term, "significance of desire". Austin argues under significance of desire that such significance could only be expressed under two ways, as command by sovereign or request. A legislated law, in a parliamentary democracy, would be enlisted under proper law, passed by sovereign as it has been made by an intelligent being to its citizen, which would call for strict interpretation of law. On the other hand, Austin also signifies that constitution would be an 'improperly called law', as even sovereign is not above such law and Austin would also not agree to parliament being called a sovereign, as here, its people who participate in making sovereign so it would not justify the habitual obedience of sovereign. Albeit under Austin's definition of law, constitution would not be counted as it is not backed by sanctions, which is an essential requisite for law by Austin. But right to vote is not a civil right or constitutional right, rather it is a statutory right, as Supreme Court ruled, and comes from a special legislation, which is subject to its limitations[34]. Further, Kelson, in his 'pure theory' of positivist' law, excluded morals, politics and other social factors from law. He distinct between legal and moral norms, in which latter would limit itself to the peripheries of prescribed action rather describing, ought to positions. Kelson had also referred Constitution as *Grundnorm*, to which even Supreme Court relied, but the criticism would be that such *Grundnorm*, as Kelson defined, was not formed by any other act or in reference to other sources. These conditions remained unsatisfied in Indian constitution, thus the reference of Supreme Court towards Constitution on Art. 326 in the case would not make it fall under the category of *Grundnorm*. Therefore although Supreme Court tried to make constitution, in reference to other legislations, as the basic norm but it could not satisfy its requisites.

HISTORICAL SCHOOL OF JURISPRUDENCE

This school takes into account the general principal governing its origin and development of law. Maine considers Montasque to be the first profounder of this schools and gives approach of 'Esprit des Lois' (spirit of law) which signifies that all the laws shall have a historical approach. Hugo contends that law is not only the result of legislation, nor is a command and also not the result of social contract. But it's a way or pattern in which denizens acquire these rules in their life, through necessities or accident and these rules becomes habit, which then shall be called as law, in proper sense. Savigny, also, being one of the profounder of this stream of school of thought had stated that law could not be an arbitrary or deliberative

[34] N.P Ponnuswami v Returing Officer, Namakkal Constituency, A.I.R. 1952 S.C. 64

act of legislation, but it has to find it roots from the conscience of people and their customs. India, before commencement of the constitution had concept of *Dharma*, rather than *Adhikar*. These duties were derived from various scriptures and manuscripts. On the contrary Indian constitution gave rights to citizen and concept of dharma lost its relevance in legal Diaspora. Courts had faced problems while bifurcating the right on the basis of constitutional and statutory rights. As each statute had its relevancy through the constitution[35], still they were bifurcated with regards to special nature of an statue, but separation of statutory right only infringed the basic political and civil rights, which are enshrined in UN convention on political and civil rights. The right to vote, which draws it relevance from Jurists like Hobbes, John Locke and Jean Jacque Rousseau and their ideological participation in French Revolution in 1789, had diminished the bifurcation of an active citizen and a passive citizen, which was solely based on power to vote. This distinction was discarded and right to vote was given to each and every citizen, above the legal age, but the present judgement undermined such classification and had deprived a class of citizen from their voting right, albeit they are presumed to be innocent under adversarial law system, which instigate an re-approach towards the social contract theory clarification given by Hobbes. "The law," says the historical jurist "embodies the story of a nation's development through many centuries, and it cannot be dealt with as if it contained only the axioms and corollaries of a book of mathematics"[36]. Thus, the right of universal adult franchise cannot be judged by utilitarian viewpoint and depriving a class of citizen of their basic political and civil rights.

On the part of comparative jurisprudence, most of the European countries, which are part of European human right commission, are offering voting rights to under trial and to prisoners, also. Countries like France, where stated the movement of liberal rights in 1789, offers voting rights to prisoners, if not otherwise barred as additional punishment. Thus, abrogation on the rights of adult franchise are considers to be an additional punishment, which is only applicable in specific crime, but in India it is considered to be a part of punishment. Countries like Greece and United Kingdom, who were not earlier giving voting rights to under trials, are now convinced on enjoyment of such rights by captives for better recreation in prison

RIGHTS-

Salmond describes right as the interest, recognized and protected by law, which shall be respected by duties in response. Rights, when infringed, or duties, when not performed, shall constitute a wrong.

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[35] *Id.* at 1

[36] Nathan Isaacs , *"The Schools of Jurisprudence. Their Places in History and Their Present Alignment"* Harvard Law Review, Vol., Jan 1918 at 373-411

Austin advances this definition by stating that a right shall only be created when the other being is obliged or forbears somethings as consideration to that right. But such cheek by joule status of rights and duties has been criticized under various illustration as under partnership act if a minor, who is entitled for share in profit, can ask the firm to show the accounts, but this right of the minor is not complemented with a duty upon other partner to show the account. Thus, in some instances duty and right may not be supplementary. Same lies in the case, herein,; albeit, a citizen has a statutory right in a democracy, which is right to vote, but such right is not barring state to mandatorily act upon the same. Thus from the perspective of the Supreme Court, Austin describes the supplementary nature of rights and duties, as every right may have a duty but not vice-versa. Likewise, Holt C.J.[37] describes the distinction between such rights as **perfect and enforceable rights** & **imperfect and unenforceable rights**. Latter would constitute the right to vote as it's a statutory and legal right, as per Salmond, which does not attract mandatory enforceability.

Beside, all the theories a contradiction that comes in between is the nature of right that is right to vote for under trials. As Supreme Court says, it's a statutory right formed under special law of representation of people act, 1951. But the same statute draws its constitutionality form Art. 326 of Indian Constitution. The criteria of debarring an elector from voting list as well as power to legislate on election provisions are well specified in the Constitution[38]. Therefore, all the acts falling on the lines of election law shall satisfy the provisions of Art.325, 326, 327 and 328. Thus, right to vote of not just a statutory right but also constitutional right so it cannot be counted as imperfect right, which is unenforceable.

Another critique of such approach towards right to vote to under trials would be that in India currently more than seven lakh under trials prisoners are behind the bars, who are deprived to this right as a citizen. On the contrary, under trials prisoners who are bailed out can enjoy such right, so the distinction comes at the status of confinement. In the judgement of Hussainara Khatoon v. State of Bihar, it was observed that there are many prisoners, who either are serving beyond their punishment term or are below poverty line, because of the reason that they seems incapable of paying the penalty or bail bonds. Thus. Here **right to equality** among the prisoners of same kind can be challenged. Therefore, it creates a negative right towards state.

Thus this contradiction puts right to vote for under trial in category of perfect and enforceable right, where a claim of such right has a supplementary duty from the state. In words of **Tawney**, such right

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[37] Ashby v. white, (1703) 92 ER 126, : (1703) 2 Ld Raym 938
[38] INDIA CONST. art. 327

rights are capacity of an individual to modify the conduct of other individuals at his own desire, which confers power on such right. Thus, an obligation is created upon state to act on virtue of providing equality; as in words of Holland, who describes an obligation, as a tie whereby a person is obliged to perform as a consideration for benefit of others.

CONCLUSION

The judgement of providing voting rights to eleven million Non-resident Indian[39] through e-ballot voting within eight week, would further the inclusiveness of Indian electors under representation of people's act. But before providing such rights to distant citizens, we must introspect the status of "inland citizen" under voting rights system. As per the data of National Crime record bureau, in India more than seven lakh under trial prisoners are confined. Many of such prisoners are bailed out, with respect to crime and bail bond of the particular case. Under adversial system of law, a person is presumed to be innocent until proven otherwise, thus an under trial prisoner would be innocent until otherwise proven. But being innocent, they are denied their right to vote, which out to be the backbone of a democratic set-up, for the reason that:-

Right to vote is a statutory right, which comes from a special legislation, thus infringement of such rights would not amount to be a negative aspect for life of a convict.

Through not involving culprits and confines, it would de-criminalise the politics.

Both the presumption of the Supreme Court are based on positivist thought process of judges, though it requires some liberal interpretation and a naturalist approach. Roscoe Pound propounded the word, 'Social Engineering", of which a part talks about public and private interest and role of state in between, as building a bridge between the two. In the present case, a private interest of a person upon his right to vote, which is bed rock of democratic set-up, has been suppressed by the larger public interest of de-criminating politics. But the public interest itself lies o the wrong presumption and the law would not serve its purpose as a criminal would still be able to stand for election from constituency, if not any serious offence is charged against him and on the other hand, a person, who has not been charged as criminal, would be innocent, which is contrary to Supreme Courts' presumption. Further, the judgement where public interest prevails over private interest would be utilitarian, not social engineering.

[39] Nagender Chindam vs Union of india; Writ PetitionsCivil No. 80/2013 W.P.C No. 1010/2013 W.P.C No. 265/2014

Supreme Court also flawed on terming right to vote as a statutory right, as most of the jurist quote it is a right under freedom of expression[40] under a democratic set up. In the judgement Supreme Court relied on high court on the observation that right to vote to under trial is not violation of fundamental right, but statutory right, but they failed to acknowledge that such right is protected under Art. 326 of Indian Constitution, which makes it a constitutional right. In the same provision, crime is regarded as a criteria for disqualification as elector, but mere suspension or undergoing trial would not be constituted under crime. Thus, this would not be justified to abrogate right to vote for under trials.

On the current viewpoint of supreme court, it also gives insight of optimism, as also Dworkin had provided critique to positivist jurist H.L.A Hart on rule of adjudication, which Supreme Court seems applying, that whenever a dispute comes up, due to dynamic conditions of society new principles evolves, which do away with primary and secondary rule and a new principle is established. Thus hart also left a window open for morals and ethics that can touch upon the adjudicators.

[40] INDIA CONST. art. 19 cl. (1)(a)

Performance and Emission Characteristics of a DI Diesel Engine running on Diesel - WCME (Waste Cooking Methyl Ester) blends with Nanoadditives

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Abstract

In the present investigation an attempt was made to analyze the performance, combustion and emission characteristics of a DI Diesel engine running on Diesel – Waste cooking Methyl Ester (B20), B20 blend with Cerium oxide nanoadditive as a fuel. The WCME was mixed with diesel 20 % by volume basis. Cerium oxide nanoparticle was mixed with B20 blend by means of an ultrasonicator to obtain a stable suspension, in a two-step process. The physiochemical properties of the fuel blends have also been investigated through experimentation by means of ASTM standard testing methods. It was observed that, the cylinder pressure and heat release rate are 69.33 bar, 69.13 bar, 70.45 bar, and 52.5 J/deg.CA, 45.93 J/deg.CA, 61.38 J/deg.CA respectively, for Diesel, B20, B20 with Cerium oxide nanoadditive. Further, the brake thermal efficiency for the B20 with cerium oxide nanoadditive is found to be higher (33.66%) when compared with B20 and neat diesel at full load condition. It is observed that, cerium oxide nanoparticle used as an additive in B20 blend, it leads to reduce the NO_x, unburnt hydrocarbon and carbon monoxide emissions when compared to B20 and neat diesel.

Keywords: *Diesel engine performance, waste cooking methyl ester, nanoadditives*

1. Introduction

The world energy consumption is increasing day by day due to the utilization of the fuel resources. Among the resources of utilization, the transportation sector is the main source for the consumption of fossil fuels, which leads to increasing the fossil fuel requirements. The petroleum reserves are depleting at a faster rate due to the increase of various applications, and its effect on the environment leads to the green house effect. Diesel engine manufacturers face a major challenge to meet the stringent government emission norms. Automobile exhaust has always been a major source of air pollution. The major responsible for the air quality deterioration is vehicular emission such as particulate matter, hydrocarbon, carbon dioxides carbon monoxides and nitrogen oxides. So the researchers, finding out alternative fuels for replacing diesel as well as satisfying the stringent government emission norms. Hence, they preferred biodiesel as the best alternative fuels for compression ignition engine due to renewable in nature. Biodiesel is classified into i) first generation fuel is extracted from food crops. ii) second generation deals with non food sources iii) third generation the fuel obtains from algae. Many researchers identified with various methyl ester and its diesel blends as the alternative fuel for compression ignition engine [2,5,6,7,8,10,12,16]. The performance and emission characteristics of biodiesel produced from edible oil source (palm) and non-edible oil source (Jatropha) compared that with fossil diesel fuel. The test results indicated that both PB20 and JB20 fuels produces slightly lower brake powers and higher brake specific fuel consumption compared to diesel fuel. However, the authors noticed that, PB20 and JB20 fuels slightly

increases nitric oxides (NO) emissions compared to diesel fuel [9]. Nowadays, biodiesel derived from waste vegetable oil or animal fats that can be used as an additive to the diesel or entirely replace conventional petroleum diesel fuel. The problem of waste oil management can be resolved by using the waste vegetable oil. Evaluated [1] the best method for the production of biodiesel produced from vegetable cooking oil. They observed that, the use of cooking oil as a raw material for biodiesel production has proven to be of significant value as compared to other raw material choices of various origins such as the oilseed crop. The brake thermal efficiency, carbon monoxide, unburned hydrocarbon and smoke opacity are lower in the case of waste cooking oil biodiesel blends than the neat diesel. Moreover, they found that, specific energy consumption and oxides of nitrogen of waste cooking biodiesel blends are higher than the neat diesel [11]. Waste cooking oil biodiesel provided significant reductions in CO, and unburned HC, but the NO_x was increased [18]. Studied [3] the various aspects such as necessity of second generation biodiesel, procedures for the use of second generation biodiesel, cost effectiveness, biodiesel conversion technology, improving efficiency of the production process as well as performance and emission characteristics. The extraction of biodiesel from waste cooking oil, oxidation stability and performance and emission characteristics of a single cylinder DI diesel engine was studied and they have noticed that, pyrogallol as an additive was added to the biodiesel to increase the oxidation stability [17]. Biodiesel leads to reduction of HC, CO and particulate mass concentrations and number concentrations but an increase in NO_x [4]. The effect of dispersion of various nanoadditives on the enhancement of the performance and emission reduction characteristics of a CI engine fuelled with diesel, biodiesel and its blends critically reviewed [14]. Studied, the combustion, engine performance and emission characteristics of a single cylinder diesel engine using two modified fuel blends namely diesel-soybean biodiesel (B20) and diesel-soybean biodiesel-ethanol blend with alumina nanoadditives. The authors observed that the presence of oxygen in the soybean biodiesel and the better mixing capabilities of the nanoparticles, reduce the CO and UBHC appreciably, though there is a small increase in Nox at full load condition [13]. The same author further investigated the combustion and engine performance enhances of a single cylinder diesel engine fuelled with D80JBD15E4S1+cerium oxide blend and the results are compared with neat diesel as a reference fuel. The authors concluded that the presence of cerium oxide nanoparticle enhances the atomization rate that facilitates complete combustion [15]. In the present work, the combustion, performance and emission characteristics of a Compression ignition, stationary diesel engine, using two modified fuel blends namely, B20 (Diesel 80%+Biodiesel 20%) and diesel-waste cooking methyl ester blends with cerium oxide nanoadditives (B20+cerium oxide).

2. Materials and Methods

The waste cooking oil was collected from the different sources such as restaurants, canteen and cafeterias situated in and around Chennai, Tamilnadu, India. The waste cooking methyl ester oil was extracted by using the transesterfication method. In the present investigation two modified fuel blends prepared. The first blend consists of 80% diesel and 20 % waste cooking methyl ester (B20) and the second blend consist of 80% diesel and 20% waste cooking methyl ester with 100 mg of cerium oxide nanoparticles (B20+cerium oxide).The commercially available cerium oxide nanoparticle of size 15-30 nm used as a nanoadditive and its surface area are 30-50 m^2/g. The Properties of the fuel blend is shown in table -1.

Table-1 Properties of the fuel blend.

Fuel	Density (Kg/m^3)	Viscosity (cst)	Calorific Value (Kj/kg)	Caluclated Cetane Index
Diesel	840	2.69	44229	51
B20	838	2.95	42434	58
B20+cerium oxide	840	3.27	41998	55

The schematic arrangement of the experimental setup is shown in Fig-1. A 4.4 kW constant speed (1500rpm) diesel engine was coupled to an A.C generator and the load was varied by using the rheostat arrangement from no load to full load. Exhaust gas temperature was measured using K-type thermocouple. The exhaust gas emissions were measured using AVL 444 exhaust gas analyzer. The engine was first allowed to run with neat diesel followed by B20 and B20 with cerium oxide nanoadditives blend. The engine combustion and emission parameters were recorded during the test at various loads.

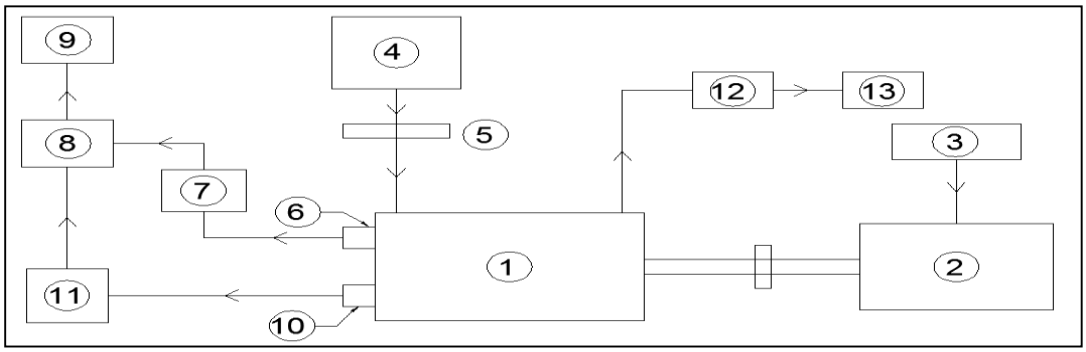

Fig.1 Experimental set-up

1.Diesel engine 2.A.C generator 3.Control unit 4.Fuel tank 5.Fuel measurement 6.Pressure transducer 7.Charge amplifier 8.A/D card 9.Computer 10.TDC position sensor 11.TDC amplifier circuit 12.AVL exhaust gas analyser 13.Smoke meter.

3. Results and discussion

In this section, performance, emission and combustion characteristics are presented and discussed. Fig.2 compares the brake thermal efficiency of B20 and B20+cerium oxide with diesel at different loading condition. The brake thermal efficiency of the B20 blend is found to be marginally lower compared to B20+cerium oxide and neat diesel at full load condition. However, in the case of B20+cerium oxide blend there is a continuous increase in efficiency compared to neat diesel at all load. This is due to the presence of higher oxygen in the fuel and also higher evaporation rate of the cerium oxide nanoparticle. Further, the brake thermal efficiency for the B20 with cerium oxide nanoadditive is found to be higher (33.66%) when compared with B20 and neat diesel at full load condition. Fig.3. shows the variation of the BSFC, with load. It is seen from the figure that all the tested fuels, the BSFC decrease with an increase in load. Beyond the 50 % of the load, the BSFC for B20 blend is higher than the B20+cerium oxide and neat diesel due to the lower calorific value and higher viscosity. The

BSFC is 0.254 kg/k.W.h, 0.269 kg/k.W.hr and 0.252 kg/k.W.hr respectively, for neat diesel, B20 and B20+cerium oxide fuel blend at full load condition. Fig.4 shows the variation of NO_x emission of diesel with B20 and B20+cerium oxide blend. Formation of NO_x is due to the combination of nitrogen and oxygen in the air at higher temperatures.The NO_x emission for B20+cerium oxide blend is lower compared to B20 and neat diesel up to 75% of the load. However, beyond the 75% of the load it is slightly increased compared to the neat diesel and B20 blend. This is due to the presence of cerium oxide nanoparticles, which increases the diffusion controlled combustion duration. Fig.5 shows the variation in carbon monoxide of all the tested fuels with respect to the load. At part load conditions the B20 and neat diesel is higher CO emissions than the B20+cerium oxide blend. However, beyond the 50% of the load CO emissions are drastically reduced for B20 and neat diesel. The B20+ cerium oxide blend maintains a constant value till 50% of the load, beyond the 50% of the load the B20+cerium oxide blend gradually reduced and it reaches the same value of B20 and neat diesel at full load condition. The variation of combustion chamber pressure with crank angle for the tested fuels at the rated load is given in fig.6. It is observed that peak pressure occurs after top dead centre for all the tested fuels. B20+ cerium oxide blend exhibit slightly higher pressure compared to B20 and neat diesel. The maximum cylinder pressure is almost identical for all the tested fuels. The peak pressure is 69.13 bar, 69.34 bar and 70.45 bar respectively, for B20, neat diesel and B20+cerium oxide fuel blend at full load condition. The heat release rate for diesel, B20 and B20+cerium oxide blend are given in fig.7. The heat release rate curve shows the availability of heat energy which can be converted into useful work. The magnitude of the heat release rate is 45.93 J/CA, 52.50 J/CA and 61.38 J/CA respectively, for B20, neat diesel and B20+cerium oxide fuel blend at full load condition.

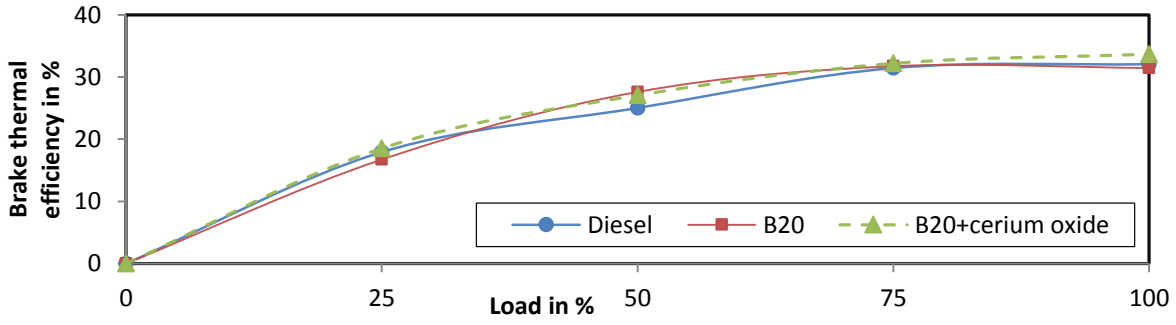

Fig.2 Variation of brake thermal efficiency with load

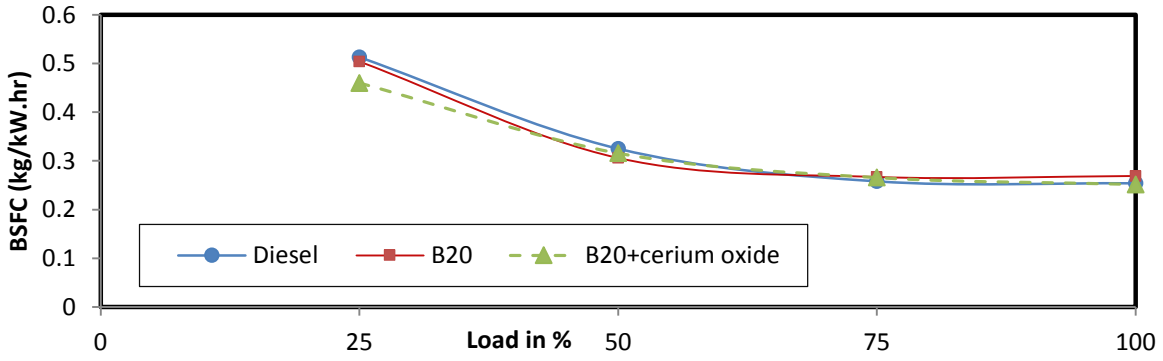

Fig.3 Variation of brake specific feul consumption with load

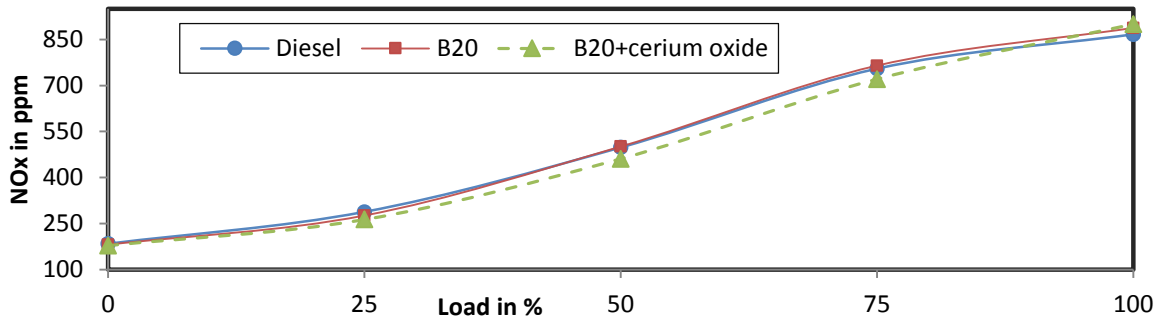

Fig. 4 Variation of NO_x emission

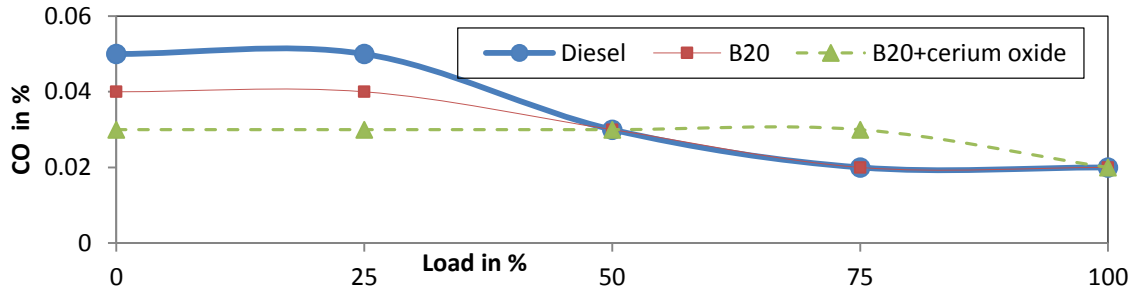

Fig. 5 Variation of CO emission

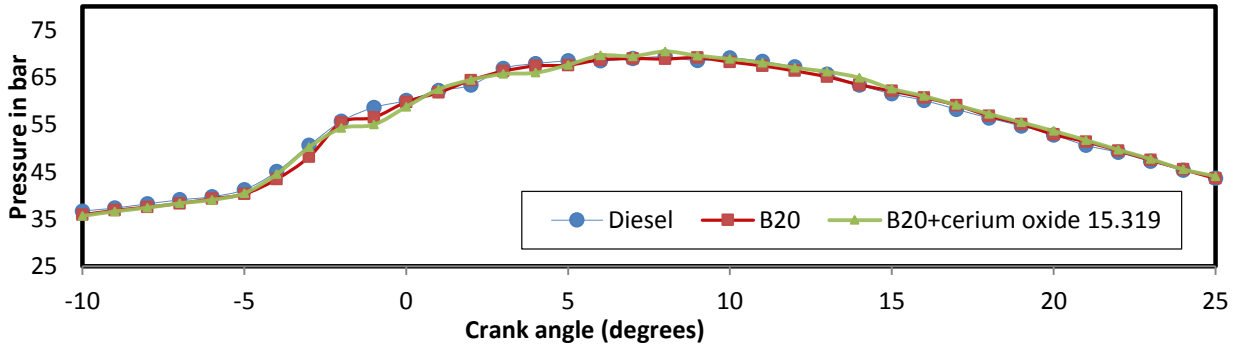

Fig.6 Pressure variation at full load

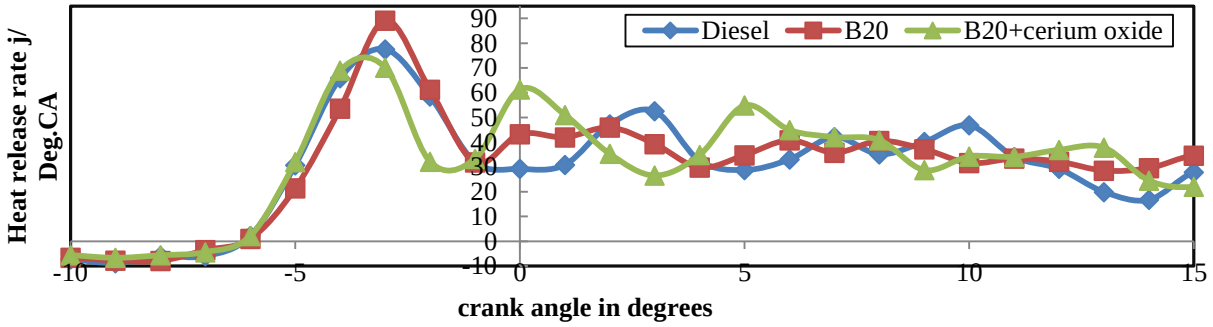

Fig.7 Variation of Heat release rate

4. Conclusions

The performance, emission and combustion characteristics of a diesel engine using biodiesel derived from waste cooking oil and its blends with nanoadditives (B20 and B20+cerium oxide) are compared with the neat diesel and the results are summarized as follows:
1. The brake thermal efficiency for the B20 with cerium oxide nanoadditive is found to be higher (33.66%) when compared with B20 and neat diesel at full load condition. 2. The BSFC is 0.254 kg/k.W.h, 0.269 kg/k.W.hr and 0.252 kg/k.W.hr respectively, for neat diesel, B20 and B20+cerium oxide fuel blend at full load condition. 3. The NO_x emission for B20+cerium oxide fuel blend is slightly increased at full load compared to the other two fuels tested. Overall, cerium oxide nanoaprticles enhances the atomization rate, that facilitates performance and slightly increases the NOx emission at full load.

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Ramificantions of Religion in India

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Abstract

Religion is the substratum of any society and has a very intricate relationship with the political, cultural and social state of affairs that exists in a country. Religions are complex, detailed belief systems where each one will have its own ideology, belief system and philosophy which might either be in contradiction or be relatively similar to that of another religion. The contradiction that applies to Religion in totality is that of how though it could both bind individuals and establish a sense of brotherhood or it could be the genesis of unwanted bloodshed and animosity. It could either be a cohesive force or a divisive one. Even though many of the countries proudly call themselves 'Secular' due to their rich heritage and presence of a multitude of religions it is not reflected in the state of affairs as parts of the demographics are unable to transcend these boundaries and see it as a unifying force and seeks to create anarchy in the system based on religious differences. This can be studied in depth about the historical significance of religion in India as it was a very vital and crucial element which helps us understand the circumstances in which India gained independence and the powerful influence which religion still has today.

***Keyword**: Contradiction, Secular, Ideology*

1. Introduction

It is impossible to separate India from its religions since the two are inextricably interlinked and each religion with its system of practices has seeped through various stratas in the society and has a deep and profound effect on each individual. Interestingly, India is often seen as a post-colonial success story. In August 1947, India had achieved the much desired freedom after having been under the British rule for centuries. This independence came at a cost as it led to the division of the country into two separate states which led to the Dominion of India and Pakistan coming into existence and this could be cited as one of the reasons which fuelled bloodshed which further tainted Indian history for the decades that followed. India is a country which is rich in history, cultural and religious traditions which are deeply entrenched within the society and most Indians are socialised from birth into religious practices. Inspite of the progress which India has been able to achieve through the advent globalisation and liberalisation, religion-based violence in Indian society "continues to be a concern," during the first year of Narendra Modi's rule as Prime Minister, according to a report on worldwide human rights abuses released by the U.S. State Department.[41] Even though Narendra Modi has expressed his views regarding how he

[41] Narayan Lakshman, *Religious violence still a concern: report*, THE HINDU, June 26th 2015 http://www.thehindu.com/news/national/religious-violence-still-a-concern-report/article7355498.ece

and his government would not accept violence against any religion, on any pretext" and that it would take forceful steps if such crime occurred[42],this has in no way curbed the atrocious incidents which take place in the name of religion.

1.1 Tracing the Impact of Religion on India

One of the most interesting aspects about religion is the impact it has on politics as it provides us with an understanding of the conflicting ideologies of both Secularism and Communalism in India and how they have repeatedly clashed over the years.Politcs and Religion as such is very volatile and sensitive in nature and when combined together has the ability to cause terrible repercussions. It is potent enough to lead the most rational individuals to lose their minds and succumb to their instincts. This does not necessarily imply that religion always has a negative influence since there are individuals who do not use the foundation of religion to cause destruction or a situation of anarchy in the society but use it for their own personal well-being which paves way for a healthy development. Each religion has its own ideologies and the contradictions between the faiths lead to the creation of distinct communal identities which paves way for the development to the stage of communalism. This occurs when Religion is deliberately used as a tool for the achievement of political gains. The rising trends of Communalism poses a major threat towards the integrity of a nation. According to Bipin Chandra "Communalism is the belief that because a group of people follow a particular religion, they have as a result, common social, political and economic interests."[43] "Some other authors have defined communalism as a form of indifference.Condescension, hatred or aggressive attitude to all the members of a religious community other than one's own, based on a real or imaginary threat from an individual or a group of that community or an actual damage done to one's personal interest or way of life or to those of one's religious community."[44]All the occurrences in a society are interpreted by communalists in connection with religion. Lack of progress or development of one community is regarded as the fault of another community and when one community achieves the pinnacle of excellence and propagates social development it is viewed as a domination of the rival community. The impact of communalism can only be analysed by taking into consideration the character of the communal problem. All communal issues might be due to an amalgamation of factors and might not just be due to immediate provocation or conspiracy. Communalism can be practiced in distinct ways by different communites.There are many dimensions within the concept of Communalism." It is important to note that Indian society was never homogeneous throughout the history, it was highly diverse religiously, culturally, caste-wise and linguistically but there was hardly any tension between these groups. It all began with the establishment of British rule in India and so most of the scholars agree that communalism is a modern

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[42] Ellen Barry, *Modi Promises to Punish Religious Violence in India*, THE NEW YORK TIMES, Feb 17th, 2015, at A3.

[43]BIPIN CHANDRA,COMMUNALISM IN MODERN INDIA (Vikas Publishing House Private Ltd,1984)

[44] ZENAB BABU,POLITICS OF COMMUNALISM (Popular Prakashan Bombay,1989)

phenomenon and not a medieval phenomenon."[45]Though there might be inclinations to have the perception that Communalism between Hindus and Muslims has prevailed since Muslims took over India. Muslim attacks on India is said to have originated in the 10th century A.D. during the times of Muhammad Ghazni and Muhammed Gori.Even though there were destructions of the areas of worship of Hindus and building of mosques over these areas and considerable efforts were made to convert the natives to Islam, these did not provide substantial grounds for the genesis of the phenomenon of Communalism. There were other instances which displayed religious tolerance."When Sivaji sacked Surat, he brought back the copy of the Holy Quran bearing it reverently on his head."[46]The various societies which existed in India had undergone a radical change under the British colonial rule as there was an effort to tamper with their very essence. In other words, the unambiguous articulation of religious groups assumed primary importance under the modern governing system, and confrontations became palpable along those articulated lines.[47]The Rebellion of 1857 is one of the most significant events to have taken place in Indian history. It was by far the largest, most widespread and dangerous threat to British rule in India in the nineteenth century.[48]There was a transfer of control of India which took place from the hands of the East India Company to the British Crown. Religion played an instrumental role in the occurrence of this revolt. The sepoys in the Bengal army felt that one of the ulterior motives of the British was to convert the majority of the population of India to practice Christianity .Indeed, Christianizing India was a vital element in the Liberal project to reform and uplift Indian society, begun in earnest with the governor-generalship of Lord William Bentinck in 1828.[49]Mistrust of British intentions with regard to religion were particularly acute in the British army, where high caste sepoys believed the religious tolerance traditionally allowed by the British officers was rapidly being reversed.[50]The General Service Enlistment Act, 1856 was met with severe negative reactions from the Indians and furthered cemented their doubts regarding the British intentions to establish dominance of their citizens and religion. This Act, in contrast to previous legislation, which allowed most of the recruits to enlist on terms of service within the subcontinent only, dictated that no recruit would henceforth be accepted to any of the Presidency armies unless he was prepared to undertake overseas services when required.[51]This

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[45] Azgar Ali Engineer, *On Sociology of Communalism*, http://shodhganga.inflibnet.ac.in/bitstream/10603/22489/10/10_chapter5.pdf.pdf

[46] KHUSHWANT SINGH, THE END OF INDIA 78(Penguin Books 2003).

[47] Sekine Yasumasa, Religion and Politics in Contemporary India, The Complexities of Secularism and Communalism ,FAULTLINES, Volume 11,available at http://www.satp.org/satporgtp/publication/faultlines/volume11/Article4.htm

[48] . T. A. HEATHCOTE, THE MILITARY IN BRITISH INDIA: THE DEVELOPMENT OF BRITISH LAND FORCES IN SOUTH ASIA, 1600-1947 103 (Manchester University Press, 1995); BERNARD PORTER, THE LION'S SHARE:A SHORT HISTORY OF BRITISH IMPERIALISM 28 (London: Longman 1975).

[49] THOMAS METCLAFE,IDEOLOGIES OF THE RAJ:THE NEW CAMBRIDGE HISTORY OF IINDIA 33 ,(Cambridge University Press 1994).

[50]MADAN PAUL SINGH, INDIAN ARMY UNDER THE EAST INDIA COMPANY 156-157 (Sterling Publishers 1976).

[51] EDWARD SPIERS, THE ARMY AND SOCIETY 123 (Addison-Wesley Longman Limited 1980).

was a source great dilemma for the recruits who were Hindus as not enlisting would mean the loss of a profession which was a symbol of prestige and honour. On the other hand, enlisting under these new terms and conditions would require them to undergo expensive purification ceremonies as crossing the oceans leaves the individual to be in an impure state and not adhering to the performance of these ceremonies might lead to him being ostracised from his community. The infamous cartridge was the final straw as it managed to offend the religious sensibilities of both Hindus and Muslims and paved way for the Revolt. The East India Company had decided to introduce the Enfield Rifled Musket and one of the methods to speed up the loading process was with the introduction of a paper cartridge. Britain was in charge of the production of the original cartridges and to protect the elements of the cartridge it had been covered in tallow which was made of either beef or pork fat. The consumption or touching of beef and that of pork was a severe violation of the religions of Hindus and Muslims respectively. The East India Company soon realised their mistake and allowed the animal fat to be replaced with vegetable fat or gave the soldiers an option of tearing the cartridge with their hands but the damage caused was too severe to be fixed by granting these concessions as battalion after battalion refused to use these cartridges and this defiance arose from the fact that for years the British chose to ignore the growing level of sepoy discontent. The common desire of the individuals to attain freedom and the growing feeling of nationalism within the individuals led to all these communities fighting for achieving independence inspite of the religious difference brewing between them. On January 26th 1950, the Indian Constitution came into force and India had achieved the status of a republic and the Congress Party had come into power with Jawaharlal Nehru being declared as India's Prime Minister.One of the major challenges which has been faced by independent India was to cope up with the fragile situation which existed within the country due to the stratifications in the society on the basis of caste and religion. Nehru had conceptualised a state policy which was secular in nature and did not have element of an anti-religious or non-religious state but one which displayed equal tolerance for all religions and did not prioritise any religion over another.To safeguard secularism Nehru was ready to dismantle the idea of a single national identity through a minoritarian perspective.[52]He dreaded the form of nationalism which might occur if the majority perceived themselves as the dominant section and tried to bring the minorities under them too. Nehru understood that India with its heterogeneous and multiple culture and ethnicities could only truely develop as a nation when the interests of all religions are given equal significance and protection. The word 'Secular' was only inserted in the Preamble, by Constitution (42nd Amendment) Act, 1976 but it is to be noted that it is because of the secular nature of the Constitution which was already embodied in the enacting provisions (Arts. 25-30)

[52] Ragini Nayak,*Jawaharlal Nehru:a legacy revisted*,THE HINDU, November 16th, 2014,http://www.thehindu.com/opinion/open-page/open-page-jawaharlal-nehru-a-legacy-revisited/article6603356.ece

that the Supreme Court could observe (in 1973) that secularism was a basic[53] feature of the Indian Constitution even before the word 'secular' was inserted in the Preamble in 1976.In *Indira's case*,[54] the basic feature of Secularism was explained to mean that-"The State shall have no religion of its own[55] and all persons shall be equally entitled to the freedom of conscience and the right freely to profess, practise and propagate religion."

One of the immediate causes of the religious conflict could be traced to the existence of Hindutva which is a nationalist ideology which propagates the idea that Hindu culture needs to attain the status of being recognised as the Indian national identity where the other existing cultures should mould their practices in accordance with this dominant group. This could be understood as an ideology which found its genesis in the pride and fear of the majority group and its attempt to ostracise the minority group who they feel might be a cause of threat at some point. On December 6th 1992, Babri Masjid which was built in the sacred city of Ayodhya which was the birthplace of Hindu deity Rama was destroyed by Hindu mobs. This demolition was preceded by processions which were made by the Hindu nationalist leaders in an attempt to gain support of the masses and resulted in the death of Muslims as a consequence of the riots that followed. The riots in Bombay alone had claimed around 900 lives of Muslims but this had no negative impact on the 1994 general elections considering the fact that the result achieved was on the basis of religion based political mobilization and Hindu nationalist leaders as for the first time were able to achieve the highest number of seats in the Parliament. These riots occurred even after the demolition of the mosque Interestingly these riots had found support from various organisations which had come into existence such as the Vishwa Hindu Parishad (V.H.P), the Bajrang Dal(B.D),the Hindu Jagran Manch(H.J.M) which were propagating the ideology that outsiders such as Muslims and Christians need to be eliminated to ensure the glorious era of Hinduism in India. All these organisations functioned in sync with Bharatiya Janata Party (B.J.P) as its head. Interestingly BJP which was a small party in the 1980s, grew in leaps and bounds in the span of a decade and managed to establish itself as a member of the governing coalition by 1998.Before BJP had come into power, it was the Congress Party which enjoyed a dominant position from the time of India's independence to the 1990's due to a conglomeration of factors such as its secular ideologies, popular leaders and on the back of its independent credentials. However it witnessed a serious decline since the 1970's which provide ample opportunities for the growth of smaller parties.One of the easiest ways to achieve this would be catering to a particular dissatisfied section of the society and the 1980s and 90s saw parties use these social divisions in their campaigning for achieving and fulfilling their political goals.BJP proved to very successful in this aspect as they were able to fuel the beliefs that Hindus were being

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[53] Kesavananda Bharti v. State of Kerala, AIR 1973 SC 1461(para 302,509,1437);Valsamma Paul v. Cochin,(1999) 3 SCC 545,(para 25).

[54] Indira Nehru Gandhi v.Rajnarain, *AIR* 1975 SC 2299 (para 251).

[55] In other words, it shall not be a 'theocratic State' [para 666, HEDGE AND MUKHERJEE, JJ. In Kesavananda Bharti v. State of Kerala case,AIR 1973 SC 146]

discriminated against by other groups in 'their own'country.This shows how vital the Hindu-Muslim antagonistic relations was in cementing the position of BJP.

The Muslim community has usually been at the receiving end of the hostility of the Hindu nationalists but over the past few years this has extend towards the Christians as well. The death of Australian -born Christian missionary Graham Stewart Stains and his two sons in Kheonjar district in the State of Orissa by a murderous crowd is one such instance which shook the nation due to its sheer brutality. His role as a Christian preacher was what ultimately resulted in his death, as Orissa had become the battleground involving Christian and Hindu missionaries in a war for the hearts and minds of the tribals.[56]. According to Defence Minister George Fernandes, who was part of the cabinet team to Manoharpur, there were at least 60 attacks on churches in Orissa between 1986 and 1998, "the highest number in any state".[57] On the 23rd of August, 2008 Swami Lakshmananada Saraswati and his four disciples were shot and killed while celebrating the Janmastami festival at his ashram at Jalespata .The Christian community was suspected to be behind his murder since he had openly expressed his negative views regarding Christian missionaries. Even though the Naxalites had taken responsibility for his murder, many still blamed the Christians and the serious of riots that followed is the largest violence which has been inflicted on the Christian population in the India for the last three hundred years. These riots had caused the deaths of more than 100 people, injured more than thousand individuals, destruction of 300 churches and 6000 homes and led to the displacement of around 56,000 people.

Even from a cultural and social perspective, religion has managed to have a profound effect on India. An individual's choice regarding the occupation he would pursue is subject to various factors ranging from characteristics unique to him as an individual such as personality attributes, educational qualifications, resourcefulness, ability to take risks and status of employment. Religion also has a major role in influencing the economic behaviour of an individual. This can be understood by taking the Varna system which exists within Hinduism into consideration where Hindus are classified into four social classes namely Brahmins, Kshatriyas, Vaisyas and Sudras.Each of these classes were distinct in the functions which were expected to be performed by them. Dalits constituted the community of individuals who were the last group in the hierarchy in the Varnasrama Theory. Dalits were the victims of the constant hatred meted out to them by centuries of atrocious behaviour by the upper castes of India. Their occupations revolved around menial activities such as sweeping, tanning, scavenging and all types of manual

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[56] Ruben Banerjee, *Burning Shame: The gruesome murder of an Australian missionary and his two sons in Orissa shocks the nation - and rattles the BJP-led Government at the Centre*, INDIA TODAY, February 8th 1999, http://indiatoday.intoday.in/story/staines-killing-murder-of-australian-missionary-and-his-two-sons-in-orissa-shocks-india/1/253086.html.

[57] Lalit Pattajoshi and Chetan Krishnaswamy,*Graham Staines Story*, http://ibsresources.org/articles/staines.shtml

work which required them to serve the elite first three groups in the hierarchy. This led to generations of Dalits being ostracised from the society and being deprived of opportunities which will enable them to break the class barriers and achieve equal socio-economic and political status. Inspite of the presence of significant constitutional and legislative protection to ensure the existence of a competent criminal justice system[58], there are instances of lapses within the procedural system in India.Laxmanpur-Bathe, in Arwal district along the Sone river, was targeted by upper caste militia Ranvir Sena because it members believed the village's dalits, mostly poor and landless, were Maoist sympathisers involved in the killings of 37 upper caste men in Bara in Gaya in 1992. [59]The 26 accused were convicted by the lower court but later the Patna High Court acquitted them in 2013 citing "lack of evidence".[60] A similar instance is when the High Court acquitted nine out of ten accused in the Miyapur massacre for lack of evidence, overturning a lower court's order.[61]This consistency in the judgements enables us to understand that though the courts cite lack of evidence when it comes to acquitting the accused ,this might not always be the case and it may also have a lot to do with the deeply embedded prejudices embedded in the Indian society against Dalits.Hence this enable us to understand that through the years even though India has been rapidly developing through the process of liberalisation and globalisation, religion still plays a vital role as it forms the very basis of the formation of identity of an individual which enables him to find his place in the society.

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Investigation of Aggression Levels of Outdoor Field and Indoor Court Fans

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Abstract

This study aims to investigate aggression levels of open field (football) and indoor court (basketball) fans during the competition. Target population of the study consisted of male fans of a basketball team played in women's division I basketball league and male fans of a football team played in football league second division between 2015 and 2016. Research sample was composed of 400 people of whom 200 were basketball fans and 200 were football supporters. Aggression scale developed by Kiper (1984) were used as data collection tool. Frequency and percentage values were calculated based on the data obtained; considering the results of the demographic data, statistical results were obtained. Research findings were evaluated taking account of subscales of aggression scale. This assessment revealed that there are significant differences in terms of destructive aggression, passive aggression and impulsive aggression levels among aggression scale subscales when considering outdoor field and indoor court fans, supporters who do/do not play the sport and their ages.

Keywords*: Aggression in football, aggression in basketball, agression levels of fans.*

Introduction

Aggression is all kinds of behavioral or actual integrity itself exhibited with the intention of hurting or harming others (Freedman, Sears and Carlsmith, 1998). Aggression is regarded as destructive behavior pattern that exhibits within the concept of intention/intent and breaks or violates social rules (Bandura 1973). It can also be conceptualized as a required or an alternative behavior pattern to defend individual oneself as aggression can be disruptive/ destructive behavior pattern displayed towards an individual oneself or others (Ferris and Grisso, 1996). Very different situations arise about what aggression encompasses. Behaviors described as aggressive by some people may be deemed normal by other people. For societies have different cultures, certain behaviors cannot be considered as violent acts. As many non-Hispanic people appear that Spaniards' famous bullfighting is brutal and full of violence, this ritual act with a very old history is accepted as a quite noble sport for the Spanish. Registering the dominance of manpower over wild nature, this sport is named as "National Festival" in Spain (Marvin 1986). Violence is the result of a combination of many factors that interact with each other in a very complex way (Morris et al, 2002; Jürgen and Mutz, 2009). The most prominent one among these factors is the aggression and violence that fans have exhibited. "Supporter" or "fan" means someone who has always remained loyal to team colors, club or flag that athlete or athletes represent (www.tdk.org.tr). Achievement of team supported by a fan arouses a feeling of

confidence in oneself and gives someone a sense of pride (Kılcıgil, 2003). In case unintended results are obtained from the match contrary to their hopes and expectations, a feeling of anger and aggression is often seen to express in supporters. Sense of identity that supporters have had feelings for their teams are among the primary reasons why they display a feeling of aggression in sports competitions. Even though sense of belonging is regarded as an indication of fierce loyalty to team or club, it is counted as sense of identity seeking in our country. Failure to be met the expectations of spectators who assumes the fanship identity by their teams and failure to achieve satisfaction levels of individuals provoke feelings of anger, aggression and violence among the fans. Often suffering from violence and aggression in the sports competitions worldwide has led researchers to investigate the incidents that had taken place. As a result of loss of life of many people in the incidents provoked by English fans in 1989 and 1990, Taylor (1990) commissioned by British government had prepared a report of "New Regulations on the Prevention of Violence", which has been focused on four key issues:

Physical conditions of the field should be improved and designed for spectator's comfort,
Legal regulations, which will be brought though and deterrent measures against act of violence happened in the field, should be introduced,
Private security guard and general law-enforcement officers should be assigned to follow and identify spectators described as hooligans, and an effective system should be developed through methods such as electronic ticketing and cameras,
Training should be provided for actors who are being involved in the sports and will raise awareness against violence. This study aims to reveal differences that may arise in terms of fans regarding aggression and violence exhibited in sports arena. Investigation of aggression level of supporters in the outdoor field and indoor sports facility emphasizes the importance of the study.

Method

Model

Descriptive survey models are research approach aiming to describe a past or currently existing situation as it was there. Event, individual or object of research subject are tried to define within their own conditions and as are/were. Any effort cannot make to change and influence them in any way. Relational screening models are research models aimed at determining the presence and/or extent of covariation between two and more variables (Karasar 2004).

2. Research Group

Target population of the study consisted of male fans of a basketball team played in women's division I basketball league and male fans of a football team played in football league second division between 2015 and 2016. Research sample was composed of 400 people of whom 200 were basketball fans and 200 were football supporters. All of fans composing sample group

consisted of male fans since less female spectators went to the football fields to watch the football competitions than male ones.

3. Data Collection Tool

Personal information form developed by the researcher and "Aggression Scale" developed by Kiper (1984) were used as data collection tool.

3.1. Personal Information Form

Personal Information Form developed by the researcher consisted of 5 questions. This form was designed in accordance with purpose of this study. Personal information form was prepared to gather information regarding gender, age, faculty, monthly income and levels of whether participant does regular exercise, respectively.

3.2. Aggression Inventory

Having proven its validity and reliability by researcher, developed by Kiper (1984) and consisted of 30 items, "Aggression Inventory" was used in this study. Sub-tests of the inventory are called as destructive aggression, impulsive aggression and passive aggression. Items regarding destructive aggression are 1, 2, 3, 13, 14, 15, 22, 23, 24 and 29; items concerning assertiveness are 4, 5, 6, 10, 11, 12, 19, 20, 21 and 28; items related to passive aggression are 7, 8, 9, 16, 17, 18, 25, 26, 27 and 30. Each subtest consisted of 10 questions. Questions were of 7 point Likert scale, ranging from "it never suits me" to "it suits me much". Institutionally, in each subtest if a subject gives the answer "it suits me much" to each question, she/he gets 70 points; otherwise, if participant gives the answer "it never suits me" to each question, she/he gets 10 points. Cronbach alpha internal coefficient of consistence obtained for all of the inventory was found to be 0.83

3.5. Data Analysis

When analyzing the data, distributions of frequency and percentage describing personal characteristics of students composing the sample group were calculated in line with the purposes of the study. By calculating the arithmetic average and standard deviation of the answers to the scale, distributions of Aggression and Establishing Empathy levels of students were determined. Later on, Kolmogorov-Smirnov test was used to determine whether sub-dimensions of Aggression Scale and Empathic Tendency Scale are normally distributed, in order to determine whether there is a significant difference between group averages for demographic variables. T test was used for pairwise comparisons. The obtained data were analyzed using SPSS (Statistical Package for Social Scientists for Windows Release 17.0) program. Significance level was tested at 0.05 and other significance level was also specified. Results are presented in the table for the purposes of the research.

Results

Table 1. T test results showing comparison of fan groups with respect to Aggression Scale and Subscales in terms of the variables outdoor field and indoor court

Outdoor field & indoor court		N	X	Ss	df	t	p
Destructive	Outdoor	200	42,3300	9,73266	3,98	2,076	,038*
	Indoor	200	40,1850	10,89515			
Passive	Outdoor	200	26,9600	8,80546	398	2,344	,020*
	Indoor	200	25,0250	7,66735			
Impulsive	Outdoor	200	41,9886	10,54796	398	3,436	,001*
	Indoor	200	45,6050	10,50480			
Total	Outdoor	200	111,2786	18,69397	-3,98	,250	,802
	Indoor	200	110,8150	18,34457			

As seen in Table 1, it has examined whether the aggression levels of supporters differ according to situations of outdoor field and indoor court spectator. There has not been found any significant difference between situations of outdoor field and indoor court spectator and total aggression score ($t_{(400)}$=0,250; P>0,05). But, it was determined that there was a significant difference between impulsive aggression $t_{(400)}$=3,436; P>0,05), passive aggression ($t_{(400)}$=2,344; P>0,05) and destructive aggression ($t_{(400)}$=2,076; P>0,05) from aggression subscales.

Table 2. T test results showing comparison of fan groups with respect to Aggression Scale and Subscales in terms of the variable age

Age		N	X	Ss	df	t	p
Destructive	15-24	227	42,3612	10,58434	398	2,453	,015*
	over 25	173	39,8092	9,93429			
Passive	15-24	227	25,4361	8,43345	398	-1,538	,125
	over 25	173	26,7225	8,09345			
Impulsive	15-24	227	43,8678	10,54406	398	152	,879
	over 25	173	43,7036	10,85839			
Total	15-24	227	111,6652	19,53900	398	,765	,444
	over 25	173	110,2353	17,05869			

As shown in Table 2, it has analyzed whether the aggression levels of supporters differ according to situations of age. There has not been found any significant difference between the variable age of fans, their total aggression score, impulsive aggression $t_{(400)}$=0,152; P>0,05) and passive aggression ($t_{(400)}$=1,538; P>0,05). However, it was found that there was a significant difference in terms of destructive aggression ($t_{(400)}$=2,453; P>0,05).

Table 3. T test results showing comparison of fan groups with respect to Aggression Scale and Subscales in terms of state of whether fans play sports

State of whether fans play sport		N	X	Ss	df	t	p
Destructive	Yes	312	41,4551	10,61567	398	,717	,474
	No	88	40,5568	9,48666			
Passive	Yes	312	26,2372	8,53486	398	1,110	,268
	No	88	25,1250	7,39962			
Impulsive	Yes	312	43,1081	10,55343	398	-2,446	,015*
	No	88	46,2386	10,77352			
Total	Yes	312	110,8004	18,92773	398	-,501	,617
	No	88	111,9205	16,96123			

As indicated in Table 3, it has analyzed whether the aggression levels of supporters differ according to state of whether fans play sport. It has not been established any significant difference between the variable of whether fans play sport, their total aggression score, destructive aggression ($t_{(400)}$=0,717; P>0,05) and passive aggression ($t_{(400)}$=0,268; P>0,05). However, it was found that there was a significant difference in favor of non-sporting fans in terms of impulsive aggression ($t_{(400)}$=2,453; P>0,05).

Discussion and Conclusion

This study aims to examine aggression level of the fans considering outdoor field and indoor court spectator states of male fans of women's division I basketball league and fans of football league second division, their situations of whether sport plays and their ages. Elias and Dunning (1986) found that there was a largely direct correlation between violence and male-centered social structure. Dunning and Maguire (1994) stressed that use of violence in sport fundamentally defines the male identity and gets strength from society by adhering to a cultural phenomenon (patriarchal structure).

When analyzing Table 1 and considering the aggression level of supporters, outdoor field and indoor court spectator states, it has been found to be a significant difference in terms of destructive, passive and impulsive aggression from aggression subscales. One might be concluded that levels of destructive and passive aggression of open field fans are higher than that of indoor court fans. But it was found that indoor court fans are more impulsive than the outdoor field fans. Kerr and Kock (2002), and Karagözoğlu and Ay (1999) discovered that tendency towards aggressiveness of outdoor pitch football spectators were high. Researches on aggression levels of spectators by Acet (1997), and Doğan and Moralı (1999) were determined that open tribune spectators went on more rampage than grandstand spectators. Russell (1993) used a different approach to aggression and stated that aggression is likely to result from spectator size. Russell and Drewry (1976) supported the same phenomenon and determined to be an increasing positive relationship between spectator size and athlete aggression but suggesting that sense of dominance resulted in the spectator size means to have a feeling of ability to do everything among the fans. In addition, they expressed that outnumbering football fans by indoor sport ones

can cause open field supporters to be more prone to aggression. More cheering also means high-decibel sound, so that it can be said to facilitate aggressive behavior (Wanner, 1997, 271). Considering the present studies, there are findings and statements that support our results.

When we look at Table 2, it has been examined whether aggression levels of the fans differ by age groups. When we look at the results obtained from the study, it has been concluded that fans in the range of 15 to 25 aged are more destructive aggression than over the age of 50. Any significant difference could not find in terms of passive aggression and impulsive aggression. A study on a total of 3007 people in the range of 15 to 60 aged by Duque, Klevens and Ramirez (2003) reached the conclusion that subjects in the range of 15 to 24 aged were more aggressive than 25 aged and above. In a study on determination of tendencies to violence and hooliganism of fans affiliated to Football Associations by Koçer (2012), he stated that fans under 18 aged are more supported their teams than 25 aged and above, and that as their age decreases, they become more provoked by events and phenomena around them. Roversi's study on "football violence in Italy" reports that 64.7% of the persons involved in football hooliganism were under the age of 21.

As seen in Table 3 regarding aggression levels of supporters and their states of whether sport play, it has been concluded that non-sporting fans' impulsive levels were higher than the others. Any significant difference was not found in terms of destructive aggression and passive aggression. Kiper (1984) defined assertiveness as any behavior that enables an individual to clearly express one's own feelings to protect own benefits and to use own rights by recognizing somebody's rights without succumbing to the anxiety. Gökçicek (2015) has reached the conclusion that males who play sport were more aggressive and impulsive than non-sporting ones. Tiryaki (1996) investigated the relationship sport-playing and aggression of university students and came to the conclusion that those playing the sport were more aggressive than non-sporting ones.

In conclusion, it is observed that aggression levels of open field fans are higher than those of indoor court supporters and that fans under 24 aged are more aggressive than 25 aged and above. It has been concluded that impulsive approach levels of those playing the sport are lower than that of non-sporting fans.

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Teachers' Perceptions of the New Primary Science Curriculum Implementation in the Maldives: A Case Study

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ABSTRACT

Maldives has introduced a new National Curriculum in 2014. With a gradual introduction the curriculum have yet been implemented at Key Stage 1 (grades 1-3) by 2014. With curricular changes it is imperative that teachers have a sound understanding of the curriculum and they are competent to deliver the curricular essentials to the students. This study using the Science Curriculum Implementation Questionnaire (SCIQ), explored the primary science teachers' perceptions about their levels of competence and motivation factors in implementing the new science curriculum in one school in Male', Maldives. This data was corroborated with focus-group discussion data. Data indicates that, in general teachers have the intrinsic motivation to implement the new changes the curriculum brings, but there is a feeling of inadequacy with regard to certain content areas in the curriculum, as prescribed by the curriculum. Additionally, on the external factors, teachers find availability of time to be the biggest hindrance they have in implementing the curriculum. These results have implications for school wide improvements, especially in providing an alternate, more supportive and guided opportunities for teachers to plan for their lessons, interpret the curricula documents and learn through peer collaborations, lesson observations and feedback. Extending this study to schools in various areas of the country will provide a better understanding of the science teachers' current readiness level in implementing the new curriculum.

Keywords*: Science education, science curriculum, primary science teachers*

INTRODUCTION

Science curriculum reform is an ongoing issue as with other subjects in the school curriculum. With introduction of new concepts and contemporary pedagogies of science teaching and learning, school science curriculum needs to evolve to meet the changing goals of science education. The current view of basic science education is no longer simply an education in science alone, but also an education for science, and an education through science (UNESCO, 2010) [1]. The key principle of science education currently is that; students should be helped to develop big ideas of science that enable them to understand scientific aspects of the world and make informed decisions about the applications of science (Harlen, 2010) [2]. The science education curriculum of today needs to reflect these ideologies in such a way that science teachers too embrace these and through their teaching communicate these ideals and values in their students.

In Maldives the current situation of low enrolment in science subjects at the secondary level and general unpopularity of school science have become one cause for concern among science educators. In addition to this, The Longitudinal Study on the Impact of Curriculum Reforms (2012 - 2013), conducted for grades 4, 7 and 9, showed that students' overall conceptual understanding of scientific concepts are low and even lower on high order thinking and science

process skill based questions , compared with international standards (NIE, 2014) [3]. Such outcomes, requires action and scrutiny at all aspects of science education in the Maldives.

The current primary science curriculum that has been introduced in Maldives in 2014 aims to develop scientific literacy in the Maldivian school children (NIE, 2011) [4]. Through the curriculum key learning area of Environment, Science & Technology the science education curriculum in Maldives provides guidance for the science teachers so that students are provided with opportunities to explore the natural world and its phenomena through systematic and organized inquiry. Through the process skills, students are given experiences for investigation, predictions and explanations of the events of the Earth and the universe. (NIE, 2011) [4]. With these changes in the curriculum starting its implementation in the Maldives, there is an ever pressing need to study the implementation process and how this affects the current situation of science education in Maldives.

At the heart of curriculum reform lies the notion of providing flexibility and teacher autonomy in delivering the curriculum. Tan and Nashon (2014) [5] advocate that teachers have to be empowered in the curriculum implementation process through making teachers as curriculum agents and designers rather than transmitters of received ideas, and made feel capable of making the curriculum relevant and meaningful for themselves and their students. To support a well-implemented curriculum that uses valuable class time, all teachers must believe the curriculum is worthwhile, have a sense of ownership for it, and feel supported by school administrators (LaChausse, Clark, & Chapple, 2013) [6]. For all this to unfold naturally inside the classroom, teachers need to have a sound understanding of the curriculum and its underpinning philosophies, believe in their role in the curriculum and those changes that are associated with it.

However, with the specialized professional knowledge and skills such curricula changes demands, addressing and acquiring curricular expertise in science have been proven problematic for the regular primary science teacher (Sorsby & Watson, 1993) [7]. This issue is amplified when the existing science teachers lack a working knowledge of elementary science appropriate to the children at that age (Harlen & Holroyd (1992) [8]. Teachers' limited subject knowledge of science has been identified as a major factor that adversely impact on the delivery of the curriculum, (Holroyd & Harlen, 1996) [9]. In addition to this teachers' level of confidence in the classroom and subject knowledge, together with their understanding of the curriculum are also factors that are often associated with good curriculum implementation (Marsh, 2007) [10].

This paper is based on a case study conducted to explore how primary science teachers (Key stage 1: Grades 1-3) perceive their ability as well as the capacity of their own school to implement and deliver the primary science curriculum, as outlined in in the National Science Curriculum, in one school in Male', Maldives. A particular focus is on identifying those factors impeding or contributing to the overall implementation of the primary science curriculum in these grades.

The school studied was established in 1990 and initially started as a primary school and expanded into secondary in 2011. The original establishment of primary grades in this school makes it an ideal school for this study as it provides a picture of how experienced science

teachers perceive these new changes in the science curriculum. The school as of 2014, has 26 primary science teachers teaching Key Stage 1 (grades 1-3), of which 15% are male and 40% have highest qualification of a 3 years BEd. 80% of the teachers in this school have worked in this school for more than 2 years and 30% have worked for over 10 years. For privacy purposes, the school's name is undisclosed in this paper.

MATERIALS AND METHODS

Science Curriculum Implementation Questionnaire (SCIQ), a validated curriculum evaluation tool, consisting of seven scales with a 1-5 Likert scale on 49-items, (Lewthwaite & Fisher, 2005) [11] was distributed to the 26 teachers in grades 1-3 of the school. SCIQ identifies broad and interrelated factors influencing science program delivery (Lewthwaite & Fisher 2004) [12]. A description of each factor as a scale, along with a sample item from each scale is provided below.

	Scale	Description of Scale	Sample Item
EXTRINSIC FACTORS	Resource Adequacy	Teacher perceptions of the adequacy of equipment, facilities and general resources required for teaching of science.	The school has adequate science equipment necessary for the teaching of science.
	Time	Teacher perceptions of time availability for preparing and delivering the requirements of science curriculum.	Teachers have enough time to develop their own understanding of the science they are required to teach.
	School Ethos	Overall school beliefs towards science as a curriculum area. Status of science as acknowledged by staff, school administration and community.	The school administration recognizes the importance of science as a subject in the overall school curriculum.
	Professional Support	Teacher perceptions of the support available for teachers from both in school and external sources.	Teachers at this school have the opportunity to receive ongoing science curriculum professional support.
INRINSIC FACTORS	Professional Adequacy	Teacher perceptions of their own ability and competence to teach science.	Teachers at this school are confident science teachers.
	Professional Knowledge	Teacher perceptions of the knowledge and understandings teachers possess towards science as a curriculum area.	Teachers have a sound understanding of alternative ways of teaching scientific ideas to foster student learning.
	Professional Attitude and Interest	Teacher perceptions of the attitudes and interest held towards science and the teaching of science.	Science is a subject at this school that teachers want to teach.

[11]

18 questionnaires were returned and statistical analysis (means and standard deviations) was done using SPSS 20. Questionnaires were used in this study because it is a convenient and easy method for quantitative data collection (Cohen, Manion & Morrison, 2007) [13].

A conveniently chosen group of 3 teachers (all females) in focused group discussions provided qualitative data which were used to corroborate the data from the questionnaire. Discussions were led with themes from the questionnaire focusing on identifying perceptions and challenges faced in implementing the science curriculum for Key Stage 1.

RESULTS AND DISCUSSIONS

Table 1.1 below presents the mean and standard deviations for the SCIQ questionnaire.

Table 1.1: *Science Curriculum Implementation Profiles for Sultan School (n = 18)*

Scale	Mean Score	Standard Deviation
Resource Adequacy	3.18	0.685
Time	2.67	0.550
School Ethos	3.56	0.376
Professional Support	3.45	0.468
Professional Adequacy	3.70	0.686
Professional Knowledge	3.75	0.478
Professional Attitude and Interest	3.71	0.458

The extrinsic or the environmental factors

Teacher's response on their perceptions about how perceive on the adequacy and appropriateness of the resources they have in implementing the science curriculum, has a means score of 3.18 on the scale. The standard deviation is large (0.68) comparative to the other scores on other scales in the instrument. This indicates a relative amount of diversity in the responses teachers have provided. Overall there is somewhat a perception that teachers do not believe that the resources provided by the school are helpful or useful for them in implementing the curriculum.

Considering the time factor or scale, this scored the lowest mean score (2.67) in all the areas identified in the instrument, and to which there is a general agreement amongst the respondents (indicative by s small standard deviation of 0.55). Overall it can be suggested that time issue, is the most prevalent impeding factor in the curriculum implementation, as felt by the teachers. This time issue is likely to be in the lack of preparation time and also the amount of time available for the delivery of the curriculum content in the classroom time.

Interview comments from one teacher also identifies this issue:

To me, with this new curriculum I feel like I am running a race. So much work to do...lesson plans, marking, assessments and there is not enough time to do all that….the school thinks we are robots and we can do this easily…..

Interestingly time factor seems to be a big issue for teachers as shown in similar studies conducted using the SCIQ instrument (Payne & Lewthwaite, 2002 [14]; Lewthwaite & Fisher, 2004 [12]; Sharp, Hopkin & Lewthwaite, 2011 [15]).

Teacher's response on their perceptions about how they perceive the school's belief about science as a curriculum area scale has a mean of 3.56 with a standard deviation of 0.376. This indicates that teachers do believe to some extent that the school does place a value on the role and importance of science in the curriculum by its administrators and other school staff. There is an overall consistency in this belief as indicative of the low standard deviation. Overall, it might be suggested that respondents felt that the school management and other staff recognized the importance and status of science as an important area of study in the school curriculum.

On the scale of professional support the mean score of 3.45 indicates a mild agreement by the respondents to the fact that school does provide professional support opportunities on matters of science curriculum implementation. There is a general agreement to this view as indicated by a low standard deviation (0.46). However, one of the responses from the interview is a bit contradictory to this view:

"It is a challenge that we teachers lack some of knowledge about the content and there is no one around here we can ask for guidance or support and sometimes we feel we are alone in this…like a swim or sink type of feeling…"

Overall, it might be suggested that respondents felt a clear distinction between the levels of support and staff development opportunity available to them both internally and externally, the latter in particular, clearly is a cause for concern as evident by the interview response.

The intrinsic factors

On the scale of professional adequacy which considers the teachers' perceptions of their confidence and readiness level to teach primary science effectively, the mean score was 3.7, but the responses were a bit diverse as indicative of a larger standard deviation (0.686). One possible reason for the diversity in response could be in the teachers' level of involvement in the curriculum development, other professional knowledge they might have had from professional development programmes they have attended to. Overall, it might be suggested that most respondents felt they were competent and adequately prepared to teach primary science and thought they could do it well.

On the scale of professional knowledge which considers the teachers' perceptions of their curricular understanding with regard to the subject matter knowledge and pedagogical content knowledge, the mean score was 3.75, and a standard deviation of 0.468, indicative of general agreement on this response.

In the interview one teacher's comment supports this:

"The new content is a much needed change. It gives teachers the opportunity to let students to explore and calls for teachers to use and teach scientific vocabulary".

Such response indicates that respondents are aware of where and why the changes have been made in the curriculum and believe that they have the working knowledge to implement the changes in the curriculum.

On the scale of professional attitude and interest which considers the teachers' attitude, motivation and desire to teach primary science, the mean score was 3.71, and a standard deviation of 0.458, indicative of general agreement on this response.

Interview responses in support of this says:

"The new curriculum has brought a positive change to the teachers' perception"

Such response indicates that respondents are happy with the new changes and the improvements it will bring to primary school science. There is general motivation to teach science and overall positive attitude towards science teaching among the respondents.

In summation, the picture of science curriculum implementation in this school is such that overall the primary science teachers are happy with the new curricular changes and are even enthusiastic about it, but are worried about the time constraint it puts on their workload. In addition to this teachers also worry about the lack of support provided to them by school and other central authorities developing the curriculum, such as National Institute of Education and the Ministry of Education. At this point in time, primary science teachers in this school are motivated to move forward with the implementation of the new science curriculum, but in order to maintain this level of engagement with the curriculum, factors this study has identified, especially the school environment factors such as time and resource availability are aeas that the school needs to genuinely address immediately.

CONCLUSION

This current research represents presents a picture of science curriculum implementation in a typical school in Male'. With these findings, there are several avenues for further research and recommendations for better practice that can be made. Of these, recommendations at the school level, school management should provide ways to overcome the limited time constraint teachers have. By providing avenues for group planning, collaboration seminars for discussion of curricular materials and discussions platforms could alleviate this and provide more professional support for the teachers. Furthermore, to provide better understanding of the curriculum and more ownership in the delivery and the resources, teachers through support from curriculum developers or teacher educators, and other central bodies could develop school level resources that are more suited for their school contexts. At a national level, more focused reviews of curriculum and teachers' discussion and recommendations needs to be taken into considerations. More voices and input from the teachers need to be included in this and better and more reaching mechanisms need to be established for this to happen.

Further research needs to be conducted in other Maldivian schools, and in other areas of the country to map out their school SCIQ profiles so that more focused support can be provided. This could also be supplemented with central level policy making so that school improvement will be more oriented towards the development of the school in areas where support is required.

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Progression of the Criminal Justice System in Sri Lanka through a Policy Framework for Sentencing

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Abstract

In any criminal justice system, the stage of sentencing is considered crucial since it represents the ultimate goal of any justice delivery system. In the process of sentencing, judges play a highly significant role even though they are not permitted to exercise absolute discretionary power. In this context a sentencing policy framework and guidelines can bring clarity and consistency to the criminal justice system in a state. Therefore, in the absence of a sentencing policy in Sri Lanka, a doubt arises as to the degree of fairness and justice maintained by the system of criminal justice system. The key research question to be addressed in this research is how an introduction of a framework of sentencing policy can develop the system of criminal justice system in Sri Lanka and the research places special emphasis on the sentencing guidelines. This research is conducted through the critical analysis method and the legal research methodology. Primary and secondary data is gathered through a review of primary sources viz. case law, and secondary sources viz. books with critical analysis, law journals and conference papers. It is submitted that a system of sentencing guidelines developed through an introduction of a sentencing policy framework can further the criminal justice system in Sri Lanka and introduction of sentencing guidelines must be soon done while simultaneously retaining the respect for judicial discretion.

Key Words: Criminal Justice, Sentencing, Policy and guidelines, Sri Lanka

Introduction

It is the function of criminal law to set out standards of what is permissible or not and operate as a method of social control. Punishment is attached to criminal law in a way which cannot be sequestrated from one another. As defined by Garland Punishment is the '*legal process whereby violators of criminal law are condemned and sanctioned in accordance with specified legal categories and procedures*' (Garland, 1990). Sentencing is the procedure of inflicting a punishment for a crime for which an accused has been convicted succeeding a trial or has pleaded guilty. In the process of sentencing, judges in any country are not vested with absolute discretion even though they have power to decide among range of possibilities of punishments as defined by the statutes.

For the purpose of understanding the importance of sentencing guidelines, it is significant for a legal scholar, a practitioner, judge or even laymen to understand the concept of punishment which underlies the process of sentencing. The principal justifications for punishment can be recognized under four wider theories namely retribution, deterrence, incapacitation and rehabilitation. The first theory of punishment, retribution roots back to the beginnings of the ancient societies and reflects vengeance. More commonly, today it refers to giving the offender just deserts and using punishment as a censure of denunciation (Stephen, 1883). Desire for vengeance operate at two levels. First, this theory satisfies, the desire of the victim or connected parties to the victim for vengeance and at the second level it satisfies the desire of public for vengeance and ultimately prevent private retaliation. According to the theory, the offender must be purified through suffering and they should pay their debt to the society (Walker, 1991).Unlike utalitarianists, retributivists focus on imposing a punishment which commensurate with the crime that has been committed and not on the beneficial consequences of the punishment. Simply, this theory reflects the biblical dictum of 'eye for and eye and tooth for a tooth'.

The theory of deterrence, quite contrary to the theory of retribution focuses on the consequences of the punishment and therefore can be categorized as a forward looking theory. This theory operates at three levels, namely, individual deterrence, general deterrence and educative deterrence and seeks to reduce future crimes by the threat or example of punishment. Utalitarian philosophers like Jeremy Bentham considered that main proponent of punishment as deterrence and Becarria taking a similar view have argued that main objective of punishment can be to prevent an offender from committing further crimes against the society (Bean, 1981).

Lawton L.J., in In *R v Sargeant* [1975] admitted that neither, rehabilitation nor deterrence succeed in preventing some criminals from committing crimes as long as they have the capacity to do so. In such cases, those offenders should be locked up for a long period to protect the public since it will incapacitate them offender. (Morris, 1994). In history, death sentence, severance of limbs and even castration have been utilized as methods of incapacitation although in the contemporary society such methods are more likely to be imprisonment and other community measures like imposing curfew. This theory attracts much criticism and some scholars like Morris argues that sentences which incapacitate the offenders should be permitted only where there exists reliable information showing a high probability of committing crimes in future by the offender.

According to the final theory out of four theories of punishment, aims to reform or rehabilitate offenders through punishment and this theory is considered to be one of the most ambitious developments in the penal theory. As recognized in a report prepared by the Sentencing Commission Working Group (2008), the origins of this concept are connected to the humanitarian movement for prison reforms. Further, utalitarian theory going in line with theory of rehabilitation argues that punishment should essentially have a reformative effect on the offender (Ten, 1987). Under this theory, the offender when rehabilitated, does not abstain from committing crime since he/she fears the punishment and rather would not engage in future crimes as a result of change in the offender's values. While rejecting any connection between guilt and punishment, rehabilitation theory recognizes crime as a symptom of social disease which needs to be cured by rehabilitation.

Generally, in sentencing judges are vested with discretion to choose between penal alternatives as enshrined in the statutes. Sentencing being an essential component of a criminal justice system aims to administer justice and protect the public. To achieve these aims, sentencing seek to prevent offenders from engaging in future offences while trying to ensure that sentencing would direct to a just punishment which would also be viewed by the society as just and compensate the victims of crimes. Further sentencing should lead to reformation of the offenders as well.

Sentencing although viewed by many as a routine or a mechanical process is in fact a far more complicated process which ultimately calls forth issues of consistency and fairness in punishment. In most countries, an advanced system of sentencing guidelines developed through a proper sentencing policy framework operate to guide they judges in their judicial exercise. However, in Sri Lanka such framework is not yet developed and this paper analyzes extensively how such system can bring forth more desirable results. The key research question to be addressed in this research is how an introduction of a framework of sentencing policy can develop the system of criminal justice system in Sri Lanka and the research places special emphasis on the sentencing guidelines.

Materials and Methods

This research is conducted through the legal research methodology and the traditional black letter approach has been followed. Primary and secondary data is gathered and critically analyzed through a review of primary sources namely case law, and secondary sources namely books with critical analysis, law journals and conference papers and commission reports. Scope of the research is limited to issue of maintaining consistency in sentencing. The lack of scholarly writing concerning the sentencing policy in Sri Lanka operated as the main limitation to the extension of this research.

Results and Discussion

In deciding a punishment and the degree of punishment, a judge has different alternatives, depending on the defendant's crime and its circumstances. This discretion is justified by the need of permitting a judge to give consideration special or unique factors relating to the offender's behavior, criminal history or facts regarding the crime as demonstrated by *Gunasekere v Solomon* [1923]and *Appuhamy v Wijesinghe* [1945] . In addition, within this discretion, a judge can also take other related factors in to account. This proves that sentencing is not a routine or a mechanical procedure which can be effected through exact rules. Within the criminal justice system of Sri Lanka, the judges are faced with challenges which impact sentencing. One of the many such challenges is to ensure that the judicial discretion is used responsibly in a way which promote transparency and accountability, while also preserving consistency. Therefore, these challenges demand the introduction of a strong policy framework.

When deciding on range of forms punishments and the degree of punishment, judges usually evaluate the objective punishment with regard to the circumstances of the case. For instance in *Piyasena v The Attorney General* [1986] , *Chandradasa v Liyanage Cyril* [1984], the judges have emphasized on the deterrent effect of the punishment when deciding on a sentence since the crimes were considered to the most serious nature. *Chandradasa v Liyanage Cyril* [1984] involved a case where the respondent has made a threat of bodily harm to a judicial officer and the justice Athukorela clearly expressed his view that actual or a threatened injury to a judge to alter a decision constitute the most heinous crime out all contempt committed against the lawful authority of courts. However what is noteworthy in this context is that the perception of the seriousness of the crime and therefore the degree of punishment to be offered can differ from one judge to another.

Further, different judges in like cases can give considerations to different issues and this is known as inter-judge disparity. One judge may consider the impact of the sentence on offender's family which another may disregard it in a similar circumstances. This may occur even by the same judge depending on the value he attaches to related concerns like above in different stages of his judicial career and this kind of disparity is known as intra-judge disparity. In addition to discrepancies of sentencing which occur due to justifiable reasons, decisions may vary according to personal and religious beliefs of judges and their social class. Racial bias, gender bias, and class bias are thee of such problems which ideally should not have any place in a criminal justice system although practically such preconceptions will always find its way even in the most advanced systems. For example, a in a case involving racial violence against minority by the majority in a country, a judge belonging to a minority community persuaded by his own experience and positive liking towards his own people, may decide upon a much harsh punishment than one belonging to the majority. In a case of violence against women, a male judge who favours the patriarchal societal structure may choose to treat the offender leniently quite different from a judge who believes in feminist ideology.

According to the above analysis it is clear that there is a great possibility of sentencing disparities to exist in Sri Lanka like in any other society and addressing this problem is significant since the minimization of discrepancies operates not only for the benefit of both the offenders and the victim but for the society at large. Maintaining consistency in the process of sentencing is a necessity to preserve rule of law and maintain public confidence in the criminal justice system in a country.

Many jurisdictions has specified mandatory sentences as one of the methods for preserving consistency in sentencing. For instance as demonstrated by the 1995 amendment to the Penal Code, inter alia, in case of Rape (section 364), Incest (section 364 A), Acts of Gross Indecency (section 365 A), Grave Sexual Abuse (section 365B), method of mandatory sentences also operates in Sri Lanka. In case of mandatory sentences. A penal statute will specifically lays down the minimum sentence (generally for serious offences) that is to be imposed on an offender for a particular crime. This however, does not terminate the judicial discretion since the judge has the option of imposing a severe punishment that what is specified by the statute. Nevertheless, this method has been subjected to harsh criticism since it takes away the ability of the criminal justice system to leniently treat the offender who ought to receive a lesser punishment than the minimum sentence due to valid reasons and related valid concerns. Therefore it can be submitted that, imposition of mandatory minimum sentence alone in the absence of a policy framework which specifies sentencing guidelines cannot bring forward the desired effect of justice.

A policy regarding sentencing guidelines, can inter alia set up a framework by stating range of sentences appropriate for particular offences. This would not interfere the exercise of the judicial discretion. Sentencing guidelines would add flexibility to the criminal justice system and it will necessitates the judges to operate within the specified range and thereby reduce discrepancies in sentencing. However, unlike under the method of mandatory sentences, sentencing guidelines will offer freedom to judges to treat the convicts more or less harshly after taking all relevant factors as also specified by the policy framework in to consideration. This in fact can be submitted as the method which strike the proper balance between consistency and the respect for judicial discretion. It is also noteworthy that expecting complete consistency in sentencing is not practical since there will always be various judicial opinions. However, effect of a policy framework and guidelines would be the reduction of the possibility of sentencing disparities to great extent in like cases.

Conclusion

A just criminal justice system should ensure the preservation of equality. Article 12 (1) of the Constitution of Sri Lanka states that all persons are equal before the law and are entitled to the equal protection of the law. However, imposing same sentence on every criminal for the same offence without taking related concerns in to account does not promote equality or justice and can ultimately lead to absurd results. In fact concept of individualization suggests that punishment must fit the characteristics of the offender even in similar offences. In fact the calamity to overcome is not the imposition of different sentences but preventing that judicial discretion to impose different sentences would not depend on the judges' individual ideologies. In this context, sentencing guidelines can operate as a judicial tool which guide judges.

Sentencing guidelines should inter alia, although not exhaustive specify the matters to be taken into account when imposition of a sentence for example character of the offender, remorse on the part of the offender and impact of the sentence on related parties. Further, such factors should be different depending

on the type of the offences and the categories of offenders. For example, a policy framework can clearly distinguish between the sentencing guidelines for juvenile offenders from the rest and specify mandatory considerations to be taken into account when deciding on a sentence.

A policy framework for sentencing can clearly establish the objectives of sentencing and identify the policy principles which lead to actualization of those objectives. It can inter alia develop consistency of sentencing to a greater extent which would ultimately result in justice, transparency and public confidence on the criminal justice system in Sri Lanka. Sentencing guidelines will promote predictability as well and will provide assistance to both prosecutors and defense counsels in making their decisions as to making appeals against judgments. It will clearly provide guidance for them to realize in what circumstances a judge exceed the parameters specified by the guidelines. Therefore, according to the findings, it is finally submitted that developing a system of sentencing guidelines through an introduction of sentencing policy framework can undoubtedly further the progression of the criminal justice system in Sri Lanka by reducing discrepancy in sentencing for similar offences in like circumstances while simultaneously retaining respect for discretion of judges.

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Effect of the Process Parameters on Build Time in Fused Deposition Modeling using Taguchi Method

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Abstract*: Fused Deposition Modeling (FDM) is an additive manufacturing technology commonly used for modeling, prototyping and production applications. It works on an "additive" manufacturing principle by laying down material in layers. A plastic filament or a metal wire is unwound from a coil and supplied to produce a part. Taguchi method is a statistical method developed by Genichi Taguchi to improve the quality of process in engineering, biotechnology, marketing and advertising. It involves the identification of proper control factors to obtain the optimum results for the process. Orthogonal Arrays are used to decide on the set of experiments. Results of these experiments are used to analyze the data and predict the quality of the process used. The objective of this work is to adapt Taguchi and Full factorial methods to fused deposition modeling process. L_9 orthogonal array and S/N ratio are used to study the performance characteristics on build time. Print speed, layer thickness and extrusion density are the parameters selected. Accordingly, a suitable orthogonal array (L_9) is developed and experiments performed. Based on analysis of S/N ratio, optimum parameter values are obtained and the confirmation experiments are carried out by using full factorial method.*

Key words: *Fused deposition modelling, Taguchi analysis, Prototyping, S/N ratio*

Introduction:

1.1 Fused Deposition Modelling (FDM)

Fused Deposition Modelling (Fig. 1) is an additive manufacturing technology commonly used for modelling, prototyping and production applications. It is one of the techniques used for 3D printing. FDM works on an "additive" principle by laying down material in layers. A plastic filament or metal wire is unwound from a coil to supply material and to produce a part. FDM begins with a software process which processes an STL file, mathematically slicing and orienting the model for the build process. Although as a printing technology FDM is very flexible and it is capable of dealing with small overhangs by the support from lower layers. Hence, FDM has some restrictions on the extent of the overhang, and cannot produce unsupported structure.

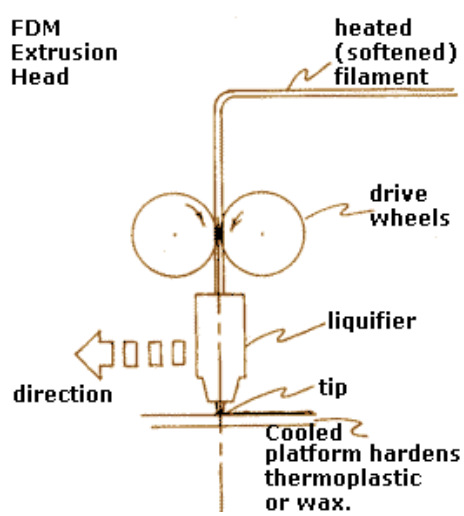

Fig. 1 Working Principle of FDM

In FDM parts consisting of overhangs, thin base sections have to be built with support structures such as honeycomb, raft layers.

1.2 Materials used

The materials used for manufacturing parts are Acrylonitrile Butadiene Styrene (ABS), Polylactic acid (PLA), Polycarbonate (PC), Polyamide (PA), Polystyrene (PS), lignin and rubber. Among these materials, the commonly used are Acrylonitrile Butadiene Styrene and Polylactic acid. ABS is a common thermoplastic polymer [1, 2]. Its glass transition temperature is approximately 105 °C. ABS is amorphous and therefore has no true melting point. It is a terpolymer made by polymerizing styrene (40 – 60 %) and acrylonitrile (15 – 35 %) in the presence of polybutadiene (5 – 30 %).

Polylactic acid is biodegradable thermoplastic aliphatic polyester derived from renewable resources, such as corn starch, tapioca roots, and chips of starch or sugarcane. PLA can be processed into fibre and film. The melting temperature of PLA can be increased by 40–50 °C and its heat deflection temperature can be increased from approximately 60 °C up to 190 °C by physically blending the polymer with PDLA (poly-D-lactide).

1.3 Design of Experiments

Experiments are carried out either to discover something about a particular process or to compare the effect of several factors on some phenomenon under study. Design of Experiments (DOE) is an experimental approach to determine relationships between process or product input and its output. It helps to identify key variables or factors and their levels contributing to output.

1.4 Full factorial design

The full factorial design is the simplest design to create, but involves extreme consumption of resources, time and materials. In full factorial design each factor tested at each condition of the factor. Number of tests (N) is given by, N=LF where L= number of levels (High “+1” and Low “-1”) and F= number of factors. Each combination thus obtained is to be tested to find the significant parameters affecting the process or product.

1.5 Taguchi method

Taguchi method was developed by Genichi Taguchi in 1950’s to improve the quality of manufactured goods. Taguchi design involves reducing the variation in a process through robust design of experiments. The overall objective of this method is to produce high quality product at low cost to the manufacturer. He developed a method for designing experiments to investigate how different parameters affect the mean and variance of a process performance characteristic that defines how well the process is functioning. The experimental design proposed by Taguchi involves using orthogonal arrays to organize the parameters affecting the process and the levels at which they should be varied. It allows for the collection of the necessary data to determine the factors that most affect product quality with a minimum amount of experimentation, thus saving time and resources [3].

Methodology:

Steps involved in FDM are:

1. Development of a CAD model
2. Generation of standard triangulation language (.STL) file
3. Slicing the .STL file
4. Support Structures
5. Manufacturing
6. Post processing

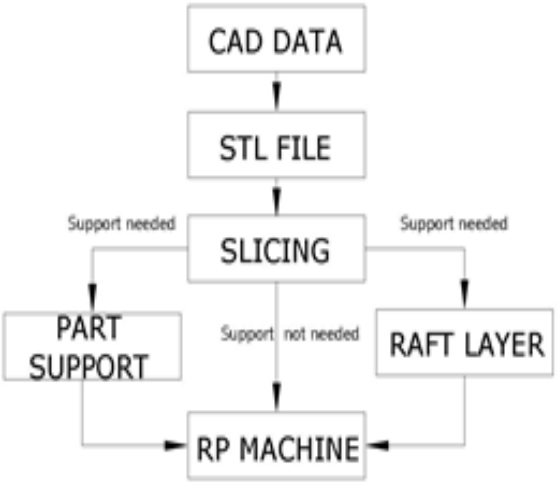

Fig. 2 FDM Methodology

Table 1 Printer Settings for FDM

Sl.No	Parameter	Value
1	Layer thickness	0.2 mm
2	Perimeter	3 mm
3	Infill density	40 %
4	Infill pattern	honeycomb
5	Perimeter speed	30 mm/s
6	Infill speed	60 mm/s
7	Support speed	60 mm/s
8	Speed of travel	130 mm/s
9	Support spacing	2.5 mm
10	Raft layer	2 numbers
11	First layer width	0.1 mm
12	Infill width	0.52 mm
13	Support width	0.52 mm
14	Solid infill width	0.52 mm
15	Filament diameter	1.75 mm
16	Extruder temperature	185 ºC

Parameters used for DOE are:

Print speed: it refers to the speed at which the nozzle head travels around the bed while depositing the semi molten plastic.

Layer thickness: Slice height is the thickness of each layer measured in the vertical or Z direction

Infill density: It is the amount of material deposited within the perimeter of the object.

The use of Taguchi's parameter design involves the following steps

Identify the main function and its side effects.
Identify the noise factors, testing condition and quality characteristics.
Identify the objective function to be optimized.
Identify the control factors and their levels.
Select a suitable Orthogonal Array and construct the Matrix
Conduct the Matrix experiment.
Examine the data; predict the optimum control factor levels and its performance.
Conduct the verification experiment.

The experiments are conducted on FDM setup. The CAD model was designed using Catia V5 and sliced using CURA engine for the corresponding designed parameters as per L_9 orthogonal array [4]. The process parameters (print speed, layer height and infill density) are varied using the control panel. The material used is ABS wire having 1.75mm diameter.

The Full Factorial Design requires a large number of experiments to be carried out as stated above. It becomes laborious and complex, if the numbers of factors are more. To overcome this problem Taguchi suggested a specially designed method called the orthogonal array to study the process with lesser number of experiments to be performed. Taguchi recommends the use of the loss function to measure the performance characteristics that are deviating from the desired target value. The value of this loss function is further transformed into Signal-to-Noise (S/N) ratio. Normally, there are three categories of the performance characteristics to analyze the S/N ratio (Nominal-the-best, Larger-the-better, and Smaller-the-better). One that best fits the situation is selected to analyze the performance [5].

Table 2 Process Parameters and Levels used in FDM

Process Parameters	**Levels**		
	1	**2**	**3**
Print speed (A), mm/s	40	55	70
Layer height (B), mm	0.4	0.2	0.1
Infill density (C), %	50	30	20

Table 3 L_9 Orthogonal Array (OA) used for the experiments (Coded units)

Experiment number	**Process Parameters**		
	A	**B**	**C**
1	1	1	1
2	1	2	2
3	1	3	3
4	2	1	2
5	2	2	3
6	2	3	1
7	3	1	3
8	3	2	1
9	3	3	2

3.0 Results and Discussions:

A suitable orthogonal array (L_9) consisting of 3 process parameters and 3 levels is considered for analysis (Table 3). The build time is measured in seconds and the corresponding S/N ratios are tabulated in Table 4. Regardless of the category of the performance characteristics, a smaller S/N value corresponds to a better performance. Therefore, the optimal level of the machining parameters is the level with the lowest S/N ratio [6]. Based on the analysis of the S/N ratio, the optimal performance parameters governing the build time is at 70mm/s print speed, 0.4 mm layer height and 20 % infill density. Figure 3 shows the effect of the process parameters on the build time.

Table 4 L_9 Orthogonal Array for Taguchi method (Uncoded Units)

Experiment number	Process parameters			Build time (s)	S/N Ratio
	Print speed, A (mm/s)	Layer height, B (mm)	Infill density, C (%)		
1	40	0.4	50	1876	65.4647
2	40	0.2	30	2639	68.4288
3	40	0.1	20	4146	72.3526
4	55	0.4	30	1383	62.8164
5	55	0.2	20	1941	65.7605
6	55	0.1	50	5542	74.8733
7	70	0.4	20	1173	61.3860
8	70	0.2	50	2622	68.3727
9	70	0.1	30	3722	71.4155

Table 5 S/N ratio values for Build Time by Factor Level

Level	Process Parameters		
	Print speed (mm/s)	Layer height (mm)	Infill density (%)
1	68.75	72.88	66.50
2	67.82	67.82	67.55
3	67.06	63.22	69.57
Delta	1.63	9.66	3.07
Rank	3	1	2

Table 6 Analysis of S/N ratio for build time

Sources	DF	Seq SS	Adj SS	Adj MS	F	P (%)
Print speed (A)	2	4.302	4.302	2.1512	6.13	2.68
Layer height (B)	2	140.483	140.483	70.2413	200.12	87.75
Infill density (C)	2	14.606	14.606	7.3028	20.81	9.12
Residual error	2	0.702	0.702	0.3510		0.43
Total	8	160.093				100

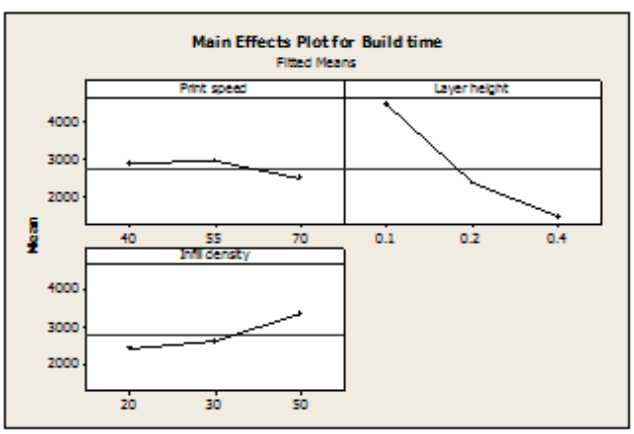

Fig. 3 Effect of process parameters on build time

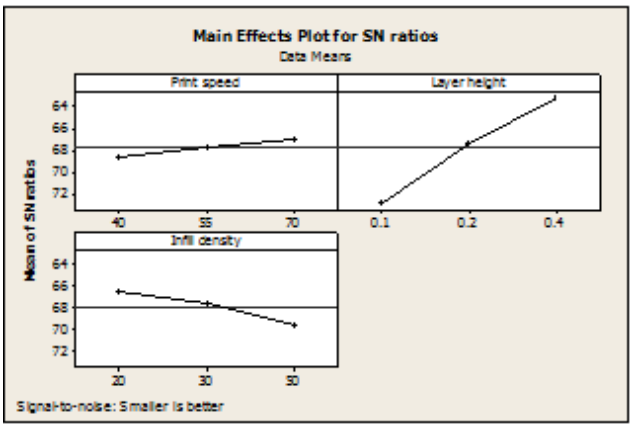

Fig. 4 Main effects plot for build time using analysis of S/N Ratio

The effect of process parameters on the build time using S/N Ratio is shown in Fig. 4. The increase in layer height causes a lower quality output but causes an enhancement of the build time. From Table 5, layer height has the maximum impact on built time and print speed has the lowest impact on build time. A reduction in the infill density also increases the build time [5]. It is observed from Table 6 that the print speed (A), layer height (B) and infill density (C) affect the build time rate by 2.68 %, 87.75 % and 9.12 % respectively.

It is evident from the results of the full factorial analysis shown in Table 7, the best build time characteristics obtained were at print speed (70 mm/s), layer height (0.4 mm) and infill density (20 %) with the built time of 1173 s. From Taguchi parameter design the optimum parameter levels obtained are also the same (Table 5). Thus, it can be inferred that Taguchi parameter design will give accurate results with lower number of experiments.

Table 7 Results of Full Factorial Method

Expt. No.	Process Parameters			Build time (s)	Expt. No.	Process Parameters			Build time (s)
	Print speed (mm/s)	Layer height (mm)	Infill density (%)			Print speed (mm/s)	Layer height (mm)	Infill density (%)	
1	40	0.4	50	1876	**15**	55	0.1	30	4276
2	40	0.2	50	3856	**16**	55	0.4	20	1956
3	40	0.1	50	7636	**17**	55	0.2	20	1946
4	40	0.4	30	1396	**18**	55	0.1	20	3556
5	40	0.2	30	2639	**19**	70	0.4	50	1186
6	40	0.1	30	5716	**20**	70	0.2	50	2324
7	40	0.4	20	1348	**21**	70	0.1	50	4696
8	40	0.2	20	2356	**22**	70	0.4	30	1876
9	40	0.1	20	4146	**23**	70	0.2	30	1756
10	55	0.4	50	1456	**24**	70	0.1	30	3722
11	55	0.2	50	2896	**25**	70	0.4	20	1173
12	55	0.1	50	5542	**26**	70	0.2	20	1456
13	55	0.4	30	1383	**27**	70	0.1	20	2896
14	55	0.2	30	2116	-	-	-	-	-

4.0 Conclusions:

Based on S/N ratio, the optimal performance parameters governing the build time in FDM process is 70 mm/s print speed (A3), 0.4 mm layer height (B1) and 20 % infill density (C3).

Layer height has the highest impact (87.75%), print speed (2.68 %) has the lowest impact, on the build time and infill density (9.12 %) in between.

Taguchi's Method of parametric design gives accurate results with minimum number of experiments.

Results obtained by full factorial and Taguchi's methods are in line.

Build time increases with decrease in layer height with the reduction in quality or resolution of the part.

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HEAT TRANSFER ENHANCEMENT IN A DOUBLE PIPE HEAT EXCHANGER BY USING NANOFLUIDS

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Abstract— *In the present study heat transfer characteristics of of Al_2O_3 based nanofluid was studied in a double pipe heat exchanger. Experiments were conducted in a double pipe heat exchanger with water and aluminum oxide based nanofluid at different mass flow rates. Physical properties of the nanofluids like thermal conductivity and viscosity were determined at different volume fractions of the nanoparticles in the base fluid. Heat exchanger results indicated a significant enhancement in the heat transfer characteristics like Nu, heat transfer coefficient and heat transfer rate by using nanofluids. When the volume fraction of the nanoparticles varied from 0.01 to 1 % the average nusselt number and heat transfer rate were increased by 9.5 and 19% respectively.*

Keywords: *Nanofluid, Nusselt number, Heat transfer, Thermal conductivity, Viscosity.*

Introduction.

Effective utilization, conservation and recovery of heat are critical engineering problems faced by the process industry. The economic design and operation of process plants are often governed by the effective usage of heat. A majority of heat exchangers used in thermal power plants, chemical processing plants, serve to heat and cool different types of fluids. Both the mass and overall dimensions of heat exchangers employed are continuously increasing with the unit power and volume of production. This involves huge investments annually for both operation and capital costs. Hence it essential to reduce the overall dimension characteristics of heat exchangers. The need to optimize and conserve these expenditures has promoted the development of efficient heat exchangers. Double pipe heat exchangers are the simplest devices in which heat is transferred from the hot fluid to the colder fluid through a separating cylindrical wall. Double pipe heat exchangers can be considered as an alternative to shell-and-tube heat exchangers. These heat exchangers are cheaper for both design and maintenance, making them a good choice for small scale industries, but on the other hand, low efficiency of them besides high space occupied by such exchangers in large scale industries create problems. Different techniques have been used by researchers to improve the efficiency of double pipe heat exchangers. These efforts include passive and active methods

such as creating turbulence, increasing area, etc. Most of them
are limited by inherent restriction of thermal conductivity of the conventional fluids (such as water, mineral oil and ethylene glycol). The poor heat transfer properties of the employed fluids are obstacles for using different types of heat exchangers. Solid particles are having higher thermal conductivity than fluid. When solid particles of small size will be dispersed in a liquid medium it has been observed that the heat transfer characteristics will be improved. However, due to large size of micro and macro-sized particles, they will create problems like clogging of flow channels due to poor suspension stability, erosion of heat transfer device, and increase in pressure drop. These problems were solved by using particles of size lesser than 100nm which are called as nanoparticles. Different types of particles like metallic, nonmetallic, oxides of metal and polymeric can be used as nano materials. These nano sized particles when mixed with the base fluid the physical properties of the resulting mixture will be altered. Nanofluids are suitable for engineering applications and show several potential advantages such as better stability, dramatically high thermal conductivity and no extra pressure drop compared to other suspensions. Thermal conductivity, viscosity, density and specific heat are some of the interested thermal properties with the focus is on use of nanofluids to cooling/heating applications. These properties again change with volume fraction of the nanoparticles, particle size, and temperature and also with time

Masuda et.al [1] conducted experimental study of variation of thermal conductivity of the nanofluids like Al_2O_3, TiO_2, SiO_2 with water combinations. They observed that for a particle diameter of 13 nm thermal conductivity increases upto 30% at volume fractions less than 4.3 %. Murshed et.al [2] observed 27% increase in thermal conductivity for TiO_2 for a size of 15 nm and 20% increase for Al_2O_3 water nanoparticles of the same volume fraction. He concluded that particle size influences thermal conductivity of nanofluids. He et.al [3] experimentally showed that shear viscosity increases with increase in particle size. They measured the viscosity of TiO_2- water nanofluid for various particle sizes and observed an upward trend in the viscosity with increase in particle diameter. Anoop et. al [4] studied the variation of viscosity with temperature and also with the volume fraction for CuO- ethyl glycol mixture. They found that it reduces with temperature and increases with volume fractions.

Several researchers have used analytical models to predict the thermal conductivity and viscosity of nanofluids [5]. Because of their higher value of thermal conductivity than the base fluid they have been widely used in heat exchangers like shell and tube type, automobile radiators and double pipe heat exchangers.

Farajollahi et. al [6] studied the effects of using γ-Al_2O_3/water and TiO_2/water nanofluids by varying the Peclet number and volume concentration of nanoparticles in nanofluid used in a shell and tube heat exchanger. Results indicated that heat transfer rate was augmented by increasing the concentration of nanoparticles in the base fluid. It was also observed that for a specified Peclet number, TiO_2/water nanofluid displayed better heat transfer characteristics when operated at its optimum concentration when compared to the characteristics displayed by the use of γ-Al_2O_3/water nanofluid. K.Y. Leong et. al [7] focused their study on the application of ethylene glycol based copper nanofluids in an automotive cooling system. It was observed by the authors that, overall heat transfer coefficient and heat transfer rate was higher when Cu/ethylene glycol nanofluid was used as a coolant compared to ethylene glycol alone. Peyghambarzadeh et. al [8] studied the usage of aluminium oxide based nanofluids in the cooling circuit of a vehicle by studying the heat transfer characteristics of ethylene glycol, water, their mixtures. The effects of usage of nanofluids in car radiators were experimentally determined for different flow rates and volume fractions of the nanoparticles. It was observed that the usage of nanofluids demonstrated a discernible increase in heat transfer rate.

Several authors have used nanofluids in a double pipe heat exchanger to observe the effects of volume fractions, temperatures, and mass flow rates on the heat transfer characteristics. Reza Aghayani et al.[9] studied heat transfer characteristics in a double pipe heat exchanger with counter turbulent flow using aluminum oxide based nanofluid. Comparison of experimental results with valid theoretical data based on semi empirical equations showed an acceptable agreement. Experimental results showed an increase in heat transfer coefficient and Nusselt number up to 19%–24%, respectively. Also, it has been observed that the heat transfer coefficient increases with the operating temperature and concentration of nanoparticles.

Senthilraja et.al [10] conducted Experimental investigations of heat transfer coefficient of CuO/Water in a double pipe heat exchanger. The nanofluid was prepared by dispersing a CuO nano particle in deionized water. CuO/water nanofluid with a nominal diameter of 27 nm at different volume concentrations (0.1 & 0.3 volume %) at room temperature were used for the investigations. Experimental result showed that the convective heat transfer coefficient and Nusslet number increases with increasing the liquid flow rate and volume fractions of nanoparticles.

Vatsal Patel et.al [11] experimentally investigated effect of addition of CuO nanoparicles in base cold fluid using counter flow concentric tube heat exchanger. The heat transfer coefficient and friction factor of the CuO –Water nanofluid flowing in a counter flow concentric tube heat exchanger under turbulent flow conditions were determined. The results showed that the convective heat transfer coefficient of nanofluid is higher than that of the base liquid by about 3.45 – 9.5%. The heat transfer coefficient of the nanofluid increases with an increase in the mass flow rate of the nanofluid. Literature related to study of heat transfer characteristics in a double pipe heat exchanger using nanofluids is very limited. In the present study Al_2O_3 based nanofluid is used as hot liquid flowing inside the inner pipe whereas cold water in the annulus. For different mass flow rates of the hot liquid and for different volume fractions of the nanoparticles in the base fluid experiments were conducted and the results have been compared with water without nanoparticles and have been presented.

2. Experimental set up

Fig 1. Photograph of the experimental set up

Parallel and counter flow double pipe heat exchanger setup was fabricated for the conduction of experiments as shown in fig 1. Closed circuit of heat exchanger was fabricated using G.I. and copper pipes connected with various pipe fittings. The upper pipeline and the two parallel transverse pipelines are required to switch the flow directions between parallel flow and counter flow using forged ball valves. The setup also has provisions for screwing thermocouples into it for measuring the inlet and outlet temperatures of hot and cold fluid. A source of water is present for constant supply of cold water to the heat Exchanger. A tank, geyser for heating the nanofluid and thermostat switch are assembled to the heat exchanger. A reciprocating pump of 0.5 HP is used to pump the fluid back to the Heat Exchanger. Temperature sensors (Thermocouples) are used for temperature measurement at inlet and exit of both fluids. Initially experiments were conducted using only pure water in order to set the base line data. Hot fluid (water) at 50 °C was made to flow through the inner pipe. Cold fluid was made to flow in the annular with a constant mass flow rate of 0.02 kg/s. Inlet and out let temperatures of the cold and hot fluid were recorded. Experiments were conducted by changing the flow rates of hot water to 0.03, 0.04, 0.05 and 0.06 kg/s.Later experiments were conducted by using nanofluid. Al_2O_3 based Nanofluid of different volume fractions were prepared by dispersing nanoparticles (size 40 nm) in base liquid (water). Surfactant was added and ultrasonification was done for 4 hours to get a stable solution. Experiments were repeated using this nanofluid mixture for 0.01, 0.05, 0.1, 0.5 and 1% of volume fraction of nanoparticles in the base fluid for the above mass flow rates. Temperature readings were recorded for all the set of experiments and heat transfer characteristics were determined.

3. Physical properties of nanofluid

By assuming the nanoparticles are well dispersed within the base fluid thermo-physical properties of nano fluid at different volume fractions are calculated. Density, viscosity, specific heat and thermal conductivity of the nanofluid are the important properties influencing the heat transfer rate in a double pipe heat exchanger. These properties were predicted by using the correlations used by Naraki et.al [5].

$$\rho_{nf} = (1 - \emptyset)\rho_f + \emptyset\rho_p \quad \text{----------(1)}$$

Specific Heat of Nanofluid, Cp_{nf}

$$= \frac{\phi\rho_s Cps + (1-\phi)\rho_{bf} Cp_{bf}}{\rho_{nf}} \quad \text{----------(2)}$$

Dynamic viscosity of Nanofluid, μ_{nf}

$$= \mu_{bf}(1 + 15.415\phi)(\phi \leq 5\%) \text{----------(3)}$$

Equivalent Thermal conductivity of Nanofluid, k_{eq}

$$Keq = \frac{k_s + 2k_{bf} + 12.332\phi(k_s - k_{bf})}{k_s + 2k_{bf} - 6.166\phi(k_s - k_{bf})} \text{----------(4)}$$

Figure 2 shows the variation of thermal conductivity with the volume fractions. It can be revealed that the thermal conductivity of the nanofluid increases with an increase in the concentration of nanoparticles. The thermal conductivity of nanofluid with 1% of nano particle concentration is 21% more than thermal conductivity of pure water. Many researchers have attributed this drastic increase in thermal conductivity due to the Brownian motion of nanoparticles figure 3 shows the influence of volume concentration on the viscosity of the nanofluid. It can be seen that as the volume concentration of the nanoparticle increases viscosity also increase. This can be attributed to the fact that an increase in particle concentration means that the particles are more closely packed, thereby increasing the particle-particle interactions. This leads to an increase in resistance to flow. When the volume concentration was increased from 0 to 1% the viscosity was increased by 19%.

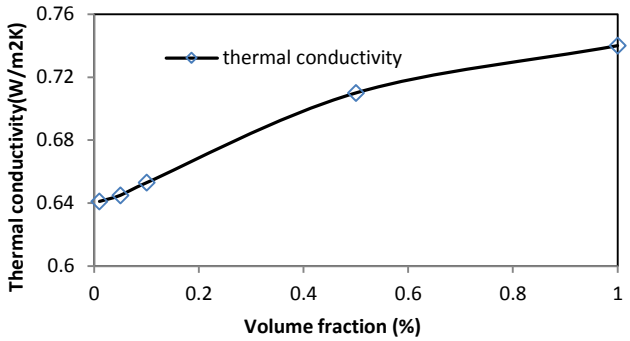

Fig 2. Variation of thermal conductivity of the nanofluid with volume concentration of the nanoparticles

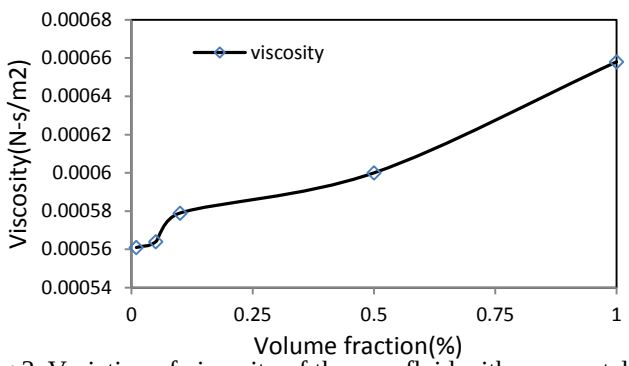

Fig 3. Variation of viscosity of the nanofluid with nanopartcle concentration of the nanoparticles

4. Results and Discussions

Experiments were conducted using water and Al_2O_3 based nanofluids for different mass flow rates and different volume fractions as discussed in section 2. The following relations were used to determine the heat transfer coefficient and heat transfer rate.

$$\text{Reynold's No. } Re_{nf} = \frac{4\times m_h}{\mu_{nf}((\pi d_i))} \text{----------(5)}$$

$$\text{Prandtl No. } Pr_{nf} = \frac{\mu nf \times Cpnf}{keq} \text{----------(6)}$$

$$\text{Nusselt No. } Nu_{nf} = 0.021 \times Re_{nf}^{0.8} \times Pr_{nf}^{0.4} \text{---(7)} \quad [5]$$

$$\text{Heat transfer coefficient } h_i = \frac{Nu_{nf} \times k_{eq}}{D_h} \text{----------(8)}$$

Difference between the outlet and inlet temperature of the cold fluid was plotted against the mass flow rates and is shown in the fig 4. Cold water and hot water inlet temperatures were kept constant and also mass flow rate of cold water remained constant. It shows that as the mass flow rate of hot water increases, ΔT of the cold water increases showing increased heat transfer. ΔT in case of nanofluids is higher than the pure water showing the increased heat transfer capability with nanofluids. As volume fraction increased ΔT further increased showing increase in heat transfer rate with the increase in nanoparticle concentration in base fluid.

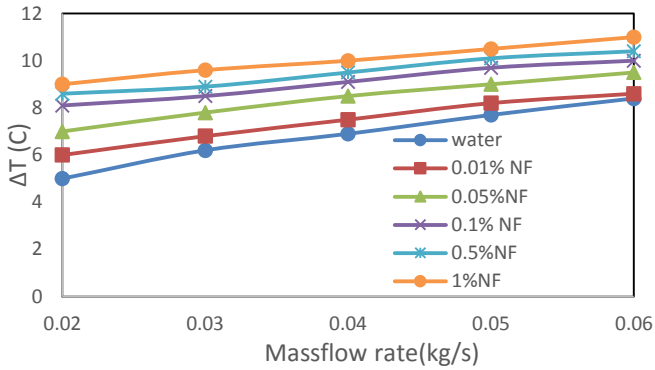

fig 4. Variation of ΔT with mass flow rates for water and nanofluid

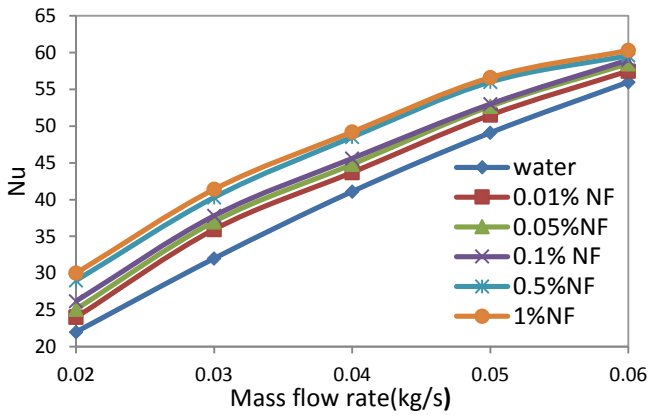

Figure 5. Variation of NU with mass flow rates for water nanofluid

Figure 5 shows the variation of Nu with mass flow rates for both water and nanofluids. It can be observed that as mass flow rate is increased Nu increases for both water and for nanofluids. Nu is higher for nanofluids than water for all mass flow rates. Due to the random motion of the Al_2O_3 particles in water the effective thermal conductivity increases and hence thermal boundary layer will be reduced which may be responsible for the increase in Nu. As mass flow rate is increased fluid turbulence in addition to Brownian motion of the suspended nanoparticles will cause the thermal layer to further decrease there by increasing Nu. Figure 6 shows the Nu variation with the volume fractions. Initially for lower volume fractions there is a rapid increase in Nu and it becomes steady for higher volume fractions. On increasing the volume concentration from 0.5% to 1% increase in Nu was very marginal. For higher volume fractions even though the thermal conductivity increases, viscosity of the nanofluid also increases which negates the earlier effect and hence thermal boundary layer will be increased which reduces Nu and heat transfer rate. Hence there lies an optimum volume fraction of nanoparticles to be added to base fluid which will gives maximum improvement in heat transfer characteristics.

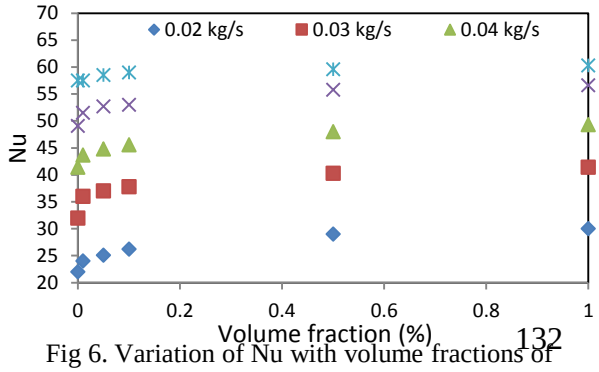

Fig 6. Variation of Nu with volume fractions of nanofluid

It can be observed from the figure 7 that Al_2O_3 based nanofluids exhibit higher value of heat transfer coefficient than water for all mass flow rates. For 1% volume fraction of nanofluids the heat transfer coefficient was increased by 19.3% for 0.06 kg/s when compared with water. Again the reason may be nanofluid containing suspended particles will increase the thermal conductivity of the nanofluid. Amorphous movement of nano particles in the base fluid results in high energy exchange and hence increase in heat transfer coefficient.

Figure 8 shows variation of heat transfer rate with and without nanofluid. It can be seen that nanofluids show better heat transfer rate when compared with water. Heat transfer rate was increased by 2.4, 13.2, 19.1, 26.7 and 31.05 % for 0.01, 0.05, 0.1, 0.5 and 1 % by volume fraction respectively of the nanoparticles when measured at 0.06 kg/s. Higher thermal conductivity and random motion of nanoparticles in the base fluid increases the energy transfer and hence decreasing thermal boundary layer may be the reason for increase in heat transfer rate. As the volume fraction was increased increase in thermal conductivity is negated by the increase in viscosity and this results in decrease of heat transfer rate as can be seen from the figure that when the volume fraction was increased from 0.5 tt 1 % heat transfer rate was increased by only 13%

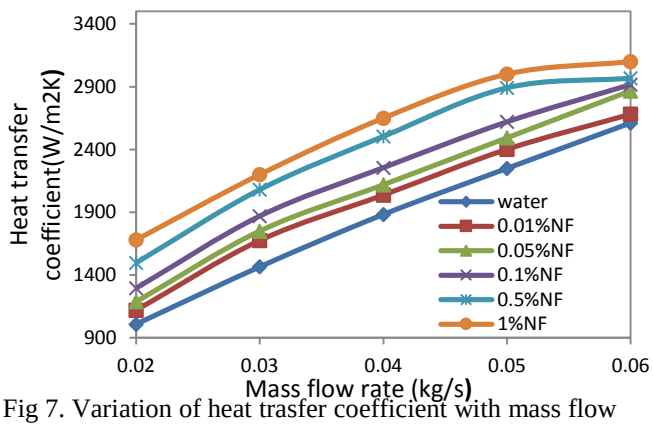

Fig 7. Variation of heat trasfer coefficient with mass flow rates of nanofluid

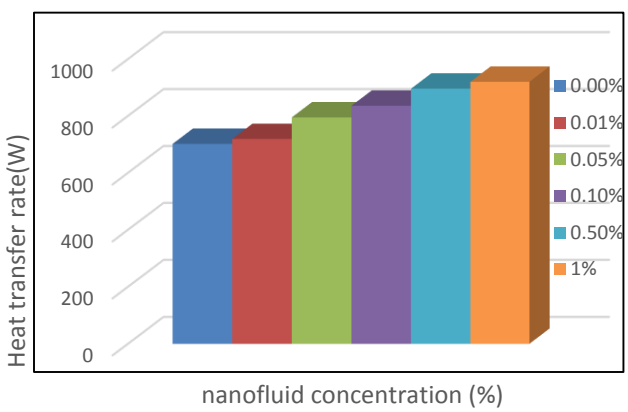

Fig 8. Variation of heat transfer rate for nanofluid for different volume concentratios at 0.06 kg/s

Conclusions

In the present study Al_2O_3 based nanofluid was used in a double pipe heat exchanger. Experiments were conducted using water and nanofluid under counter flow conditions for different mass flow rates and by using different volume fractions. Results indicated that Nu, hi and the heat transfer rates were higher for nanofluids than water. Heat transfer rate was increased by 2.4, 13.2, 19.1, 26.7 and 31.05 % for 0.01, 0.05, 0.1, 0.5 and 1 % by volume fraction respectively of the nanoparticles when measured at 0.06 kg/s showing the improvement in heat transfer characteristics using nanofluids. Hence it can be concluded that nanofluids can become an ideal choice for cooling/heating liquids when the heat transfer characteristics have to be improved in a double pipe heat exchanger.

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Nomenclature

Nu	Nusselt number
P_{nf}	Density of the nanofluid
Φ	Volume fraction of the nanoparticles
ρ_f	Density of the base fluid
ρ_p	Density of the nanoparticle
Cp_s	Specific heat of nanoparticle
Cp_{nf}	Specific heat of the nanofluid
μ_{nf}	Viscosity of nanofluid
μ_{bf}	Viscosity of base fluid
K_{eq}	Thermal conductivity of nanofluid
K_{bf}	Thermal conductivity of base fluid
K_s	Thermal conductivity of nanoparticle
Re_{nf}	Reynolds number of nanofluid
$Pr_{n\,f}$	prandtl number of the nanofluid
D_h	Hydraulic diameter.

Game Theory in the Context of Globalization

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ABSTRACT

The game theory is a body of theories that is usually applied to the study of decision making process in opposing situations. This kind of a situation arises when two individuals having different objectives act on the same system or share a common resource. It basically examines the strategic interactions between two or more agents.

The term globalization has been increasingly used since the mid-1980s and especially since the mid-1990s. In its simplistic sense, it refers to the widening, deepening and speeding up of global inter connection, and it is the increasing interdependence, integration and interaction among people and corporations in disparate locations around the world.

This paper examine globalisation using the game theory, and the researcher discovers that globalisation has been a Zero sum game where whatever one person gains, another loses, The evidence provided shows that developing countries were at the losing end of the zero-sum game, the paper concludes that there can be win-win, instead of win-lose situations. People or countries may equally benefit without losing. Usually, however, diplomacy comes down to compromise, both parties giving up something to gain something. It therefore advises that if globalization is to succeed, it must succeed for the poor and rich alike.

Keywords: Globalization, Game theory. Zero sum.

INTRODUCTION

Game theory is concerned with the decision-making process in situations where outcomes depend upon choices made by one or more players. The word "game" is not

used in the conventional sense but describes any situation involving positive or negative outcomes determined by the players' choices and, in some cases, chance. There are various aspects of the game theory, for example, the prisoner's dilemma, the game of chicken, the non zero sum game etc, however the branch of game theory that better represents these dynamics of the world as described above is called the theory of zero-sum games.

As stated earlier, one of the concerns of this paper is to adjudge or test the relevance of the game theory in the contemporary globalisation era. The key questions on this paper are, should government turn back the clock and block globalization? How do we take some of the values that globalization creates and use it to ease the transition for the losers even though their losses are outweighed by the gains of the winners?

OVERVIEW OF GAME THEORY

The Game theory first addressed zero sum games, such that one person's gains exactly equal net losses of the other participant or participants. Today, however, game theory applies to a wide range of behavioural relations, and has developed into an umbrella term for the logical side of decision science, including both humans and non-humans. The game theories that are discussed in this paper are the prisoners' dilemma, the game of chicken and the Zero-sum and the Non Zero-sum game.

THE PRISONERS' DILEMMA

The prisoners' dilemma is the best-known game of strategy in social science. It helps us understand what governs the balance between cooperation and competition in

business, in politics, and in social settings. It is a canonical example of a game analyzed in game theory that shows why two purely "rational" individuals might not cooperate, even if it appears that it is in their best interests to do so.

THE GAME OF CHICKEN

The game of chicken is an influential model of conflict for two players in game theory. The principle of the game is that while each player prefers not to yield to the other, the worst possible outcome occurs when both players do not yield. Because the loss of swerving is so trivial compared to the crash that occurs if nobody swerves, the reasonable strategy would seem to be to swerve before a crash is likely. Yet, knowing this, if one believes one's opponent to be reasonable, one may well decide not to swerve at all, in the belief that he will be reasonable and decide to swerve, leaving the other player the winner.

NON ZERO SUM GAME

Non-zero-sum games differ from zero-sum games in that there is no universally accepted solution. That is, there is no single optimal strategy that is preferable to all others, nor is there a predictable outcome. Non-zero-sum games are also non-strictly competitive, as opposed to the completely competitive zero-sum games, because such games generally have both competitive and cooperative elements. Players engaged in a non-zero sum conflict have some complementary interests and some interests that are completely opposed.

ZEROSUM GAME

This is a term used in game theory to describe both real games and situations of all kinds, usually between two players or participants, where the gain of one player is offset by the loss of another player, equalling the sum of zero. For instance, if a person plays

a single game of chess with someone else, one person will lose and one person will win. The win of one unit (+1) added to the loss of one unit (-1) equals zero.

APPLICATION OF GAME THEORY TO THE CONCEPT OF GLOBALIZATION

According to Tony Blair (2008) “globalisation” is a *good* buzzword. It implies a coming together, an understanding and a new inter-dependency. It inspires confidence in our generation’s way of doing things. It suggests progress, understanding, empathy, tolerance and respect through shared **values**. But in that it may hide a multitude of sins and unsuccessful globalisation means conflict.

Ghosh (as cited in Aghara and Ajisebiyawo, (2013) stated that the modern version of globalisation “is an attempt to wily-nilly integrate the less developed countries into the frame work of capitalism, to make them more dependent and to subject them to unequal competition . Because it is through this process that these countries can be exploited and substantial amount of surplus can be extracted from them’’ Globalisation has made more porous borders of the dependent nations while making their own selectively open through high standardisation of consumer goods, standards that render finished goods from dependent nations as inferior and therefore unable to compete with similar goods from the western nations. Some theorists also view the notion of globalisation from the prospective of exploitation and unequal development among the world society.

The underlying premise behind globalization is that the transfer of wealth from the developed countries to the developing countries would eventually result in a scenario where those at the bottom of the ladder in the developing countries would benefit from

the wealth flowing into their economies. (Steger 2009). The theory behind this is that if a Billion Dollars were invested in a country X, it would result in setting up of a manufacturing plant or a service sector company, which in turn would create jobs for the locals. Even after assuming that the jobs would increase the opportunities for the locals, there would be trickle down effects wherein the new rise in incomes of these members of the workforce would be spent on consumer durables, houses, visits to hotels and malls, as well as employing those who are not part of the formal economy like launderers, security guards, domestic helps etc. This is the trickledown theory, which posits the view that wealth created at the top trickles down to the bottom of the ladder. (Zgurovsky 2007).

True growth manifests when all sections of the society benefit and not only those at the top and according to Stiglitz and Charlton(2006) there can be a fair trade in which rich nations are obligated to open their markets to poorer nations, while the poorer nations enjoy the privilege of protecting their markets against the rich. This is because rich nations can adapt much more effectively to the competition unleashed by free trade. 'The theory is that the winners compensate the losers.

Stiglitz (2006) states that the benefits of globalisation are unevenly spread - and politicians haven't helped themselves by failing to manage the process. 'What is going on is a reflection of the fact that those who preached globalisation clearly didn't fully understand what was entailed; and in not understanding that, they oversold it, and they didn't fully prepare for the adverse effects and we are reaching a situation where the downsides of globalisation are apparent to lots of people, and the upsides are less

apparent - and people who previously regarded themselves as the winners are now losers,' Krugman,(2009).

Other factors argued against globalisation include labour and employment, where developing countries where forced to reduce minimum wages because MNCs often invested in countries where they could exploit the lowest manufacturing costs. The opinion on the effects of globalisation soon turned from excitement to ardent criticism.Various theories proved that relationship between globalisation and development has turned out to be a cliché of uncertainty. For example in theory, globalisation created opportunities for increased exports and job expansion but in reality, the developing countries competing for foreign investors offered long tax holidays and costly subsidies which reduced the positive net effects of globalisation,

CONCLUSION

The paper concludes that globalization is a kind of zero-sum game where a few individuals or nations gain at the expense of others. The evidence provided shows that developing countries were at the losing end of the zero-sum game. Since globalisation is a given, he suggests we need to ***shape it*** to serve us to the betterment of all, or at least most of us. If there is a lesson for all of us in this experience, it is that we should open our doors to the winds from all countries but we should refuse to be swept away by them. Hence, while welcoming globalization, we should also insulate ourselves from the pernicious aspects of the phenomenon.

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Mediating Role of Engagement between Total Rewards and Job Satisfaction among Employees of Indian Public Sector Banks

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Abstract

The concept of total rewards is being increasingly recognized as an innovative management practice. Rewards systems play a crucial role in determining an organization's ability to attract and retain high performers, and can lead to job satisfaction. Our objective in this paper is to examine whether reward systems influence job satisfaction via the mediating role of work engagement, through an empirical investigation of employees of public sector banks in India with a structured questionnaire. Analysis of data on a sample of 704 reveals that the relationship between total rewards and job satisfaction becomes smaller but significant when work engagement is controlled, implying partial support to the proposed mediation hypothesis. Our findings suggest that organizations should implement total rewards programmes to engage employees as well as to satisfy them. This may produce positive results at individual as well as organizational levels.

Keywords: *total rewards, work engagement, job satisfaction, mediation, public sector banks*

Introduction

Challenges put up by uncertain economic conditions are directing organizations to devise new HR practices that would help facilitate positive work-related outcomes like retaining and engaging workforce. Management practices promoting greater involvement of workers in decision-making, flexible pay, teamwork and training incentives are some interventions adopted by organizations in this context (Brun and Dugas 2008). Of these, rewards systems have a critical role in determining an organization's ability to attract high potential candidates and to retain high performing employees (Fay and Thompson 2001).

Our objective in this paper is to examine whether reward systems influence job satisfaction of employees via work engagement, by an empirical investigation of employees of public sector banks (PSBs) in India. In the following few sections we discuss the concepts of work engagement, total rewards, job satisfaction and linkages between these three constructs. Research plan and analysis of findings follow, subsequent to which we have elaborated on managerial implications of the results obtained. The paper concludes with limitations of the study and scope for further research.

Work Engagement

Engagement has become a popular term in the areas of positive psychology and positive organizational behaviour. Burnout researchers consider engagement as an opposite concept to burnout, conceptualized as high energy, involvement and efficacy (Leiter and Maslach 2001). As per this approach, engagement is defined as "a persistent, positive affective-motivational state of fulfilment in employees that is characterized by high levels of activation and pleasure" (Maslach,

Schaufeli and Leiter 2001, p. 417). Schaufeli et al. (2002) have considered work engagement as "a positive, fulfilling, work-related state of mind" (p. 74).

Total Rewards

Total rewards include "all types of rewards indirect as well as direct, and intrinsic as well as extrinsic" (Manus and Graham, 2003 cited from Armstrong and Stephens 2005, p. 13). It encompasses not only traditional and quantifiable elements like salary, variable pay and benefits, but also more intangible non-monetary elements such as scope to achieve, exercise of responsibility, career opportunity, learning and development, intrinsic motivation provided by work itself and quality of working life provided by an organization (Thompson 2002). Each aspect of reward, namely base pay, contingent pay, employee benefits and non-financial rewards, which include intrinsic rewards from the work itself, are linked together and treated as an integrated whole (Armstrong and Stephens 2005).

Total Rewards and Engagement

Total rewards, combining aspects of intrinsic and extrinsic rewards, has more influence on individual and organization rather than single reward system (Armstrong and Stephens 2005). "Total rewards' systems should also be more appealing to individuals than single reward practices because individual needs can more flexibly be met with total rewards' practices" (Hulkk o-Nyman et al. 2012, p. 27). However, the relationship between total rewards and engagement is less studied (Hulkk o-Nyman et al. 2012). In their study of employees of elder-care organizations in Finland and Italy, Hulkk o-Nyman et al. (2012) have established that total rewards system significantly explains work engagement dimensions. Sarti, Cavaliere and Hulkk o-Nyman (2011) have also provided similar empirical evidence in a sample of employees of people-care organizations in Tuscany. More recently Hotz (2015) has found total rewards as a significant predictor of work engagement in a random sample of South African employees. On the basis of findings of previous research we hypothesize that:

H1: Total rewards would be positively related with work engagement.

Work Engagement and Job Satisfaction

Being an individual-level construct, engagement is expected to be related to employees' intentions, behaviours and attitudes. The term 'employee engagement' refers to an individual's involvement and satisfaction with as well as enthusiasm for work, and employee satisfaction and engagement lead to significant business outcomes (Harter, Schmidt and Hayes 2002). Since work engagement is defined as a positive emotional state, we expect it to be positively correlated to job satisfaction. Several empirical studies have established the positive relation between engagement and job satisfaction (e.g., Harter, Schmidt and Hayes 2002; Saks 2006). Hence we hypothesize that:

H2: Work engagement would be positively related with job satisfaction.

Total Rewards and Job Satisfaction

The exact relation between total rewards and job satisfaction is yet not explored extensively. However, some studies have tested the link of rewards and recognition with job satisfaction and reported a positive association between them. For instance, Danish and Usman (2010) have found that rewards and recognition is positively related to job satisfaction. Similarly, De Gieter et al. (2008) have studied the relationship of intrinsic and extrinsic rewards with job satisfaction and reported positive connection between these constructs. Armstrong (2006) has argued that

reward programmes may logically serve as motivators in shaping behaviour of employees. In line with the above discussion we have framed our next hypothesis as:
H3: Total rewards would be positively related with job satisfaction.

Mediating Role of Engagement between Total Rewards and Job Satisfaction

We hypothesize that total rewards may be instrumental in increasing job satisfaction via engaging employees. We have also received support from literature for this hypothesis. Though some studies (e.g., Saks 2006; Andrew and Sofian 2012) have used rewards and recognition instead of total rewards in the proposed mechanism, we assume that total rewards system influences job satisfaction, and that this relationship is mediated by work engagement. Further, our previously framed hypotheses also provide support to test the mediation results, as these hypotheses are in line with the conditions laid down by Baron and Kenney (1986). The mediating hypothesis has accordingly been framed as:
H4: Work engagement mediates the relationship between total rewards and job satisfaction.

The model framed for testing this hypothesis has been depicted in Figure 1.

Figure 1: Research Model

Method

A survey was conducted across 27 public sector banks of India. Data was collected through a structured questionnaire that had two sections: the first asked for demographic information (i.e., age, gender and tenure of service) from respondents, whereas the second section was related with study variables. The questionnaire was distributed to 800 Scale-I bank employees. However, 96 had some missing data and hence were rejected. The final number of responses considered for analysis was 704.

Demographic data in Table 1 show almost balanced representation of gender (male at 53.2 per cent). The age group '30-45 years' exhibited the highest presentation (40.5 per cent), followed by 'less than 30 years' (35.5 per cent). In terms of length of service, the shortest tenure was of less than a year (14.0 per cent) and the longest was of 1-3 years (30.8 per cent).

Table 1: Demographic Profile of Respondents

	Per cent (%)
Gender	
Male	53.2
Female	46.8
Age	
Less than 30 years	35.5
30-45 years	40.5
More than 45 years	24.0
Length of Service with Bank	
Less than 1 year	14.0
1-3 years	30.8
4-6 years	29.7
More than 6 years	25.5

Measures

Total Rewards: The nine-item Total Reward Scale by Hulkk o-Nyman et al. (2012) was used to measure this variable. The scale included items related with monetary rewards (first item), material rewards (second item) and non-monetary rewards (last three items).

Work Engagement: The nine-item revised short version of the Utrecht Work Engagement Scale developed by Schaufeli, Bakker and Salanova (2006) measuring engagement on three dimensions (i.e., vigour, dedication and absorption) was adapted for this construct. Anchors of the Likert scale were based on agreement instead of frequency-based original anchors.

Job Satisfaction: The three-item scale developed by Cammann et al. (1983) was adapted to measure job satisfaction. This scale has been commonly used in engagement-related studies.

Results

Table 2 shows the means, standard deviations and correlations among the variables. *Total rewards* as a variable *is* significantly related with *work engagement* (0.679, $p < 0.01$) and *job satisfaction* (0.574, $p<0.01$). Another significant correlation is between *work engagement* and *job satisfaction* (0.598, $p < 0.01$). These values provide initial support to our hypotheses.

Table 2: Mean, Standard Deviation and Correlation

	Mean	SD	Total Rewards	Work Engagement	Job Satisfaction
Total Rewards	3.3922	.66592			
Work Engagement	3.7301	.62594	.679**		
Job Satisfaction	3.1108	.70607	.574**	.598**	
**: Correlation is significant at 0.01 level (2-tailed)					

Hypotheses drawn above are the basis for a simple mediation model, wherein the relationship between *total rewards* and *job satisfaction* is mediated by *work engagement*. To test the hypothesized mediation model, we have followed the traditional four-step approach proposed by Baron and Kenny (1986).

Table 3 presents the results of all the hypotheses. Hypothesis 1 states that *total rewards* variable is positively related to *work engagement*. Table 3 shows that *total rewards* has a positive and significant effect on *work engagement* ('a' path: B=.639, SE=.026, β=.679, t=24.537, $p<0.01$), thus supporting Hypothesis 1. Hypothesis 2 was also supported by a positive and significant effect of *work engagement* on *job satisfaction* ('b' path: B=.436, SE=.045, β=.386, t=9.777, $p<0.01$). According to Hypothesis 3, *work engagement* mediates the positive relationship between *total rewards* and *job satisfaction*. Table 3 illustrates that all of Baron and Kenny's (1986) requirements for partial mediation were fulfilled. Specifically, total effect of *total rewards* on *job satisfaction* is positive and significant ('c' path: B=.609, SE=.033, β=.574, t=18.592, $p<0.01$), fulfilling the requirement of Step 1. *Total rewards* was significantly related to *work engagement* ('a' path), and *work engagement* was significantly related to *job satisfaction* ('b' path), fulfilling the requirements of steps 2 and 3. Finally, the relationship between *total rewards* and *job satisfaction* has become smaller but significant when *work engagement* was

controlled. Hence we have concluded the analysis with partial support to the proposed mediation hypothesis.

Table 3: Results of Mediation Analysis

	B	SE	β	t	p
Direct and total effects					
Total rewards regressed on *job satisfaction* ('c' path):	.609	.033	.574	18.592	.000
Total rewards regressed on *work engagement* ('a' path):	.639	.026	.679	24.537	.000
Work engagement regressed on *job satisfaction*, controlling for *total rewards* ('b' path):	.436	.045	.386	9.777	.000
Total rewards regressed on *job satisfaction*, controlling for *work engagement* ('c'' path)	.331	.042	.312	7.888	.000
Model summary for DV model					
R^2	Adjusted R^2		F	p	
.410	.409		243.921	.000	

Discussion

The main objective of this paper was to investigate whether work engagement mediates the relationship between total rewards and job satisfaction among employees of Indian public sector banks. The results concerning *H1* reflect that total rewards system positively and significantly predicts work engagement. This finding is coherent with prior studies that have established the positive relation of rewards and recognition components (e.g., Saks 2006; Mohapatra and Sharma 2010) with work engagement. It also contributes to the less studied area of total rewards and work engagement. We have also found support for *H2* from the results, which have established a positive relation between work engagement and job satisfaction. This finding is in consonance with previous literature (e.g., Saks 2006; Andrew and Sofian 2012) as well. Another significant finding is the positive and significant association between total rewards and job satisfaction. We have found partial support for our hypothesis on mediating role of work engagement between total rewards and job satisfaction. Work engagement as a mediator explains the underlying mechanism between total rewards and job satisfaction. Overall, our study establishes that job satisfaction may develop among employees through engaging them by offering suitable total rewards.

Practical Implications of the Study

The concept of total rewards is being increasingly acknowledged as innovative as a management practice and is gaining popularity in academia and organizations. Even though its relationship with engagement and other work-related outcomes is less explored, organizations are looking for strategic ways to approach the practice. Our findings suggest that organizations should implement total rewards programmes to engage employees as well as to satisfy them. In other words, total rewards may be an important way to satisfy employees via engagement.

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Aging and Mechanical Characteristics of Precipitation Hardening Stir cast Al6061 Hybrid Composite

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Abstract

This paper is an attempt to find the age hardening characteristics and tensile properties of Al6061 hybrid composites reinforced with 2 & 4% by wt. of SiC particulate and 2% by wt. of B_4C particulate subjected to different aging cycle. Two step stir casting technique is adopted for fabrication of composites. The size of particulates used in the study is 35 µm. The cast matrix alloy and its composite have been subjected to solutionising treatment at a temperature of 558° C for 2 h followed by water quenching. The quenched samples are subjected to artificial aging at temperatures of 100, 150 & 200°C. Scanning Electron Microscope images show homogeneous dispersion of SiC & B_4C particles in the matrix. Hardness & tensile strength have improved with increase in wt. % of reinforcement. An attempt is made to find out the Intermetallic phase responsible for strengthening by Transmission Electron Microscopy. Due to positive response to age hardening treatment there is an improvement in the mechanical properties of Al6061 alloy & its hybrid composite, i.e. increase in hardness & tensile strength. It is also observed that there is a provision to alter the mechanical properties to a greater extent and better properties can be obtained by aging at lower temperatures. The fracture surface of the tensile specimen is analyzed to reveal the probable mode of failure by Scanning Electron Microscopy. The aging kinetics is more accelerated in case of hybrid composites as compared to unreinforced Al6061 alloy because of presence of reinforcement particulate, which act as nucleation site for precipitation.

Keywords: *Al6061, Silicon Carbide, Boron Carbide, Age Hardening, intermetallic*

1. Introduction

Aluminium metal matrix composites have been developed to respond the demand for lighter materials with specific strength, stiffness and wear resistance. Aluminium is preferred as a matrix material in Metal Matrix Composites (MMCs) because of its low density, easy fabricability, and good engineering properties. Among the series of aluminium alloys, heat treatable Al6061 and Al7075 have been much explored. Al6061 alloy is highly corrosion resistant and exhibits moderate strength and finds many applications in the construction, automotive and marine fields. Particulate reinforced aluminium metal matrix composites are attractive MMC material due to their high strength, ductility & toughness and good tribological properties for use in automotive & aerospace applications [1].

The Al matrix composite reinforced with SiC and B_4C particulates are new range of advanced materials, which have found vast application because of their technological importance and their exceptional increase in strength obtained by age hardening. SiC particles can be used as reinforcement in the form of particulates to improve the properties of composites. It improves overall strength of composites along with wear and corrosion resistance [2]. B_4C has low density, high hardness, high thermal stability, & chemical inertness. It has been reported that B_4C reinforced Al composite seemed to exhibit a better interfacial bonding as compared to the Al-SiC &Al-Al_2O3 composites [3]. L. Poovazhagan *et al* [4] reported that addition of SiC & B_4C resulted in increase in hardness & better tensile properties. Addition of B_4C particles increases the hardness & tensile strength as compared to unreinforced alloy because of presence of harder ceramic particles [5, 6]. V.C. Uvaraja and N. Natarajan [7] found increase in hardness value in case of Al6061-SiC-B_4C with increase in filler content.

Kulkarni *et al* [8] investigated the effect of particle size distribution on strength of precipitation-hardened alloys. Overageing of precipitation hardened alloys results in particle coarsening, which in turn affects the strength. S. Rajasekaran *et al* [9] observed that at peak aging needle shaped & rod shaped intermediate phase was found which was responsible for higher hardness in case of Al6061-SiC composites. T.G. Nieh *et al* & R. Ehsani *et al* [10,11] reported that B_4C accelerates the aging response at low temperature due to high dislocation density which enhances the nucleation rate & also diffusion rate. Chee Fai Tan and Mohamad R. Said [12] investigated presence of hardenable precipitates in the form of small plate shape in case of Al6061 unreinforced alloy. H.K. Ahn and C.H. Yu [13] and M. Abdel Aziz *et al.* [14] found that aging mechanism is more accelerated in composites with higher volume fraction due to presence of more SiC particulate, which acts as nucleation sites.

2. Experimental Procedure

2.1. Material and Sample Details

The base matrix chosen in the present study is the aluminium 6061 because it is one of the most extensively used 6000 series aluminium alloys. They have high strength to weight ratio, good formability, age hardenability and other appropriate properties. Among

different aluminium alloys, Al6061 has high machinability, high hardness property and also light weight. Table 1 gives the chemical composition of Al6061. The mixture of SiC and B_4C particles are used as the reinforcement material. Varying wt. % of SiC (2 and 4%) and fixed wt. % B_4C (2%) are used in the experiments. Properties of matrix and reinforcements are shown in Table 2.

TABLE 1: NOMINAL COMPOSITION WEIGHT PERCENT OF Al6061 MATRIX MATERIAL

Material	Si	Fe	Cu	Mg	Cr	Al
Wt. % (Actual)	0.52	0.55	0.24	0.95	0.25	Balance
Wt. % (Standard)	0.40 - 0.80	0.70 max	0.15 –0.40	0.80 – 1.20	0.04 – 0.35	Balance

TABLE 2: PROPERTIES OF MATRIX AND REINFORCEMENT

Properties	Al6061	SiC	B_4C
Elastic Modulus (GPa)	70-80	410	480
Density (g/cc)	2.72	3.2	2.5
Poisson's ratio	0.33	0.14	-
Hardness (VHN)	107	2600	3000
Size Range (Average)	-	35µm	35µm

2.2. Processing Methodology

The Al6061 billets were melt in a graphite crucible by electric resistance furnace of 5 kW rating and melting was allowed to progress until a uniform temperature of 750ºC (which is above the liquidus temperature) was attained. Small amount of scum powder is introduced in this stage to remove the slag or flux. The entire melt is then degassed by adding dry hexa-chloro-ethane tablet weighing 10 grams (C_2Cl_6) [15]. The SiC particles are preheated for 800ºC and B_4C for 200 ºC with a time duration of 2h in order to remove the volatile substances.Also, in SiC particles, preheating leads to the artificial oxidation by altering the surface composition leading to the formation of SiO_2 layer on the surface. Whereas preheating of B_4C leads to the formation of a layer of liquid B_2O_3 on the B_4C particles. This chemical reaction is thermodynamically favored having a negative value of its Gibb's free energy and increasing the adhesion work. which results in improving the wettability of the particles [15-17]. The melt was then allowed to cool for 600 ºC (slightly below the liquidus temperature) to a semi-solid state. At this stage, preheated silicon carbide mixture in varying %wt. (2, 4 and 6) was poured in the vortex resulting due to stirring. A mild steel stirrer with axis in vertical position was utilised. The speed of stirring was kept in the range 150-200 rpm and mixing is done for 10 min. to permit for better dispersion of the silicon carbide in the molten alloy. While stirring, pieces of Mg (1% wt.) are added to the melt to enhance the wettability of silicon carbide particles with the alloy melt [18]. An external temperature probe was utilized in all cases to monitor the temperature readings of the furnace. After mixing the reinforcements in semisolid state, the composite slurry was reheated and maintained at a temperature of 750ºC $\pm$10ºC (above the liquidus temperature) and once again stirring operation was performed for 10 minutes at an average stirring rate of 400rpm. The melt was poured in the cast iron molds, which are preheated to 500ºC. Al6061-SiC–B_4C hybrid composites were fabricated by altering the amount of silicon carbide particles in the range 2-4 wt.% and fixed wt.% of boron cardbide (2% wt.). The melt is allowed to solidify in air for 2h. The cast composites prepared for different mechanical tests are shown in Figure 1.

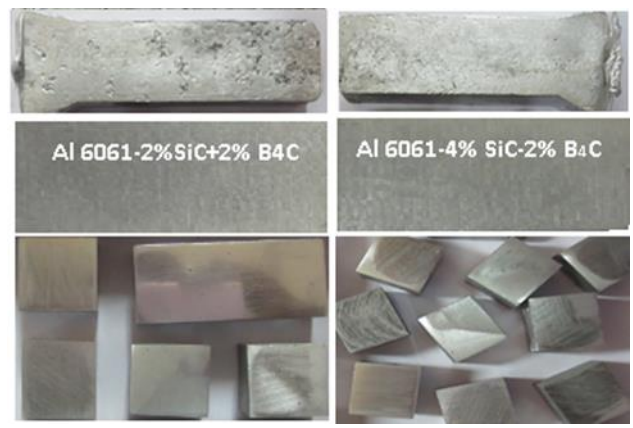


Figure 1. As cast Al6061-SiC-B_4C hybrid composites

2.3 Density measurement

The density measurements are carried out to determine the porosity levels of the samples. This is done by comparing the experimental and theoretical density values of each volume percent SiC and B_4C reinforced composites. The theoretical density is calculated using the rule of mixtures given by [19]:

$$\rho_{Al6061\text{-}SiC\text{-}B4C} = Vol_{f\ Al6061} \times \rho_{Al6061} + Vol_{f\ SiC} \times \rho_{SiC} + Vol_{f\ B4C} \times \rho_{B4C} \quad (1)$$

Where, $\rho_{Al6061\text{-}SiC\text{-}B4C}$ = Density of composite

$\rho_{Al\ 6061}$ = Density of Al6061 (2.72g/cc)

ρ_{SiC} = Density of SiC (3.2g/cc)

ρ_{B4C} = Density of B_4C (2.5g/cc)

$Vol_{f\ Al6061}$ = Volume fraction of Al6061

$Vol_{f\ SiC}$ = Volume fraction of Silicon Carbide

$Vol_{f\ B4C}$ = Volume fraction of Boron Carbide

The experimental values are calculated by weighing the sample and dividing it by volume of respective samples. Samples of 15mm diameter and 20 mm height are prepared and volume is calculated. The experimental density value is calculated as follows:

ρ_{Exp} = Weight of sample/ volume of sample

The porosity percentage is given by:

$$\% \text{ Porosity} = [(\rho_T - \rho_{Exp}) / \rho_T] \times 100\% \quad (2)$$

Where, ρ_T = Theoretical Density

ρ_{Exp} = Experimental Density

2.4 Age hardening/ Precipitation hardening treatment

The specimen prepared for above test is subjected to age hardening heat treatment. Specimens are soaked at 558^0C for duration of 2h and quenched in water maintained at room temperature. The quenched specimens were artificially aged in the furnace at 100, 150 and 200^0C for various durations of time. According to the Al-Mg-Si phase diagram melting of ternary eutectic Mg_2Si-(Al)-(Mg) phase takes place at 558^0C [20]. The presence of Mg_2Si is a strengthening phase and dissolves completely at 558ºC during solutionizing and precipitates during age hardening to maximize the strengthening effect. These secondary precipitated phases results in particle strengthening and coherency of the crystal structure of the particle and the matrix. It is reported that the samples of Al6061 composites, with the solution heat-treated at 558^0C, exhibit better strength compared to the samples solution treated at 530^0C after aging treatment [9].

2.5 Hardness and Tensile testing

Hardness tests were carried out in a Brinell hardness testing machine with steel ball indenter of diameter 5mm and a load of 250 kgf (SAROJ Brinell Hardness Testing Machine, Model:-B/3000/00, Sl# 13/06/08- India). Specimens of diameter 12 mm and length 15 mm are prepared. In order to eliminate possible segregation effect, the average of a minimum of three indentations readings is taken for each specimen at different locations of the test samples.

Tensile properties dictate how the material will react to forces being applied in tension. Tensile specimen is prepared according to ASTM-E8M standards [21]. Circular cross section specimen with diameter 6 mm and gauge length of 24 mm is prepared. Tensile test is carried out on tensometer. Diameter of specimen is measured using vernier caliper and cross sectional area is calculated. The load cell value is kept to 20.5 kN and test mode is selected as break. The cross head speed is kept constant at value of 10 mm/ min, with length increment value of 0.01 mm. The specimen is fixed firmly in gripper.

3. Results and Discussion

3.1. Microstructure Studies

Figure 2 shows Scanning Electron Microscope (SEM) image of Al6061 base alloy, Al6061 hybrid composite with 2%SiC+2%B_4C and 4%SiC+2%B_4C. In case of hybrid composites it is observed that SiC & B_4C particles are fairly distributed in Al matrix for all wt. % of reinforcements and there are no sign of cluster formation. Also the microstructure does not reveal the existence of the blow holes or air pockets. This can be attributed to effective stirring action and use of appropriate process parameters.

Figure 3 shows Scanning Electron Microscope (SEM) image and Energy Dispersive X-ray (EDX) spectra at compositional results performed on the matrix and reinforcement to ensure that the spots are dispersed SiC and B_4C.

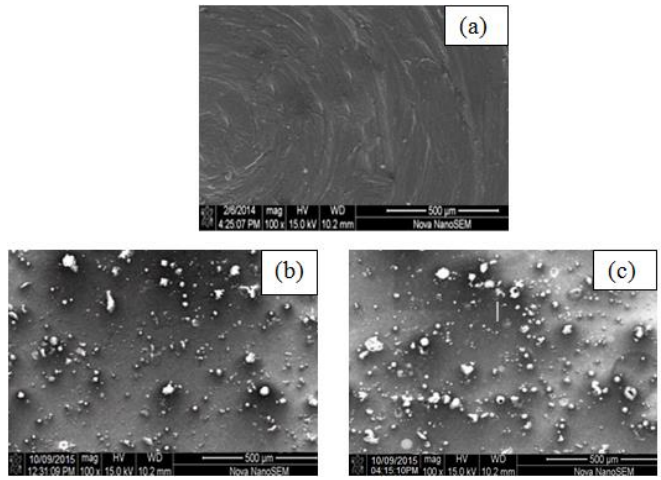


Figure 2: Scanning Electron Micrograph of (a) Al6061 alloy (b) Al6061-2%SiC+2%B_4C (c) Al6061-4%SiC+2%B_4C.

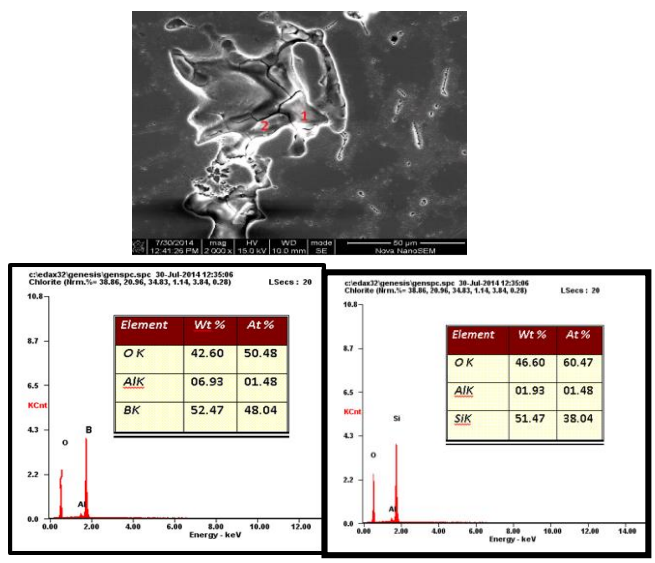


Figure 3: EDX compositional results to ensure that the spots are dispersed SiC and B4C particles.

3.2 Density Measurement

The existence of porosity, its size and distribution in composites play an important role in controlling the mechanical properties. It is thus necessary that porosity levels be kept to minimum to achieve desired high performance in service applications. Porosity in composites results primarily from air bubbles entering the slurry during the stirring period or as air envelopes to the reinforcing particles. Optimum porosity level is also extremely important to increase the nucleation sites to accelerate the aging kinetics. Table 3 represents the comparison of the theoretical and the experimental density values of Al6061 base alloy & hybrid composites, which are utilized to find porosity levels. Figure 4 shows that the experimental, theoretical density values are in line with each other and % of porosity level confirm the suitability of the liquid metallurgy technique for the successful composite preparation.

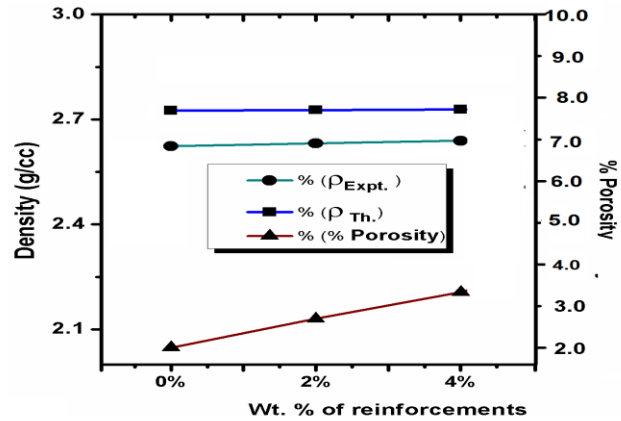
TABLE 3: DENSITY VALUE COMPARISONS

Material	Theoretical Density ρ_T (g/cc)	Experimental Density ρ_{Exp} (g/cc)	% Porosity
Al6061	2.72	2.673	1.72
Al6061-2%SiC +2%B_4C	2.704	2.632	2.66
Al6061-4%SiC +B_4C (2%)	2.716	2.624	3.39

It is observed that for different wt. % of reinforcements, the theoretical and experimental density values are very close. The increase in wt. % of SiC in hybrid composites by maintaining B_4C (wt. %) constant, increases the percentage porosity level in the composites. Percentage porosity also increases the macroscopic defects present in the material, which also contributes to precipitation process. Kok [21]; Prabhu *et al* [22] have reported that porosity levels within the range of 2-4% is acceptable levels in cast composites. This indicates that stir casting technique used to fabricate hybrid composites is highly efficient. The adoption of two stage stirring technique is responsible for the low porosity level & minimal casting defects in the composites produced.

Figure 4: Variation of theoretical, experimental densities and porosity with respect to wt. % of SiC and B_4C reinforcement.

3.3 Aging curve & Hardness test



Both as cast and aged samples were tested to determine the Brinnell Hardness Number (BHN). Graphs are plotted showing the hardness values of all the three aging temperatures against the time for Al6061 alloy and Al6061-SiC-B_4C hybrid composites as shown in Figure 5. Figure 6 shows the peak hardness values obtained in as cast and aging temperatures 100, 150 and 200°C.

In as cast condition it is clear that the hardness values increased with the addition of filler content when compared to the unreinforced alloy. The hardness value found to be increased with increase in weight percentage of reinforcement. The increase in hardness is to be expected since SiC and B_4C particles being a very hard dispersoid contribute positively to the hardness of the hybrid composite. The hardness of as cast Al6061-4 wt. % SiC +2 wt. % B_4C hybrid composite is 74 BHN when compared to 50 BHN of Al6061 alloy. Nearly 50% increase in the hardness value is seen for the hybrid composite. In case of hybrid composites the time to reach peak hardness reduces as the wt.% of reinforcement increases i.e. time to reach peak hardness in Al6061-SiC (4%)-B_4C (2%) is less than Al6061-SiC (2%)-B_4C (2%) because number of dislocations has increased with increase in wt. % of reinforcements. Composites exhibit higher value of hardness as compared to unreinforced Al6061 alloy in as-cast condition or for same aging temperature.

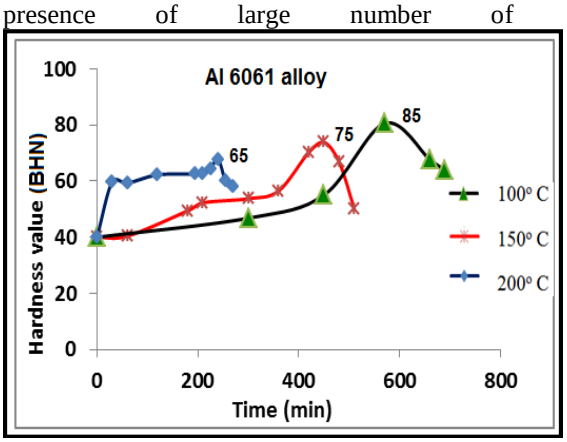
The hardness distribution graphs of age hardened samples in Figures 5(a-c) show gradual increase in hardness with respect to the increase in aging time where the hardness increases, reaches maximum and later decreases.

It is evident that composites exhibit accelerated rate of aging kinetics as compared to unreinforced matrix alloy. Aging kinetics get accelerated in the composites with increase in wt. % of reinforcements. H K Ahn *et. al* [13] have reported that addition of reinforcement up to certain level has no accelerating effect on aging kinetics, but higher addition reduces time to reach peak hardness.

The increased rate of precipitation is due to the increase in nucleation sites for the precipitation.

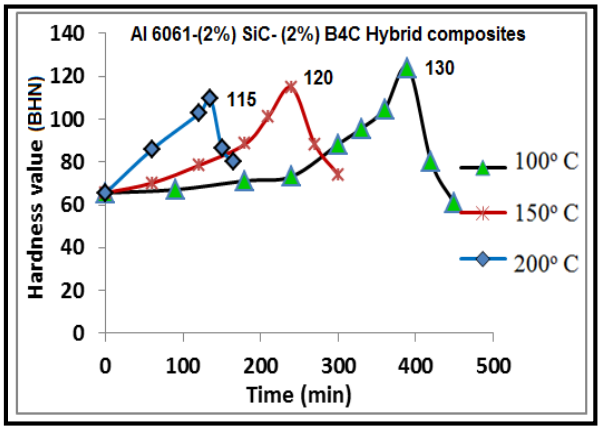
Aging is accelerated because of presence of areas with a high concentration of dislocation close to Al6061 matrix & SiC-B_4C reinforcements interface. These high density locations provide heterogeneous nucleation sites for the precipitation & a high diffusivity path for the diffusion of alloying elements [23]. Lower aging temperature shows increase in hardness of base alloy as well as composites as compared to higher temperature aging. Lower temperature aging contributes to the increased hardness by increasing the number of intermediate zones during precipitation; increase in the number of finer inter-metallic's & decreased interparticle distances. The hardness value decreases after peak aging condition, due to coarsening of precipitates which form during aging and the condition is termed as over aging. Over aging induces softness in the alloy due to which hardness value decrease drastically. The rise of temperature causes the

ageing rate to increase due the enhanced rate of diffusion of solid atom through the matrix. From the above results it can be concluded that heat treatment has a profound influence on the hardness of matrix alloy as well as composites and higher the aging temperature, lower is the time required to attain peak hardness [14]. Figure 7 shows Transmission Electron Microscope (TEM) images of Al6061-4%SiC+2%B_4C hybrid composite samples peak aged at 100ºC. It is known that the presences of β" and β' in Al matrix give rise to streaks and satellite spots in Selected Area Diffraction Pattern (SADP), respectively [24]. However, for high resolution studies of the precipitates show rectangular and round shaped stable intermetallic phases. The round-shape is due to β' which is considered to be rod-like precipitates. According to Gracio J.J et al, [25] the presence of large number of tiny

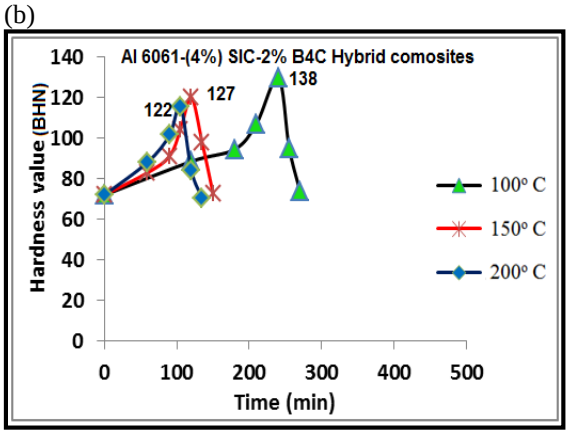


dots in the bright field images represents the β" needles along [001] $_{Al}$.

(a)



(b)



(c)

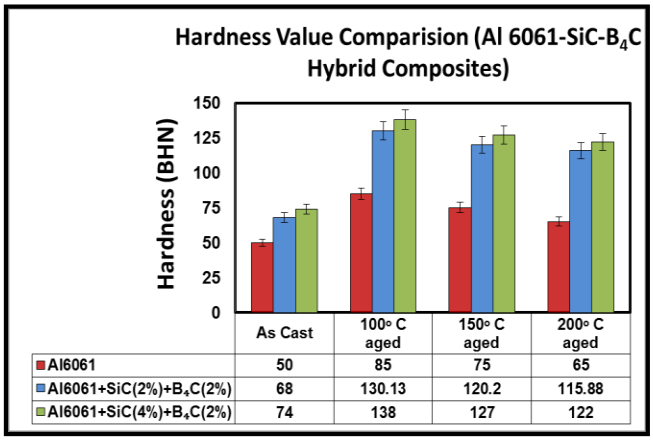
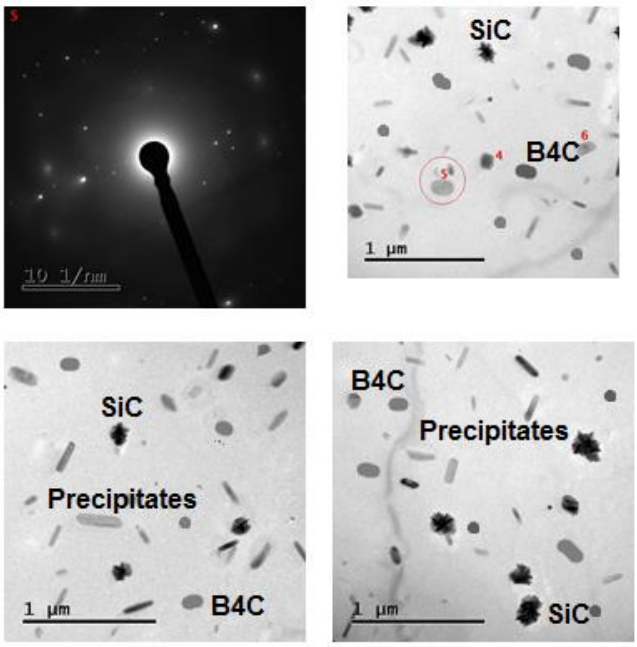


Figure 6:Hardness value comparisons

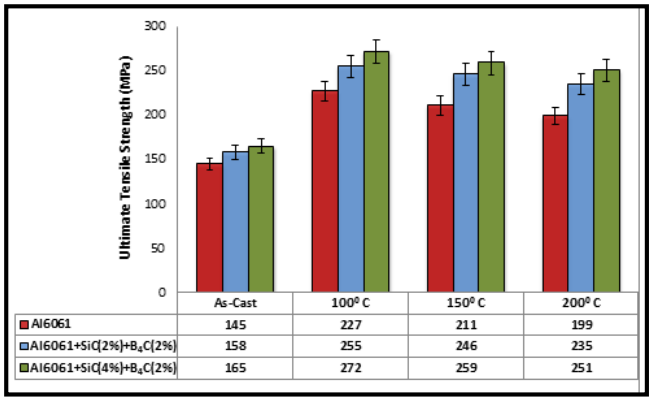
Figure 7: Bright field TEM photographs of Al 6061- 4 wt. %SiC- 2 wt. % B_4C composites aged at 100^0C for 3 h.



3.4 Tensile test

Figure 8 shows the distribution of ultimate tensile strength (UTS) of unreinforced Al6061 alloy and Al6061 alloy reinforced with SiC & B_4C. The age hardening treatment improves UTS substantially. Irrespective of whether base alloy or composites, aging treatment improves UTS. Higher the aging temperature, lower is the UTS value. Heat treated condition disperses the precipitating inter-metallics according to temperature & time of holding. Higher the temperature lesser is the number of inter-metallics that precipitates with few number of intermediate zones and larger average inter particle distance. In all alloy and composites the increment in UTS is small with the decrease in aging temperature. This marked improvement in tensile strength of both Al6061 alloy and its composites on heat treatment can be attributed to larger extent of formation of inter-metallic precipitates which act as the points of obstacles for pinning down the dislocations [4]. This phenomena of multiplication of dislocations curtails the mobility of dislocations, thereby reducing the extent of plastic deformation. This leads to significant improvement in UTS.

Figure 8 Ultimate Tensile Strength for Al6061 alloy and hybrid composites



In as cast condition the UTS value of the hybrid composites are higher than the unreinforced matrix alloy & UTS value increases with increase in wt % of SiC, which can be attributed to the presence of uniform distributed reinforcements. The incorporated reinforcements act as barrier to dislocation movements. The peak aged specimen at 200°C shows no considerable change in UTS with the increase in wt. % SiC beyond 2%. The peak aged specimen at 150°C aging condition shows remarkable improvement in UTS as the wt. % of SiC increases from 2% to 4%. Lower temperature aging shows improvement in UTS by the small addition of SiC to the matrix. This clearly indicates the dependence of reinforcements, SiC & B_4C in the alloy. Higher UTS obtained during controlled aging is due to the synergetic effect of aging kinetics and precipitation phenomena [9].

Conclusion

Al6061 matrix reinforced with SiC (2 & 4% wt.) and B_4C (2% wt.) particles are fabricated by two-step stir casting method. Age hardening heat treatment is carried out for different aging cycles and hardness related properties are evaluated. From the experimental results and analysis following conclusions can be drawn:

- Microstructure studies showed uniform distribution of silicon carbide & boron carbide particulates in Al6061 matrix. It is found that there is no agglomeration of reinforcements in the matrix.
- Porosity percentage level indicates the suitability of the casting method for the composite production.
- Density measurement showed maximum 3-4 % porosity in the case of Al6061-4 wt. % SiC – 2 wt. % B_4C hybrid composites and it is within the permissible limit.

- Hardness increased for hybrid composites in comparison with unreinforced alloy due to presence of harder ceramic particles.
- Aging kinetics is accelerated with the increase in number and wt. % of reinforcements in the composites. The highest hardness and tensile strength is obtained for the specimen with higher wt. % of reinforcements & for low temperature aging condition.
- TEM analysis shows the intermetallic phase precipitated as Mg_2Si.
- In the unreinforced alloy or composites, lower the aging temperature higher is the hardness.
- Tensile properties are improved after addition of reinforcements in comparison to unreinforced Al6061. Tensile strength improved after giving heat treatment to base alloy & hybrid composites.

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Investigating gender differences in secondary mathematics students' achievement in South Maalhosmadulu Atoll in the Maldives

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ABSTRACT

Over the past three decades researchers have opened new windows in understanding female participation in mathematics education. Lower participation of females in mathematics education, its achievement and technology related subjects, are worldwide issues. Some researchers argue that gender differences in mathematics education are due to biological factors. However, others assert that it is due to a complex nexus of factors, such as social, cultural, personal beliefs and self-confidence. This research explored gender differences in International General Certificate of Secondary Education (IGCSE) results of mathematics in one atoll in the Maldives, for which the 2014 results were used. The study also investigated gender differences in mathematics education in different schools of this atoll. A quantitative analysis revealed that boys' participation in the examination was higher than girls in the studied atoll. However, boys were seen to have performed less than girls in mathematics education. Except for school 1 and school 7, mean score for girls were higher than boys in Mathematics. Gender differences in mathematics performance in this atoll was not statistically significant. Also, none of the schools in this study had statistically significant gender differences in mathematics result for the IGCSE mathematics results in 2014. Thus, further research is necessary to confirm an existence of any gender gaps in mathematics education.

Keywords: *Gender, Mathematics, achievement*

INTRODUCTION

Although research on western education has found that girls outperform boys in school achievement, results in subjects such as mathematics are quite the opposite. The lack of contribution of girls in mathematics, science and technical fields is a great concern for researchers and policy makers [***1***]. A number of research projects were carried out and papers were published with regard to differences in achievement of mathematics, girls' lack of interest in mathematics and reasons for not participation in mathematics [***2***], [***3***]. Some researchers argue that mathematics create fear, anxiety and tension in girls [***4***], [***5***], [***6***]. Mathematics is perceived as a male domain while English is seen as a female domain [***7***]. Similarly girls value English more than mathematics and boys, vice-versa [***8***].While Mathematics grades for both girls and boys are alike, and has equal teacher ratings, parents still believe that mathematics is more difficult for daughters than sons [***9***]. Moreover, parents feel that advanced mathematics courses for girls are not as important as they are for boys. Despite equal mathematics grades, mathematics is valued more highly by boys than girls, and boys rate their mathematical skills higher than girls do. Boys' desire to have mathematics related careers may create more interest in mathematics learning [***4***], [***10***].

Numerous research studies have discussed that mathematics is commonly considered as a male domain [***7***], [***11***], [***12***] and it is widely believed that gender differences in mathematics performance does exit [***13***], [***14***], [***15***]. Mathematics is believed to be a male domain [***16***].

Studies in Greece and Australia showed that Greek students hold more traditionally stereotyped beliefs about mathematics as a male domain [***17***]. However, research shows that with respect to certain aspects, mathematics could be seen as a female domain [***18***]. Though some researchers have shown that mathematics education is a male domain, many argue against this. For example, researchers found that most students in the United States and Australia regarded mathematics as a neutral domain, and data from Australian studies have shown that females were thought to be more likely to enjoy mathematics [***19***].

In the United Kingdom (UK), though girls outperform boys in the overall General Certificate of Secondary Education (GCSE) result, in most years boys outperform girls in mathematics [***20***]. The Program for International Student Assessment (PISA) 2003 showed no evident gender differences of mathematical literacy. However, "twice as many males as females achieved at the highest PISA proficiency level" [***21***]. Similarly, an analysis of data from the Australian Mathematics Competitions [AMC] [***22***] illustrated that achievement differences favour males. For senior secondary mathematics in Victoria, in Australia, females received high mean score in almost all subjects every year from 1994 to 1999. The only exception to the pattern is that males outperformed females in chemistry and mathematical methods [***23***]. Gender differences are also evident in learning mathematics using technology [***24***].

Reviewed literatures illustrate that, in general boys' achievement of mathematics is higher than girls, especially at higher achievement levels. Nevertheless, there are inconsistencies in patterns of sex differences of mathematical skills [***1***]. Furthermore, these differences are steady enough to conclude that biological factors and differences in brain organization may be involved [***25***]. Therefore, the differences in achievement of men and women in mathematics result from the great mathematical aptitude and ability in spatial task genetically inherent in men [***13***] [***26***]. Further, there is a large difference in gender achievement of mathematical aptitude even if boys and girls were given identical formal education [***13***]. These scholars concluded that even though mathematical ability of men is innate, socialization process may have some effect on mathematical reasoning ability. In contrast, by controlling the background of mathematics learning, there were no gender differences in mathematical ability or spatial visualization [***11***]. Therefore, females are as capable as males in mathematics learning.

Though some argue that sex differences in spatial skills are due to biological factors, many contend that there are other factors which may contribute to this difference. For example, studies [***27***] [***28***] show that presence of spatial skills depend on previous experience with spatial activities and spatial skill can be taught. Ethnic background may contribute to gender differences in spatial skills [***29***]. In addition to this, one's socio cultural background may influence spatial skill [***11***]. Similarly some researchers propose that it is not the inherent mathematical ability of men that enhance the difference of achievement in mathematics. This difference could be explained by socializing experience of boys and girls. Approach of teachers and parents often reveal stereotypes about boys' superiority in mathematics [***1***].

MATERIALS AND METHODS

This study used the IGCSE exam results of the year 2014 to investigate gender differences in secondary mathematics in South Maalhosmadulu Atoll in the Maldives. Students follow two different curricula in mathematics at the secondary grades (grades 8 to 10) and students can be assessed in two different ways. The two curricula are the core curriculum and the extended curriculum assessed by an examination paper only or by a written examination paper and

coursework. In the Maldives students choose only the written paper assessment with either the core curriculum or the extended curriculum. Both curricula have different grading methods. The core curriculum grades C to G and in extended curriculum grades A* to E. These two different curricula allow students to participate in examinations according to their level of competence. The core curriculum is meant for students who are expected to accomplish grades C to G, while the extended curriculum is challenging and intended for students who are expected to achieve grades A to E. However, grades in both curricula have the same value. That is, achieving a C grade in core curriculum is the same as achieving a C grade in the extended curriculum. In this study both core and extended curriculum is included.

From the 12 Schools of the studied atoll, a total of 7 Schools responded by providing data. The data accounts to more than 70 percent of the students in the atoll. The data set was analysed by using SPSS.

RESULTS AND DISCUSSIONS

The data set consists of 50.9 percent boys and 49.1 percent girls. Table 1.1 shows distribution of gender by schools. It shows that in most of the schools boys participate more in IGCSE, only where school 5 and 6 has lower participation of boys and school 7 has equal participation.

Table 1.1: *Student participation in IGCSE by school in 2014*

	School-1	School-2	School-3	School-4	School-5	School-6	School-7
Male	55.6	52.9	53.3	62.5	45.2	14.3	50.0
Female	44.4	47.1	46.7	37.5	54.8	85.7	50.0

The data revealed that 50 percent of the boys and 41.8 percent of the girls did not achieve a qualification which is acceptable to enter into a higher education institution. Mathematics is important to further educational and career opportunities [***30***]. Educational test scores in school is dominant tool for any social exclusion in adulthood [***31***]. Students who scored A* and A is mostly boys than girls, however girls scored more B and C grade. This result shows that boys' performance is better than girls in getting higher grades in mathematics. Research has shown similar findings [***20***], [***22***], [***23***] with boys' obtaining higher grades reflecting that mathematics is regarded as a male domain subject [***11***] [***12***].

This study shows that girls had a higher mean score in mathematics except for school 1 and 7. Descriptive statistics showed that mean and standard deviation for girls are 5.30 and 2.18 respectively, and for boys mean and standard deviation are 5.10 and 2.43 respectively. This shows that girls have a high mean with small standard deviation. Therefore, girls are seen to be more consistent in their performance. Regardless of the number of A* and A scored by boys, the mean score of girls are higher than boys. In Maldivian classrooms, more boys face disciplinary actions such as detentions due to disciplinary issues resulting in less interactive time with the teacher whereas girls are the opposite. Similar findings in the UK revealed that girls are more systematic, have great communication skills, and take studies seriously. On the other hand, boys take studies far less seriously, do minimal work, get easily distracted and blame others for misbehaviour [***32***].

This study show a higher means score of girls compared to boys in 5 of the 7 participating schools. However, an independent t-test did not yield statistically significant differences between the mean grade of boys and girls for year 2014. In 2014 [$t(158.167) = 0.595$, $p < 0.01$ (two-tailed, unequal variances assumed)]. Similar results were found when the mean score of girls and boys from schools were compared. None of the schools had statistically significant results.

CONCLUSION

This research explored gender differences in mathematics achievement among Maldivian students in South Maalhosmadulu Atoll. The research revealed that there are no significant gender differences in mathematics education. However, it was found that there was a higher percentage in boys not achieving an acceptable grade in mathematics which reduces their potentials for further studies. Since mathematical ability is an important component of higher education, gender differences in mathematics achievement needs urgent attention of policy makers. Gender differences may lead to implications for gender segregation in occupation and public stereotyping may ultimately lead to unfair socialization.

While the Maldives consists of 20 administrative atolls, this study used the examination grades of IGCSE students of only one atoll. A further study is necessary to confirm an existence of any gender gap in mathematics education in the country with the use of grades on different mathematics papers or scores on different topics or a customized test for the study. To determine a clear understanding of the situation researchers could use a mixed methods approach.

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ABSTRACTS

Effect of Notched Trapezoidal Rib Turbulators on Heat Transfer and Friction in a Solar Air Heater-A CFD Study

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In this paper a two dimensional CFD analysis is carried out to study the effect of trapezoidal ribs on the thermal performance and friction factor in a solar air heater. The design parameters that influence the heat transfer performance and pressure drop in the presence of ribs are the longitudinal pitch, geometry and dimensions of the ribs. The pitch of the ribs is varied as 10, 15, 20 and 40 and the rib height is fixed at 1.4mm. The analysis is carried out at a constant heat flux input of 1000W/m^2 for different Reynolds number conditions ranging from 8000 to 24000. An average increase in the Nusselt number was found to be about 1.87 times as compared to the smooth duct while the friction factor increased by 1.91 times. The thermal enhancement factor which indicates the thermohydraulic performance of the collector in the presence of ribs is found to be in the range of 1.26–1.56.

Keywords: Notched Trapezoidal Ribs, Solar Air Heater, Nusselt number, Friction factor

Biomedical dilemmas among medical students in PNG: Mixed method study

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The ethical issues surrounding the beginning and end-of-life are controversial in various societies. Doctors' attitudes on the ethical issues of the beginning and end-of-life are associated with values, believes and philosophy of life prevalent in the society. In Melanesian culture the old members of the community are treated with high respect. Grown children have unquestioned duty to provide for their aged parents. This moral obligation is enforced by their beliefs in ancestors living in the spirits world. Hence, the issue of euthanasia has no place in traditional Melanesian culture. Regarding the beginning of life in various ethnic groups there were reports of traditional acceptance of abortive procedures (using herbs or jumping) even to the degree of killing a new-born baby in case of extramarital relation or twins. However, to our knowledge, there has been no study on the knowledge, attitudes values connected with bioethical issues among medical personnel in PNG. Ninety seven of first and last year students of Rural Medicine program took part in this mixed methods study. The questionnaire was used for twofold purpose: (1) to determine the variability of knowledge and attitudes of medical students on bioethical issues pertinent to end-of-life and beginning of life; (2) to explore the association between demographic factors, including year of study, and attitudes to issues under investigation. The semi-structured interview explored the cultural context of students' attitudes towards studied bioethical issues.

Keywords: Biomedical dilemmas; Medical students; Mixed methods study

Examining the Significance of Implementing CLIL in the Undergraduate Programmes of the State Universities in Sri Lanka

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It is intriguing that the concept of Content and Language Integrated Learning (CLIL) has been recently gaining popularity in the arena of international education as an innovative means of enhancing the quality of pedagogic activities. The CLIL approach integrates the teaching of curricular subjects with the knowledge of an additional language which may be a foreign or second language. This fundamental feature of CLIL gives learners a novel learning experience compared to the traditional teaching methodologies, and it also has the potential to promote the students' social and communication skills. Referring to the Sri Lankan higher education system, it is noteworthy that the language of instruction for most of the undergraduate programmes in the local universities is English. Consequently, almost all the curricular subjects are taught mostly in the English language and the lecturers barely focus on the learners' ability to grasp the conceptual knowledge of the relevant subjects in a non-native language. Also, it is obvious that the poor performance of some students in the curricular subjects is due to their lower competency levels in English and not in the subjects themselves. In such a context, a dual-focused approach where both content and language play a central role seems to be of vital importance. Thus, it is expected that the findings of this research project will be beneficial in reforming the existing educational curricula.

Keywords: state universities in Sri Lanka, undergraduate programmes, CLIL

Influence of Cerium oxide Nanoparticles as additive with Diesterol blend : Combustion, Engine Performance and Emissions

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Experimental investigation was carried out to study the combustion, engine performance and emission characteristics of a single cylinder, naturally aspirated, air cooled, constant speed compression ignition engine, fuelled with the modified fuel blend diesel - jatropha biodiesel - ethanol blends, with cerium oxide as a nanoadditive (D80JBD15E4S1+cerium oxide) and the results are compared with those of neat diesel. The nanoadditive was mixed in the fuel blend along with a suitable surfactant by means of an ultrasonicator, to achieve stable suspension. The properties of D80JBD15E4S1+cerium oxide fuel blend are changed due to the mixing of biodiesel and the incorporation of the cerium oxide nanoadditives. Some of the measured properties are compared with those of neat diesel. The results are very encouraging and reported in detail. Reduction in ignition delay, higher cylinder peak pressure, and higher heat release are observed at higher loads in the case of D80JBD15E4S1+cerium oxide fuel blend compared to neat diesel. Further, the BSEC is minimum (3.89) at full load compared to neat diesel (4.33). The presence of the cerium oxide nanoparticle changes the reaction patterns and heat transfer rate that increased the NOx emission by1.72 % in the case of D80JBD15E4S1+cerium oxide fuel blend at full load condition when compared to neat diesel.

Keywords: Diesel engine performance, alternative fuels, cerium oxide nanoparticle.

Mythologized Ideal Heteronormative Family of India and Indonesia: Patriarchies, Gender Subordination and Law

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The modern Indian and Indonesian states also share secular traditions, certain cultural and family values and even construction of heteronormativity in these countries. Heteronormativity informs the normativity of daily life, including institutions, laws and regulations that impact the sexual and reproductive lives of members of society as well as the moral imperatives that influence people's personal lives. Heteronormativity refers to practices, norms governing those practices, institutions that uphold them and effects produced by those norms within individuals. For women in India and Indonesia, the normative family model is based on pre-marital virginity, chastity during marriage, and motherhood. A broad study of various forms of direct, indirect and structural forms of violence against women in Asia pointed to the prevalence of patriarchal notions of honor, shame and sexual purity linked to violence against women. Globally patriarchal gender norms are a key factor in the prevalence of intimate partner violence. In this paper attempt is to see the evolution of heteronormativity and gendered expectation of women's behavior in India and Indonesia and the constitutional rights that women are having in these countries, the laws related to them; are the laws going to help when the awareness and political efficacy itself is not there.

Key words: heteronormative, feminism, law

Gendering Sustainable Development: India's Experiments with Green Technologies

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UN Women World Survey Report (2014) stated: "achieving sustainable development means recognizing the synergies between gender equality, sustainability, engagement with tensions and trade-offs." We argue that India, a mammoth and unwieldy democracy, is now committed to global protocols to cut carbon emissions. In this frame, we point out that Indian women engineers and cottage-industry workers are making strides solar energy fields, and serve as models of green technology innovators. Kochi airport is the first in the world to operate completely on solar energy, where a woman engineer is a design team-member. On the other end of the spectrum, women in Barefoot College, with minimal education are stitching together solar cells like a "quilt" to provide their communities with cheap electricity. These are just 2 examples, where enterprising Indian women are drivers of social change. To provide a fuller map, we will illustrate clear instances where Indian socio-cultural biases impede women from participating fully in sustainable development initiatives. Our argument thus straddles innovations taken from green technologies and gender studies theoretic in the arena of sustainable development, echoing UN Women's concerns between sustainability, tensions, and trade-offs."

Keywords: Equality; Sustainability; Community Engagement; Enterprise; Technology; Social Change.

A New Look at the Acquisition of Private Lands in Sri Lanka.

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Land acquisition by the state took place and is now taking place in Sri Lanka for various reasons. Since massive development projects such as harbours, airports, and roads are essential to a country, acquisition of private lands has become inevitable. The state has the power to acquire a privately owned land for public purpose and with the payment of compensation. But this does not consider the particular public purpose for which the land is acquired. It is noteworthy that people lose their ancestral homes, businesses, everyday environment and infrastructure when acquiring lands. Therefore, it is questionable whether the private ownership could be covered with just paying compensation where people are attached to their lands sentimentally. Since Sri Lankan constitution does not guarantee right to property as a fundamental right it is with great importance that the owners of the affected lands have to be granted suitable lands. Accordingly the main objective of this research is to examine the relevant statutory provisions with regard to land acquisition in Sri Lanka, and also the research aims to identify a proper interpretation for the public purpose. The paper uses relevant books, agreements, statutes, journal articles, web sites as secondary sources and statutes, decided cases, statistics and information gathered through relevant authorities are used as primary sources.

Keywords: Land acquisition, public purpose, private ownership

Spheroidizing and Hardness related Properties of AISI 6150 Spring Steel

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The high temperature phase austenite in steel has the property to transform into a variety of room temperature phases like coarse pearlite, bainite & martensite depending upon the cooling cycle. The machinability and toughness depend upon the shape and distribution of pro eutectoid harder phases. The spherical or oval shapes give lesser resistance for machining process. So it is required to design the heat treatment to tailor the property as required by the application. In this view, it is proposed to study the mechanical and micro structural properties of EN47 steel undergoing Spheroidization. The aim of this work is to test the hardness, toughness and wear property of the steel in spheroidised condition. Hardening treatment improves hardness of the material, a marginal decrease in hardness value with improved ductility is observed in tempering. Hardening and longer duration tempering show better wear resistance compared to other heat treatments. Both mild and severe wear regions are observed. Generally mild wear region is observed above 5 hours of continuous running of the specimen. Micro structural analysis shows the existence of pearlitic structure in as bought & normalized specimens, lath martensitic structure in hardened specimen

Keywords: Spheroidization, Hardness, Wear Test.

Hypotonic Hemolysis: Effect Of Temperature

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It has been shown that cold makes the red blood cells more vulnerable to hypotonic stress in solutions of NaCl. What will be the effect if KCl is substituted for NaCl? In order to answer this question 10 µl of blood collected from volunteers, was mixed with 400 µl of solutions of either NaCl or KCl of same tonicities contained in micro centrifuge tubes. After incubation for 1h at 37º C or at 4º C and centrifugation for 5 minutes at 7500 rpm, 250 µl supernatant from each tube was collected and used for estimation of hemoglobin. 3 ml distilled water was added to each sample and the absorbance was read at 575 nm in a spectrophotometer Supernatants from tubes containing only distilled water served as controls. Hemolysis in controls were taken as 100%. All the values were expressed as percentages of the controls. Paired Student's t test was used to calculate significance. The results indicate that hemolysis has not occurred in isotonic or 3/4th isotonic solutions of either salts. Hemolysis at 37º C was significantly higher in half tonic KCl than NaCl solutions ($P<0.02$). At this strength, cooling promoted the hemolysis in NaCl but not in KCl solutions when compared to hemolysis at 37º C ($P<0.02$ vs $P<0.07$). It is concluded that a temperature-dependent process protects the red cells in hypotonic solutions of NaCl.

Key words: hemolysis, hypotonic, cold

Analysis The Issue Of Rising Child Abuse In Polonnaruwa District

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Rise of child abuse is the biggest cancer to the Sri Lankan society. It is a moral and legal issue. This study main focus on Polonnaruwa district which is one of the highest districts that child abuse cases are reported in Sri Lanka. Therefore it is essential to have good understand of social and economic standards of this area. Here it is mainly focused on five of the nine police divisions in Polonnaruwa district which covers the whole territory of Polonnaruwa district. Investigation and data analysis are used in order to carry out the research by using both qualitative and quantitative methods. The main objective of this paper is to investigate circumstances of the reported child abuse cases and to aim at achieving better understanding of the reasons and the sources that enhance the increase of child abuse in Polonnaruwa district. Also this research is concerned about the steps that had been taken by the responsible authorities to reduce this rising issue. The awareness programs are taken into higher consideration. In conclusion the paper will discussed on the rising issue of child abuse in Polonnaruwa district and how it generates a bad image of Sri Lankan society. The final section of the paper is dedicated to suggestions and recommendations for reducing child abuse in Polonnaruwa district.

Keywords – Child Abuse, Crime, Polonnaruwa District, Social Responsibility.

Psychological distress in cancer patients

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Background: Stress in cancer patients directly affects the outcome of treatment. Aim of the study is to assess stress levels in Sri Lankan cancer patients.
Methods: A sample of cancer patients (N=210) were assessed using an Interviewer Administered Questionnaire and the General Health Questionnaire- 12 item version (GHQ-12).
Results: Sample consisted of 97 breast, 32 oral, 32 colon, 25 lung and 24 uterine cancer patients. The mean age was 55 years (SD = 10.2). Overall mean GHQ score (mGHQs) was 22.5 (SD=3.8). Half of the participants (51%) reported disabilities; their mGHQs was 23.8, while mGHQs of those without disability was 21.1($p<0.001$); .among the former, 49% had two disabilities (mGHQs-21.2), 28% had more than three disabilities (mGHQs- 24.8). The highest mGHQs of 27.8 was reported by patients with difficulties in attending self-care. Participants' stress levels were different based on the combination of the disabilities they experienced; those with difficulties in talking and attending self-care reported the highest mGHQs (32.0). Majority (64%) earned monthly income <Rs 10000 and their mGHQs was 23.2 while that of those who earned > Rs.10000 was 21.3 ($p<0.001$). Mean GHQ scores of patients with different cancer types were not significantly different ($p=0.056$).
Conclusion: Cancer patients with disabilities were severely stressed. Psychosocial support services should target patients experiencing disabilities and those who are from lower economic background.

Key Words: cancer, psychological distress, GHQ

Lexicon Based Improvement Of Sinhala Optical Character Recognition

Dineesha Ediriweera

This research proposes a system to improve the accuracy of Sinhala OCR by using a lexicon at a word level. Words are implicit to be correct if a match is found on the lexicon; otherwise a word hypothesis net is generated with probable candidate words utilizing 3 techniques. The first, Confusion character pairs detect and correct majority of the OCR errors. The remaining erroneous words break into parts such as prefix suffix and stem, and use for validation in the second. At last, exhaustive search of confusion character groups fix the word at a compromise of computational resources for which syntax rules and word boundary limitations are used to weigh down. The best matching word is based on the maximum score obtained by similarity measures and word statistics.

NOx Prediction in a Dual fuel CI Engine

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Diesel engine performance is comparatively superior to its counterpart petrol engines with lower specific fuel consumption. However diesel engines are notorious for higher level of NOx emissions and Particulate Matter (PM) at near to full load conditions. Use of gaseous fuel to supplement the liquid fuel and operating the engines in dual fuel mode results in reduced emissions at near full load conditions. The control of relative proportion of liquid fuel and gaseous fuel is an important aspect in controlling the combustion performance and hence engine out emissions. This paper presents a computational method for the prediction of engine out NOx from the dual fuel compression ignition (CI) engine. The experiments were conducted at different loads and relative proportion of diesel and LPG. The different performance parameters and emissions were obtained and used for the validation of computation results. A two-zone combustion model has been developed using MATLAB customised codes to predict the in-cylinder pressure rise, heat release rate NOx formation using engine parameters, fuel characteristics and fuel consumption rate. The outputs of combustion model are used to predict the NOx formation. In order to estimate the rate of NOx formation the combustion event is divided into steps of 1^0 Crank Angle (CA). Analysis of both inducted and injected fuel has been carried out separately using Extended Zeldovich equation. The species mole fractions of different products are obtained from Olikera Model. The NOx formed at each CA is added together until the temperature inside the combustion zone drops to 1700K, called as engine out NOx and compared with experimental results.

Keywords*:* Dual fuel engine, LPG, engine out NOx, in-cylinder pressure, combustion model

Role of Chemistry in Nuclear Medicine

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Nuclear medicine is a medical specialty involving the application of radioactive substances in the diagnosis and treatment of disease. In nuclear medicine procedures, radionuclides are combined with other elements to form chemical compounds, or else combined with existing pharmaceutical compounds, to form radiopharmaceuticals. These radiopharmaceuticals, once administered to the patient, can localize to specific organs or cellular receptors. The use of radionuclides for diagnosis dominates the field of medical application and is a pivot of diagnostic nuclear medicine. Nearly 95% of the radionuclides are used for diagnosis and just 5% for therapy. The role of various branches of chemistry in nuclear medicine is obvious. Nuclear chemistry deals with radioactivity, nuclear processes and nuclear properties. It is the chemistry of radioactive elements together with the chemistry associated with equipment (such as nuclear reactors, accelerators, cyclotrons) which are designed to perform nuclear processes. The role of Inorganic chemistry plays its role especially in the production of production of ^{99}Mo and development of metal - based radiopharmaceuticals, in particular, ^{99m}Tc radiopharmaceuticals. Role of Organic chemistry is apparent in the development of PET radiopharmaceuticals and the role of Biochemistry with emphasis on understanding the biological behavior of radiopharmaceuticals. Recent developments in radiopharmaceuticals suggest that a variety of new tracers for diagnostic and therapeutic application could

be produced on the basis of knowledge of chemistry as this field has proven to be the backbone of nuclear medicine.

Cultural Political Economy of Accounting: A Review of Literature with reference to Less Developed Countries

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This paper presents a review of literature on cultural and political economy of accounting. Research studies have been done in Management accounting and controls in developed economics, but less research focus on development economics and anthropology. Accounting is influenced by and, influences, the organizational and social context within which it operates. Literature observed that culture is independent but closely related with Mode of productions, but both culture and mode of production are powerful tools on shaping social relations and control. This paper reviews the literature on how the decision makers respond to the cultural and political expectations of the society within which it operates. This paper emphasizes researchers of culture and management accounting should be able to recognize that accounting is an artefact and its language, concepts and practices are an expression of a modernistic, industrial, materialistic set of belief and practices. Representations of accounting which assume global applicability are problematics as the translations of representation of accounting in other cultural setting may be different. Hofstede studies have been used to analyze the difference in accounting where there are different cultural settings. There are some survey based studies investigated differences of Management Accounting Control of different cultural differences, but still understanding is provided on how and why different culture and political contexts reproduce different management accounting controls.

Key words : Cultural and Political Economy, Less Developed Countries, Literature

Sri Lanka needs more women Representation in Politics

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According to the literacy level in Si Lankan women they are equally capable as men and it is evident that women are competitively promoted to high ranking positions in both government and public sector offices with male officers. However despite these achievements it can also be noted that, in the parliament, where the representation is much needed is not represented by women adequately. Although women represent 52% out of the total population of Sri Lanka, in 2015, only 6% of the parliament seats are taken by women. This is quite similar with the 2nd tier political structure where women represent 6% of seats in provincial councils, and 2% of seats in local government. The Convention on Elimination of all Forms of Discrimination against Women (CEDAW) is the main document which speaks about the eradication of discrimination against women and which has taken large steps to give equal recognition to women in all aspects of life. Although Sri Lanka is a party to this Convention the required level has not been achieved yet. The main objective of this research is to analyze the prevailing situation in Sri Lanka with the appropriateness of proposed amendments in this regard and finally to provide some recommendations to uphold women representation as prescribed by international instruments. This normative study was mainly based on International Conventions, domestic Statutes, case laws and secondary data available in this area.

Keywords: Political representation of Women, Equality, CEDAW