I would like to begin by congratulating the faculty and students of the editorial team for their efforts in bringing out the First issue of the research and Development magazine “Research Digest”. Their hard work and toil is reflected across the pages.

This magazine is a step towards Research awareness which in turn will develop research skills and is designed exclusively for churning out the technical writing skills among staff and students. Since challenges and opportunities are the two sides of the same coin, this magazine challenges students to bring latest technical topics and opportunity to share their knowledge in technical field. This magazine motivates students to grab more knowledge about current trends in field of engineering thereby preparing them for global employment.

The dedication of all who have come together to grow GIFT in the last years has paid off immensely. I would like to express my thankfulness to all of them. The past endeavours definitely pose a sense to help heading them to market. The work rendered by faculty and students in advancing technology to solve the world’s biggest challenges is the call of the day, directly could not but help boosting the economy. This magazine motivates the potential readers to grab knowledge about current trends in the field of Research thereby preparing them for global achievements.
“That is perfect, This is perfect
Perfect comes from Perfect
Take perfect from perfect
The remainder is perfect”

Dear Readers,

The central point is you are perfect - Happiness equated with God whose inherent nature is happiness – Bless. Every living creature longs for happiness in whatever stage he is standing. Happiness is the outcome of knowing our real nature. So the purpose of human life is to know self and be happy. But the fact is we went wrong and started doing shadow hunting. In fact we turn our back towards sun the real source and we create a self shadow and start moving towards treating the shadow as self and start nourishing it. In this witch hunt we achieved a name and fame in the society at the cost of increasing stress and related health issues. Life's main purpose is peace of mind - a product of simple living and high thinking. Happiness can only be achieved by turning our face towards the source. The source enlightens your move to development. Research is the only way that ensures you that you are in the developing path. “Research Digest” is one novel approach to bring you near to the source. Friends, only a little attention on these points will go in a long way in our personal life and nation building.

Stay Blessed!

Mr. Anup Sankar Sadangi
Asst. Professor, ECE

www.gift.edu.in
Engineering is the biggest Platform of Research. In this contest, GIFT has not set its step back. Starting from its inception, GIFT has its own way of research. The Software Development Unit (SDU) was the first research lab set by the student and faculty members. The first delivery of this lab was an unbeatable development “College Management System (CMS)”. In order to ensure that software can evolve in a way that maintains its inherent multidimensionality, SDU at GIFT ensures that the different dimensions evolve together in a consistent manner.

**College Management System**

It deals with all kind of student details, academic related reports, college details, course details, curriculum, batch details and other resource related details too. It tracks all the details of a student from the day one to the end of his course which can be used for all reporting purpose, tracking of attendance, progress in the course, completed semesters years, coming semester year curriculum details, exam details, project or any other assignment details, final exam result; and all these will be available for future references too. Our program will have the databases of Courses offered by the college under all levels of graduation or main streams, teacher or faculty’s details, batch execution details, students’ details in all aspects. This program can facilitate us explore all the activities happening in the college, even we can get to know which teacher / faculty is assigned to which batch, the current status of a batch, attendance percentage of a batch and upcoming requirements of a batch. Different reports and Queries can be generated based on vast options related to students, batch, course, teacher / faculty, exams, semesters, certification and even for the entire college.

Effort made by our faculty members towards research has given an immense result. In consequence, today, we have been enriched with the following Centers to suffice the R&D activities.

1. Software Development Unit
2. Robotics Workshop
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What is there in.

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- A Novel Approach for Measurement of High Temperature in Induction Furnace Using Digital Photography and Image Processing
Strengthening Corporate Social Responsibility (CSR) initiatives by NALCO for Inclusive Development

Dr. Namita Rath, HOD, MBA

Abstract
The Companies Act 2013 and the Revised DPE (Department of Public Enterprises) guideline have urged the Public Sector Undertakings (PSUs) to embrace a robust CSR practice that is in the interest of all stakeholders. These Rules intend to attain the nation’s aim of inclusive growth. Millennium Development Goals (MDGs) commit the international community to a comprehensive vision of development - that places human development as the centrepiece of social and economic progress. Long before the concept of CSR came into picture, the NALCO has provided leadership towards solving socio-economic and environmental issues, natural calamities, education, public health issues etc. in India. The proposed study would examine the CSR practices of NALCO so as to achieve the goal of inclusive growth. The methodology of the study would be based on field visit, interaction with the beneficiaries and primary data. CSR initiatives of NALCO in four key areas i.e. health, education, livelihood and infrastructure would be taken up to study inclusiveness of CSR by NALCO. Thus, the study would attempt to explore Corporate Social Responsibility practices in NALCO in the context of inclusive growth.

Corporate Social Responsibility (CSR):

Inclusive growth is a process of development in which there is increasing opportunities and improving access to these opportunities, either for the majority (according to the World Bank) or most particularly for the most marginalized (according to the IPC-IG and ADB). For the Organization for Economic Co-operation and Development (OECD) inclusive growth is where the gap between the rich and the poor is less pronounced and the “growth dividend” is shared in a fairer way that results in “improvements in living standards and outcomes that matter for people’s quality of life (e.g. good health, jobs and skills, clean environment, community support).” Investment in human capital is universally recognized as a key pillar of achieving inclusive growth. Investments in health and education have been proved to better economic development outcomes and to how inclusive growth is in practice. Provision of basic infrastructure and skill development for a sustainable livelihood is a key area for inclusion of the marginalized groups. Under this background, the study would attempt to delineate the efforts of NALCO in promoting inclusive growth.
This obligation is seen to extend beyond the statutory obligation to comply with legislation and sees organizations voluntarily taking further steps to improve the quality of life for employees and families as well as for local community and society at large (Ratnam, 2006).

CSR as a concept means being ethical towards stakeholders that is not harming or hurting any stakeholder (Sethi, 1979; Carroll, 1979; Waddock, 2004; Wood, 1991; Jones, 2005). It means at minimum being legally compliant to the rules of the land (Sethi, 1979; Carroll, 1979). CSR has a dominant goal to better the condition of various stakeholders (Riordan et al., 1997; Steiner, 1972; Waddock, 2004; Sethi, 1979; Fukukawa and Moon, 2004).

**Literature review**

Planning Commission (2007) says that CSR needs to be fully integrated into company’s policies and culture. CSR should involve the local communities and work together on common strategies to ensure that solutions are found on local issues while keeping in view of the national priorities and the development paradigm. The corporate sector should respect human rights and take into consideration the impact of its economic decisions, especially in situations like setting up of Special Economic Zones (SEZs). Companies along with Governments need to ensure adequate and culturally sensitive rehabilitation and resettlement of displaced persons, wherein local people are partners in the process and find viable alternatives / livelihoods.

Centre for Corporate Research and Training (2003) studied large Indian companies, more specifically the companies that were included in the National Stock Exchange’s broad based index - S&P CNX NIFTY, during January 2003. The study revealed that although many companies were aware of CSR and its benefits, the concept had not yet been the part of core business strategy. While most companies had policies in place related to labour issues, community relations and environmental practices, they were not backed by comprehensive implementation and monitoring systems. Community programmes or social development initiatives, in most cases, were philanthropic and/or ad-hoc in nature and not integrated into core business activities such as marketing and brand management.

Confederation of Indian Industry (2007) viewed that the challenge before leadership is to combine the strengths of business and technology with opportunities that help solve the tough problems of development and link social concerns with market forces – for a more equitable and sustainable model of growth for India, Asia and the world.

Prahalad (2010) suggested replacing traditional notions of government-channeled aid with a new model for relieving poverty and stimulating development. The new model
relied on the MNCs to tap the market that exists at the bottom of the economic pyramid. He demonstrated that it is possible to develop business models that allow the poorest of the poor to participate actively in their own economic development by becoming entrepreneurs. To him, though the individuals at the bottom of the pyramid (referred to as BOP) have little money, collectively they represent a vast pool of purchasing power and they welcome opportunities to escape their oppressive burdens, including predatory intermediaries and corrupt governments.

A survey by TERI-Europe and ORG-MARG (2001) in several cities in India revealed that more than 60% of the people felt that the companies should be held responsible for bringing down the gap between rich and poor, reducing human rights abuses, solving social problems and increasing economic stabilities.

**Objective of the Study**
The objective of the study is to evaluate the CSR initiatives by NALCO Foundation under four key areas i.e. health, education, livelihood and infrastructure which directly go in promoting inclusive development of the people and the locality.

**Methodology of the Study**
The study involves field visit, observation of CSR initiatives under NALCO Foundation and interaction with the beneficiaries in the neighbourhood of the NALCO plants and mines which constitute an important group of the primary stakeholders of the Company.

**Facilities for Research**
The Department of MBA has a dedicated band of faculties for research and training in the field of Human Resource Development, Finance and Marketing. They come from reputed institutes of the state and are have got exposure through training in national level institutions.

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**Manufacture and Characterization of Functionally Graded Materials using NALCO high purity Aluminum for Automotive and Space applications**

*Mr. Aravind tripathy*  
HoD, mechanical

**Abstract:**
From the past few years, materials research and development has shifted from monolithic to composites and advanced composite materials (otherwise known as Functionally Graded Materials) etc, adjusting to the need for reduced weight, quality, high performance and optimum cost and so on. Advantages of Aluminium Metal Matrix composite used in areas of aerospace and automotive industries include high performance, reliability, economical and environmental benefits. The main objective involved in designing the metal matrix composite is to combine the desirable attributes
of metals and ceramics. Delamination failure in composites subjected to severe operational condition led to the development of Functionally Graded Materials (FGM) meeting these requirements. The modern development in the field of science and technology has created a demand for many advanced engineering materials. In recent days, aluminium related metal matrix composite is a probable material for many applications such as transport, aerospace, marine and automobile applications. New and modern manufacturing technologies such as Solid Freeform Fabrication (SFF) have provided the opportunities to develop such multi-functional advanced composites where these materials are microscopically heterogeneous and are typically made from mixture of two or more materials that are appropriate to achieve the desired objectives. The mechanical properties such as Young’s modulus, Poisson’s ratio, Shear Modulus of elasticity and material density vary smoothly and continuously in preferred directions in FGMs.

Part – II

Literature Review:
Present study aims at production of Functionally Graded Material with a view to developing a process to produce Functionally Graded – Aluminium based composite material for aerospace and automotive applications. Thorough literature survey has been made, which shows that there is less information available in this area of research. Considering the importance of the project, strategic to defense application it is essential that understanding the science of this process, activities should be taken up.

A study on the effect of different input process parameters namely particle size of alumina, wt. % of alumina and stirring time on the hardness, impact strength and tensile strength. Three parameter i.e. particle sizes of alumina (75, 105 and 150 micron), wt. % of reinforcement (3%, 6% and 9%), stirring time (15, 20 and 25 minute) was used to fabricate different sample of AMMCs and the effect of these input process parameters on the output response have been analyzed using analysis of variance (ANOVA), results showed that the wt. % of alumina, stirring time and the particle size of alumina have a significant effect on the hardness, impact strength and tensile strength[1].

Experimenting on quality of the Al6063/Al2O3 composite using stir casting method, Al 6063 plate is cast with varying mass of Al2O3 (3%, 6%, 9%), distribution of Alumina and Aluminium is examined by microstructure analysis, hardness distribution and the material is tested for its mechanical Properties such as tensile strength and Hardness

An elaborative review on machining of Aluminium metal matrix composites (AMMC) especially the particle reinforced Aluminium metal matrix composites. They have attempted to give brief account of recent works to predict cutting parameters & surface generated in AMMC and enumerated on how suitable
selection of the machining parameters, machining of AMMC can be made economical

An investigation on the use of investment casting process to fabricate 6063/Al2O3 metal matrix composites, the tensile properties has been evaluated. The EDS report confirms the presence of Al5Cu2Mg8Si6, Al4CuMg5Si4 and Mg2Si compounds in the 6063/Al2O3 composites. The yield strength and fracture strength increase with increase in volume fraction of Al2O3, whereas ductility decreases. The fracture mode is ductile in 10% volume fraction composite and the brittle fracture is observed in 20% and 30% volume fraction composites.

An investigation on Aluminium alloys for wear resistance during working conditions has shown Aluminium oxide as reinforcement is potentially very effective in developing hard, wear-resistant composite materials. They evaluated the wear behaviour of aluminium reinforced Al 6063 aluminium alloy matrix composite with various parameters by using pin-on-disc machine. The wear rate was decreased with increasing the Weight % of Aluminium oxide.

Experimenting on particle reinforced light metal matrix composites (MMC) manufactured by thermal spraying of semi-finished material (atomization and co-deposition of reinforcement particles and metal melt), followed by inductive reheating and semi-solid forging, the matrix alloy was Al Mg3; silicon carbide was used as particulate reinforcement. Semi-solid processing ability of the MMC material after thermal spraying was verified by manual deformation testing. Optical and Scanning Electron Microscopy showed some in homogeneity in the SiC particle distribution. However, mechanical properties from tensile and 4-point bending experiments were encouraging [6].

An overview of different fabrication processes, some recent research studies and the need to focus more on research efforts in improving the promising FGM fabrication methods such as Powder metallurgy (PM), Solid Freeform Fabrication (SFF), Laser based SFF process such as Laser cladding method, Selective Laser Sintering (SLS), 3-DPrinting (3-DP) and Selective Laser Melting (SLM) etc, has been made here.

Once the efficiency of SFF processes is improved and extensive studies on material characterization on components produced are carried out in order to generate a comprehensive database and to develop a predictive model for proper process control. More and more researches are welcome for better process control through more powerful & improved feedback control for overall FGM fabrication process improvement. This will improve the overall performance of the processes, bring down the cost of FGM and improve reliability of the fabrication process.

Production and properties of NALCO Alumina Nanofluid: A cost effective formulation and study of its stability

Wazeda begum
Assistant professor, Mechanical

Abstract

Conventional fluids such as water, ethyleneglycol, engine oils are normally used as a heat transfer fluids. Several experimentations have been done to increase the heat transfer rate of the fluids. Nanofluids are prepared having appropriatethermophysical properties. Here NALCO Alumina is proposed to be studied for the preparation of Nanofluid.

Aluminium Oxide (Al₂O₃) or alumina is one of the most versatile refractory ceramic oxides and finds use in a wide range of applications. It can exist in several crystalline phases which all revert to the most stable hexagonal alpha phase at elevated temperatures. This is the phase of Particular interest for structural applications. Alpha phase alumina is the strongest and stiffest of the oxide ceramics. Its high hardness, excellent dielectric properties, refractoriness and good thermal properties make it the material of choice for a wide range of applications. The main purpose of this project is to produce nanopowders out of it for the preparation of a cost effective nanofluid and to study different thermal properties. As per the literatures available, it is interesting to note that Alumina produced by Nalco is of high purity > 99% and its crystal structure is α-Alumina.

We focus on materials size analysis, dispersion stability, careful exploration of surface chemistry and thermo-physical properties of Nanoparticles. The increased thermal conductivity, heat transfer coefficient and viscosity are making nanofluid more promising as compared to normal fluid. By the addition of nanoparticle in the base fluid (water) greatly affect the thermo-physical properties.

Part II

Literature Review

The concept of “nano” dated back to the year 1959 when a physicist Richard Feynman introduced the idea in a nobel lecture entitled “There’s plenty of room at the bottom”. In this, he stressed that materials can be formed by manipulating individual atoms. He also predicted that nanotechnology will bring about a scientific revolution in the next century. Today, more than 40 years later, his vision becomes a reality whereby more and more nano-based technologies are being applied in our everyday lives. As an example, Samsung Company is the pioneers in marketing products such as washing machines and refrigerators incorporating nanosized silver as antimicrobial agents.

The term "nano-technology" was first used by Norio Taniguchi in 1974, though it was not widely known. Inspired by Feynman's concepts, K. Eric Drexler independently used the term "nanotechnology" in his 1986 book. Engines of Creation: The Coming Era of Nanotechnology, which proposed the idea of a nanoscale “assembler” which would be able to build a copy of itself and of other items of arbitrary complexity with atomic control. Also
in 1986, Drexler co-founded The Foresight Institute (with which he is no longer affiliated) to help increase public awareness and understanding of nanotechnology concepts and implications. Thus, emergence of nanotechnology as a field in the 1980s occurred through convergence of Drexler’s theoretical and public work, which developed and popularized a conceptual framework for nanotechnology, and high-visibility experimental advances that drew additional wide-scale attention to the prospects of atomic control of matter.

Other scientists or researchers have also hinted the birth of this revolutionary technology. One of the co-founders of Intel Corporation, Gordon E. Moore, predicted that the number of transistors on a computer chip will double in every 18 months. What this means is that people are looking for finer structures for future technological applications. This prediction is now well known as the “Moore’s Law” 2.

Therefore it is obvious that in order to respond to the need in developing fine and miniature devices, nanoscience has become a vital and exciting field. This area not only focuses on technology applications but also fundamental understanding.

Zhang and Pinnavaia [5] synthesized mesoporous Al₂O₃ through surfactant mediated scaffolding of peptized pseudoboehmite nanoparticles. The surfactant was removed upon calcination of the resulting surfactant-containing composites at 500°C and concomitantly converts the pseudoboehmite crystallites to γ-alumina through topochemical transformation with the retention of the scaffold structure.

Baumann et al. [6] synthesized high surface alumina aerogels with low density (60-130 kg/m³), high surface area (600-700 m²/g) without the use of alkoxide precursors by the addition of propylene oxide to aqueous or ethanolic solution of hydrated aluminium salts, like AlCl₃, 6H₂O or Al(NO₃)₃, 9H₂O which was then dried by supercritical CO₂. XRD and TEM analysis indicated that the aerogels prepared from hydrated AlCl₃ in water or ethanol possessed microstructures which contain highly reticulated networks of pseudoboehmite fibres, 2-5 nm in diameters and varying length. Alumina aerogels was transformed to γ-Al₂O₃ on calcination at 800°C.

Lee et al. [7] synthesized unidirectional alumina without addition of organic solvent through hydrothermal route using a surfactant and an aluminum precursor (aluminum tri-sec-butoxide). Through this procedure unidirectional nanostructure such as nanotubes, nanofibers and nanorods were obtained depending on the nature of surfactant used. The materials maintained their γ-alumina phase up to the temperature of 1050°C.

Zhang and Lockwood [11] invented a fluid media such as oil or water and a selected effective amount of carbon as oil or water and a selected effective amount of carbon nanomaterials necessary to enhance the thermal conductivity of the fluid. One of the preferred carbon materials
is a high thermal conductivity graphite, exceeding that of the neat fluid to be dispersed therein in thermal conductivity, and ground, milled, or naturally prepared with mean particle size less than 500 nm, and preferably less than 200 nm, and most prefer less than 100nm. The graphite is dispersed in the fluid by one or more of various methods, including ultrasonicication, milling, and chemical dispersion. Carbon nanotubes with graphitic structure are another preferred. The thermal conductivity enhancement, compared to the fluid without carbon material, is proportional to the amount of carbon nanomaterial (carbon nanotubes and/or graphite) added.

Egawa and Tsujii[12] invented a heat of metal and/or metal oxide particles and high in the thermal conductivity characterized by comprising water and/or alcohol as the main component, and (a) one kind or two or more kinds selected from metal and/or metal oxide particles having an average particle diameter of from 0.001 to 0.1 μm, (b) one kind or two or more kinds selected from poly carboxylic acids and/or salts thereof, and (c) at least one kind of a metal corrosion inhibitor. The heat transfer medium liquid composition that can be used as a coolant for an internal-combustion engine, a motor and the like, a heat transfer medium for a hot water supply, heating, cooling and freezing system, or a heat transfer medium for a snow melting system, road heating and the like. In particular, the invention relates to a heat transfer medium liquid composition which is excellent in dispersion stability of metal and/or metal oxide particles and high in thermal conductivity.

Murray invented a system combining the thermal conductivity characteristics of certain nanoparticles with the high specific heat of appropriate fluids to enhance the overall heat transfer characteristics of a heat exchanger. The system comprises a fluid channel disposed in a heat exchanger unit with slurry as the convective heat transfer medium. The slurry comprises an appropriate fluid with field reactive nanoparticles suspended therein. Field emitters are located along the walls of the fluid channel whereby the distribution of nanoparticles within the slurry is manipulated to achieve enhanced heat transfer characteristics.

Oldenburg invented compositions comprising Nano rods and methods of making and using the same, the inclusion of nano rods can enhance the thermal conductivity of heat transfer medium. Surprisingly, the addition of nano rods provides substantially greater improvements in thermal conductivity than the addition of other nanostructure. Figure 1 shown nano rods dispersed in a fluid. The fluid can be used in a wide range of applications such as heating and cooling of machinery, vehicles, instruments, devices and industrial processes. Such heat transfer fluids are used to transfer heat from a heat source to a heat sink.

Preparation and properties of Aluminium-Beryllium alloys using NALCO- Aluminium for space applications
Abstract

The properties of an alloy greatly depend on the quality of the base material. NALCO-aluminium is known to be of high quality and is expected to exhibit superior physico mechanical properties. Properties such as thermal, fatigue, corrosion etc. show marked improvement depending on the purity of Aluminium.

Aluminium-Beryllium alloys for space applications belong to a family of low density - high elastic modulus is under development in order to meet the growing demand of advanced aerospace designs. These alloys are Aluminium based with 10 to 75% Beryllium and combine the high specific stiffness of beryllium with the ductility, ease of fabrication. Densities ranging from 2.0 to 2.58g/cc with excellent strength and ductility are expected by the use of high quality Aluminium of NALCO.

The molten metal route will be used in this investigation and property evaluations including fatigue and microstructure will be made.

This document is part of Sub volume B5 'Binary Systems. Part 5: Binary Systems Supplement of Volume 19 Thermodynamic Properties of Inorganic Materials' of Landolt-Bornstein - Group IV 'Physical Chemistry'. It provides an overview of the thermodynamic properties and the mixing behaviour of the binary system Aluminium - Beryllium.
Aluminum alloy is investigated under room and elevated temperatures and it is observed that the fatigue strength of 2024–T4 Aluminum alloy at elevated temperature is reduced by a factor 1.2–1.4 compared with dry fatigue strength.

Al2024–Beryl particulate composites were fabricated by stir casting by varying the weight percentage of beryl particulates from 0 wt% to 10 wt% in steps of 2 wt%. The cast Al2024 alloy and its composites have been subjected to solutionizing treatment at a temperature of 495°C for 2 hrs, followed by ice quenching. Microstructural studies were carried out to determine the nature of the structure. The Brinell hardness test was conducted on both the Al2024 alloy and its composites before and after solutionizing. Pin-on disc wear tests were conducted to examine the wear behavior of the Al2024 alloy and its composites. Sliding wear tests were conducted at various applied loads, sliding velocities and sliding distances. The results reveal that the wear rate of the composites is lower than that of the matrix alloy. The wear rate increased with an increasing applied load and sliding distance, and decreased with increasing sliding velocity.

The Weight-saving materials are becoming increasingly important, especially in the automotive and aerospace industries. Design engineers would thus like to make more extensive use of light metals such as aluminium, titanium, magnesium and their alloys; however, these materials tend to have poor wear resistance. Previous treatments and coatings applied to aluminium alloys, for example by traditional processes such as hard anodising and thermal spraying, have suffered from the low load support from the underlying material and/or insufficient adhesion, which reduces their durability. Also, although TiN-, CrN- or DLC-coated aluminium alloys (using various PVD methods) can achieve a high surface hardness, in practice they often exhibit poor performance under mechanical loading, since the coatings are usually too thin to protect the substrate from the contact conditions.

### Objectives
- Preparation of a number of novel Al-Be alloys with NALCO high purity Aluminium.
- Assessment of physico-mechanical properties of the produced alloys of varying compositions.
- Studies of Corrosion behaviour of the produced alloys.
- Optimisation study to obtain a combination of wear resistance, ductility, UTS etc.

### Methodology
1. Preparation of Al-Be alloy through molten metal route in bottom pouring furnace having composition in the range of 10-30% and cast in ingot mould in the neutral atmosphere.
2. Chemical analysis of the Al-Be alloys.
3. Study of physico-mechanical properties of Al-Be alloy
   - Tensile and Compressive Strength (UTS) with % age of elongation etc.
   - Hardness Test
   - Fatigue Strength
iv) Tribological Properties (Wear resistance)

4. Corrosion Studies

5. Study of alloy Structures
   i) Optical
   ii) SEM
   iii) TEM

6. Phase Analysis by XRD

7. Structural Property Correlation

8. Making the Al-Be alloys in vacuum furnace
   (Provisions may kindly be made to conduct the experiments either at NML, Jamshedpur or at IIT, Kharagpur)

Cooling of electric panels using thermo acoustic refrigeration Technique

Mr. Amar Kumar Das
Mrs. Swagatika Acharya,
Mr. Ansuman Nayak
Assistant Professor Mechanical

Abstract

Thermo acoustics principle is the interactions between temperatures, density and pressure variations of acoustic waves. Thermo acoustic devices can readily be driven using solar energy or waste heat and they can be controlled using proportional control. They can use heat available at low temperatures which makes it ideal for heat recovery and low power applications. The components included in thermo acoustic engines are usually very simple compared to conventional engines. The device can easily be controlled and maintained.

Acoustic waves consist not only of coupled pressure and displacement oscillations in a gas, but also of temperature oscillations as a response to the pressure variations. The interaction of these effects in gas close to a solid surface generates thermo acoustic oscillations. At the surface heat can be extracted or supplied to the gas. The result of this interaction is that a sound wave is sustained in case of a large temperature gradient along the surface. While in the reverse case acoustic work is absorbed in order to transport heat, generating a temperature gradient.

Thermo acoustic effects can be observed when partly molten glass tubes are connected to glass vessels. Sometimes spontaneously a loud and monotone sound is produced. A similar effect is observed if a stainless steel tube is with one side at room temperature (293 K) and with the other side in contact with liquid helium at 4.2 K. In this case spontaneous oscillations are observed which are named “Taconics oscillations”. The mathematical foundation of thermo acoustics is by Nikolas Rott. Later the field was inspired by the work of Wheatley and Swift and his co-
workers. Technologically thermoacoustic devices have the advantage that they have no moving parts which makes them attractive for applications where reliability is of key importance.

PANEL cooling uses controlled-temperature surfaces on the floor, walls, or ceiling the temperature is maintained by circulating water, air, or electric current through a circuit of embedded in the panel. A controlled-temperature surface is called a radiant panel if 50% or more of the heat transfer is by radiation to other surfaces seen by the panel. Radiant panel systems may be combined either with a central station air system of one-zone, constant temperature, constant volume design or with dual-duct, reheat, multi zone or variable volume systems. These systems transfers heat to or from a room by radiation and natural convection.

**Literature Review**

Thermo acoustics, as defined by Rott, is a subject dealing generally with effects in acoustics in which heat conduction and entropy variations of a medium play a vital role. In this thesis the term thermoacoustics will be used in the limited sense of the generation of sound by heated surfaces and the process of heat transfer from one place to another by sound.

In this thesis, a brief review of the history of thermo-acoustics is presented, along with a simple physical explanation of the effect, and some applications.

The generation of acoustic oscillations by heat have been observed and studied for over two centuries. Byron Higgins made the first observations and investigations of organ-pipe type oscillations, known as singing flames in 1777. At certain positions of a hydrogen flame inside a tube, open at both ends, acoustic oscillations were observed.

It shows a configuration for producing Higgins oscillations. A survey of the phenomena related to Higgins oscillations was given by Putnam and Dennis.

In 1859, Rijke discovered that strong oscillations occurred when a heated wirescreen was placed in the lower half of an open-ended pipe. It was noticed that the convective air current through the pipe was necessary for the phenomenon to occur. Oscillations were strongest when the heated screen was located at one-fourth of the length of the pipe from the bottom end. Feldman gave a review of the literature on the Rijke tube. Probably the research by Sondhauss, performed in 1850, approximates best what
we have done today as thermoacoustic oscillations. Sondhauss studied experimentally heat-generated sound, observed for centuries by the glass-blowers when blowing a hot bulb at the end of a cold narrow tube. Sondhauss tube. It is opened at one end and terminated in a bulb on the other end.

Sondhauss observed that, if a steady gas flame (heat) was supplied to the closed bulb end, the air in the tube oscillated spontaneously and produced a clear sound which was characteristic of the tube length and the volume of the bulb. The sound frequency was measured and recorded for tubes having an inside diameter of 1 to 6 mm, and having various bulb sizes and lengths. Hotter flames produced more intense sounds. Sondhauss gave no explanation for the observed oscillations. Feldman gave also a review of the literature on the Sondhauss tube. In 1962, Carter et al., during an experimental investigation of the feasibility of the Sondhauss tube to generate electricity, found that the insertion of a bundle of small glass tubes inside the Sondhauss tube improved their performance.

In 1887, Lord Rayleigh gave a qualitative explanation, in his classic work on sound[3], for the Sondhauss oscillations. His criterion for the production of any type of thermoacoustic oscillations was: If heat be given to the air at the moment of greatest condensation or taken from it at the moment of greatest rarefaction, the vibration is encouraged. Since thermoacoustic technology can also lead to devices without moving parts, attention in the low Temperature group is also focused in this direction for possible applications. The work presented in this thesis is a start in this research direction. The quantitative (theoretical) understanding of the physical principle underlying the thermoacoustic effect is well established and has been discussed in many papers. But a quantitative experimental investigation of the effect of some important parameters on the behavior of the thermoacoustic devices is still lacking. Important parameters are the spacing between the parallel plates in the stack and the Prandtl number, as they determine the energy flow. Hence, we decided to investigate experimentally the effect of the spacing in the stack by constructing many parallel-plate stacks with spacing varying between 0.15 and 0.7 mm. The effect of the Prandtl number on the performance of the thermoacoustic refrigerator is investigated using gas mixtures of helium-argon, helium-krypton, and helium-xenon. These provided gas mixtures with Prandtl numbers varying between 0.2 and 0.68. The measurements
show that the performance of the refrigerator rises as the Prandtl number decreases. The lowest Prandtl number of 0.2, obtained with a mixture containing 30% xenon, leads to a coefficient of performance relative to Carnot which is 70% higher than with pure helium.

The measurements show also that in our system a plate spacing in the stack of 0.25 mm leads to a maximum in cooling power, and that a spacing of 0.4 mm leads to the lowest temperature. A low temperature of nearly -67 °C is achieved with our cooler which is one of the lowest reported temperatures up to date. In addition, we invented a technique, using the gas in the back of the loudspeaker driving the refrigerator, to optimizethe electroacoustic efficiency of the loudspeaker. By tuning the mechanical resonance of the loudspeaker to the acoustic frequency of the resonator, an electroacoustic efficiency.

**A Novel Approach for Measurement of High Temperature in Induction Furnace Using Digital Photography and Image Processing**

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**Abstract**

Temperature measurement is an important requirement in many industrial processes. At present, conventional devices and techniques such as contact-type sensors and pyrometers are used to measure the temperature of various visible sources of heat such as furnaces, crucibles, molten mass, ingots, ovens, and weld guns. In such sources, the placement of a sensor is difficult, if not impossible. Ovens and furnaces of different types and other industrial heat sources generally use thermocouples to monitor temperatures at strategic locations. Thermocouples fail and need to be replaced periodically. This may require shutting down of the process, which is laborious and time consuming. Processes like welding demand fast responding thermal sensors. Conventional sensors like RTD, thermocouples do not meet the demand. Noncontact measurement techniques like pyrometers indicate the temperature of the targeted location only. To obtain the overall temperature distribution, it is required to scan the surface area using an optical/radiation pyrometer; however, it is not advisable to keep the furnace door open for a long time. IR noncontact-type sensors can be used, or IR thermal scanners can also give temperature distribution. However, the cost is prohibitive. Hence, there is a need to develop an appropriate system predicting point-source temperature as well as temperature distribution.

This work propose a novel noncontact temperature measurement technique using a consumer-grade digital still camera. The images of various visible heat sources are captured. Using color image segmentation, source zones are identified. The color temperature correlation is established by applying various analytical
Any color of the spectrum when highly de-saturated should approach standard white color. The three characteristics, hue, saturation and intensity represent the total information necessary to define and/or recreate a specific color stimulus. Conceptually, this definition of color is highly convenient and appropriate for an image-processing system to be used in the determination of convective heat transfer parameters from very Alumina present in the induction furnaces used in the rodding shop. The technique can be successfully used for measuring the temperature distribution of different industrial applications, like muffle furnace, salt bath furnace, induction furnace, etc.

**Part-II**

**Brief description of the subject: including work done in India and elsewhere**

**Literature Review**

It is seen that the techniques reported so far are based on the spectral distribution and pyrometer. The measurements were obviously with the analog processing techniques. Most existing two-color-based systems can only provide a measurement of averaged temperature of a small area, which is defined by the field of view of the probe. The survey reveals that the area of noncontact temperature measurement using digital photography is still virgin.

A color vision system uses a number of principles derived from a mathematical color matching model established by Grassman as described in Wyszecki and Stiles (1967) and Pritchard (1977). The basic principles used in modern tristimulus colorimetry are as follows:

1) The human eye can distinguish only three kinds of differences, which we now call hue (dominant wavelength), saturation and intensity.

2) In a two component color mixture if one component is held constant and the other changed gradually, the color of the mixture will change gradually.

3) Lights of the same color (same dominant wavelength, saturation and intensity) will produce identical effects in mixtures regardless of their spectral distribution.

4) The intensity produced by a mixture of several lights is equal to the sum of the intensities of the individual lights.

The human eye detector evaluates the intensity of an image by summing the stimuli from the three receptors, while the chromatic attributes, hue and saturation are determined by the ratios of the stimuli. Thus, light sources having widely different spectral distribution may give exactly the same visual color sensation as long as the amount and ratios of the total stimulation are the same. The intensity obtained by summing the stimuli from the three receptors is represented by a luminosity function. The details of the definitions are described by Bingley (1953), Fink (1955), McIlwain and Dean (1956), Overheim and Wagner (1982) and Pearson (1975).

The basic principles and analysis given in these references state that only three independent quantities are required to specify a color and that color intensities add linearly. Therefore, a color specification system can be envisioned as involving a three-dimensional color space with any set of convenient coordinates, and these coordinates may be transformed mathematically into any other set for convenient measurement or analysis. Colorimetric coordinate systems which can be used include the intensities of three color primaries R, G, B or hue, saturation and intensity H, S, I, or intensity and two color difference signals (I, R-I, B-I).

The fundamental quantities of tristimulus colorimetry as established by the Commission Internationale de L'Eclairage (CIE) are as follows:

X, Y and Z are the definitions of tristimulus values and the integrations are taken through the visible region of the spectrum. Eλ represents the spectral power distribution of the illuminant in which the colored object is viewed. The function Rλ represents the reflectance characteristic of the colored surface, that is, the proportion of incident light which is reflected, expressed as a function of wavelength. This quantity is strictly controlled by the liquid crystal as a response to local temperature. The three functions x, y and z describe the standard psychophysical characteristics of a normal human eye. Using the tristimulus values as fundamentals, other related quantities called “chromaticity coordinates” may be defined.
Objectives:

1. To develop a real time non contact based accurate high temperature measurement system especially for measuring temperature above 1400 °C in induction furnace used in rodding shop.
2. This method reduces the risk in measuring high temperature over conventional contact method.
3. The temperature distribution on any wall of the furnace can be obtained as well as the same procedure is used for ingots or samples that are kept in furnaces. Using this technique, the temperature of the molten Aluminum can be estimated.

Methodology

1. **Experimental Setup (Camera Characteristics)**: To obtain the sensor characteristics, different sources are used to cover the wide range from IR to UV. While designing the setup, it is ensured that the effect of stray light and reflection of light is minimized.

2. **Images Obtained and Processing**: The color values (RGB) of the images acquired are separated. The values are compared with standard digital values. Red colored images are compared with (255, 0, 0), and green and blue are compared with (0, 255, 0) and (0, 0, 255), respectively. The processing is carried out using commercially available MATLAB version 2010R(a) software. After processing the images and comparing the color values with the standard values.

3. **Source Image Acquisition**: After verifying the camera characteristics, a number of various visible light sources like wax candles, Bunsen burner, oil lamps, etc., are photographed using the camera selected. Bunsen burner is used as a controlled source for further experimentation.

4. **Temperature Measurement**: The temperature will be measured in the different zones of the flames of the sources. Zone temperature measurement is attempted using different sensors like bare and sheathed RTD, thermocouples (J and K type), IR-noncontact type thermometers, etc. Considering the range, the response time, and the dimensions of the flame zone, a miniature K-type thermocouple sensor is selected for temperature measurement.

5. **Color Temperature Correlation**: The captured image of any source consists of the combination of the color constituents RGB. Based on the color dominance in the specific portion, color zones can be identified. Each zone has different temperature. To differentiate various zones in the flame and to observe the dominance of the color in zones, image segmentation techniques are applied. Furthermore, the histograms of the RGB components of the flame will be found out.
R&D Activities

Dr. RNP Choudhary, Professor & Head, School of nanotechnology, S “O” A University Bhubaneswar, presented his forthcoming research proposal on Bismuth-based new electronics material from NALCO red mud on 1st June 2015, which got highly acclaimed by the members present. The proposal presentation was supported by the Department of electronics and Communication Engineering, GIFT. Some critical issues for the development of the material have been analyzed with the concept of series of plots and figure. The session was attended by the members of R&D committee of GIFT.

The proposal is a joint venture of Mr. Anup Sankar Sadangi, Assistant Professor, ECE GIFT and Dr. RNP Choudhary & Dr. R C Behera of S “O” A University, Bhubaneswar.

Dr. R. C. Behera presenting a PPT on Bismuth Based new electronics material Formation

Dr. RNP Choudhary presenting his Paper on Bismuth Based new electronics material Formation

“One thing I have learned in a long life: that all our science, measured against reality, is primitive and childlike -- and yet it is the most precious thing we have.”

Albert Einstein

This is the glory of all worship—to be pure and to do good to others.