ALVA'S INSTITUTE OF ENGINEERING & TECHNOLOGY

Shobhavana Campus, Mijar, Moodbidri – 574 225

Department of Mechanical Engineering

The following technical talks were organized for the benefits of U.G and Faculty members of the department for the **odd semester 2017**.

Sl. No	Date	Title of the technical talk	Name of Invited speaker
1	8-09-2017	Role of Biomimetics in Materials Design	**Dr. Udaya Bhat** Head & Assc. Professor, Dept.of Metallurgical & Materials Engg, NITK, Surathkal
2	16-09-2017	Indian power generation sector-Energy efficiency	**Dr. M S Bhat** Director (Rtd), CPRI, Bangalore
3	07-10-2017	Advanced Composite Analysis for Aircraft Structures	**Mr. Chandra Naik D** Chief Manager Quality Assurance Dept, RWRDesign Centre, HAL Bangalore
4	05-11-2017	Health Assessment of Thermal Power Plant Boiler Components	**Dr. M. Venkateswara Rao** Joint Director, Materials Technology Division, CPRI, Bengaluru
5	09-11-2017	Waste to Wealth	**Mr. Satish Kumar Dabbiru,** Assistant General Manager, (R & D), JSW Steel Ltd, Toranagallu, Bellary

1. Role of Biomimetics in Materials Design

Dr. Udaya Bhat K
Associate Professor and Head
Dept. of Metallurgical and Materials Engg,
National Institute of Technology Karanataka, Surathkal

Talk by **Dr. Udaya Bhat K**

Talk by **Dr. Udaya Bhat K**

A technical talk on the topic "*Role of Biomimetics in Materials Design*" was delivered by *Dr. Udaya Bhat K, Associate Professor and Head, Dept. of Metallurgical and Materials Engg,*, Dept. of Metallurgical and Materials Engg, NITK Surathkal on 8th September 2017.

Professor said, **Biomimetics** is the use and implementation of concepts and principles from nature to creating new materials, devices and systems. He also said that, adaptation of biomimetic methods and systems found in nature into synthetic constructs is desirable because evolutionary pressure typically forces natural systems to become highly optimized and efficient. Nature provides a database of several solutions that already work and thus serve as models of inspiration for synthetic paradigms. Biomimetic designs can be used in regenerative medicine, tissue engineering and drug delivery.

In the presentation he talked about **lotus effect,** which refers to self-cleaning properties that are a result of ultrahydrophobicity as exhibited by the leaves of "lotus flower". Dirt particles are picked up by water droplets due to the micro- and nanoscopic architecture on the surface, which minimizes the droplet's adhesion to that surface.

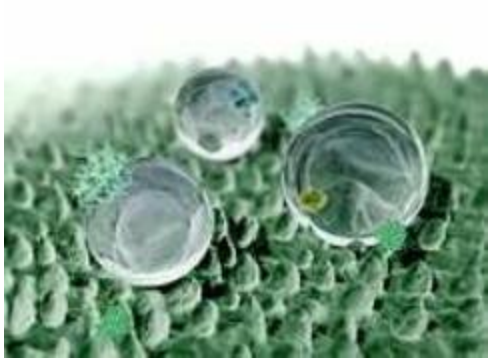
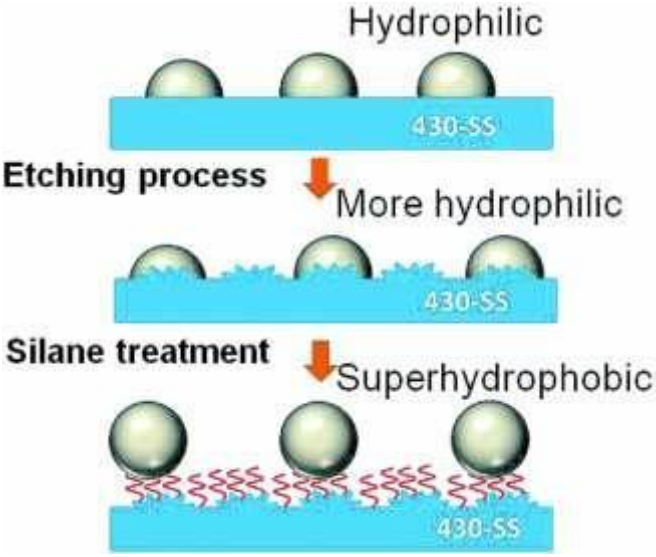


Fig: 1) Droplets of water on the lotus leaf appear spherical like beads.
2) Computer graphic of a lotus leaf surface.

Professor said, based on this technique, superhydrophobic coatings can be characterized by their unique nonadhesive and non-wetting features for various applications, such as self-cleaning, anti-corrosion, anti-icing, low hydrodynamic friction, as well as micro-electromechanical systems (MEMS). He said,

superhydrophobic coatings can be applied in automotive, building, agriculture, optical, military and aerospace systems.

Superhydrophobicity is related to the contact angle (CA) that a liquid droplet assumes with a solid surface and surrounding gas. If the CA is above 90°, the solid surface is classified as hydrophobic, and when the CA is below 90°, the surface is defined as hydrophilic. Similarly, if the CA is above 150°. The surface is considered as ultra- or superhydrophobic, and a surface having a CA of approximately zero is defined as ultra or superhydrophilic (Fig. 2).



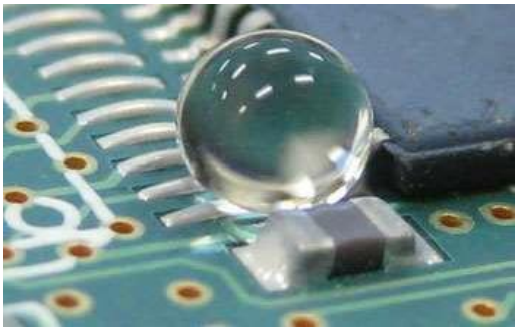


Fig : 2) Creation of super-hydrophobic 2) Super-hydrophobic Coating

Further the talk was moved to the topic, Where Do Butterflies Get Their Colors.

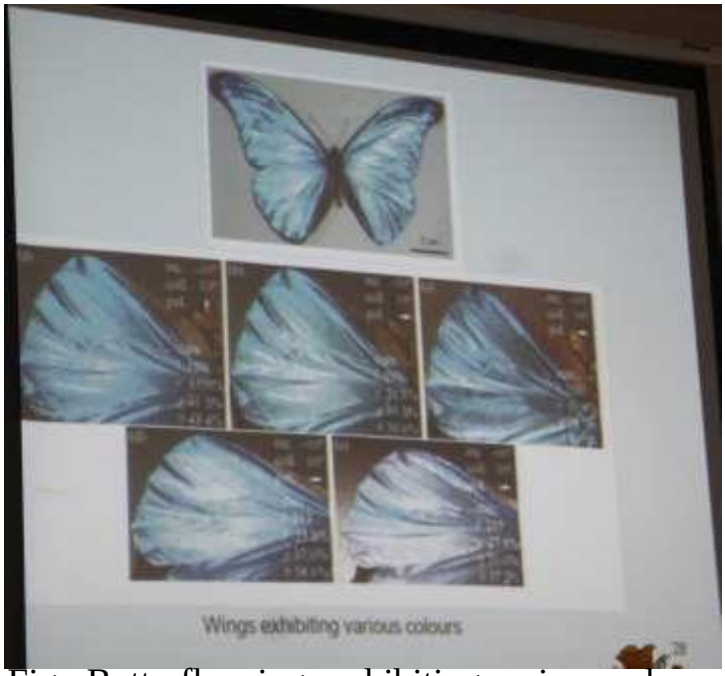
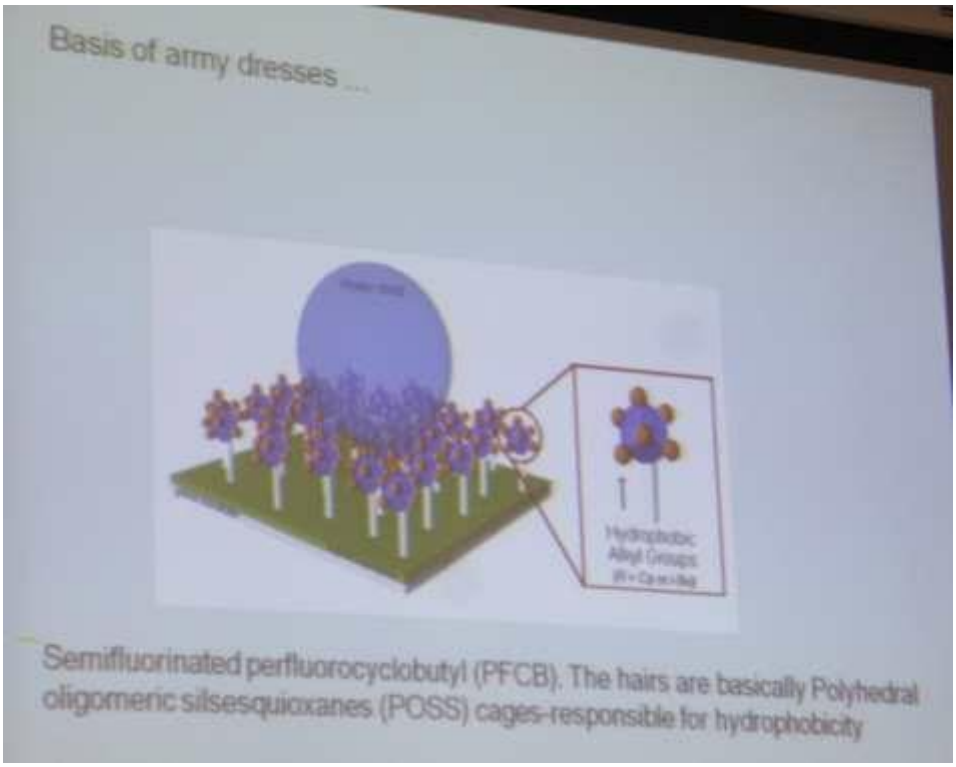


Fig : Butterfly wings exhibiting various colours

Professor said, butterflies get their colors from two different sources: ordinary color and structural color. The ordinary color comes from normal chemicals that absorb certain wavelengths of light and reflect others. Best example was given is chlorophyll colors plants green. The chlorophyll soaks up the blue and red colors of the spectrum, but not the green, which we see when it bounces back to our eye. Most butterflies get their different shades of brown and yellow from melanin.

The structural color of butterflies is where things get interesting. This type of color is from the specific structure of the butterflies' wings. The color can shift as observer, moves. This effect is known as iridescence. Mother of pearl seashells, fish, and peacocks are just a few examples of animals that have iridescence.

Other examples discussed were army dress exhibiting superhydrophobhicity.



He said, superhydrophobhicity on army dress can be achieved by coating polyhedral olgomeric silsesquioxanes (POSS).

In his presentation Profesor showed some specific SEM images which were captured by researchers at NITK Surathkal. Few of them are wings of butter fly, eye of an insect, Ductile fracture showing dimples, copper tracks on printed circuit board, and steel representing the formation of martensite etc.

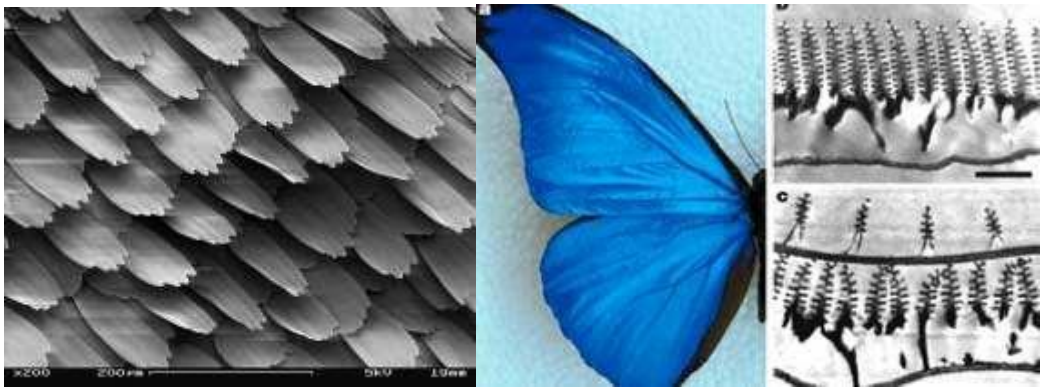


Fig : SEM image of wings of butter fly

The main benefits of this talk are students and faculty members of the department got exposure to understanding the biomimetics in real engineering materials design. The talk was specially appreciated by faculty members who have registered for Ph.D course since the talk was specific to their subject. In conclusion the talk was benefited for U.G and faculty members of the department.

Presentation of memento to Dr. Udaya Bhat K from Prof. K V Suresh (HOD Mech)

2. Energy Efficiency in Thermal Power Plant

Mr. M. Siddhartha Bhatt
Director (Retired), CPRI, Bengaluru

Talk by **M. Siddhartha Bhatt**

Talk by **M. Siddhartha Bhatt**

A technical talk on the topic "*Energy Efficiency in Thermal Power Plant*" was delivered by *Mr. M. Siddhartha Bhatt, Director (Retired), CPRI* on 15/09/2017.

Speaker said, CPRI is rendering the Energy audit and Energy efficiency service for a variety of customers for more than two decades and have undertaken audits in several energy intensive industries, thermal power stations (TPS), hydel power stations, Port trusts, oil refineries, refrigeration and air conditioning plants and buildings, etc. The services encompass the generating,

distribution and utilization segments of the power sector. Besides the fuel sector was also covered.

In the presentation he said that, Indian coals contain high ash of over 30 % to as much as 55 % GCV: 3000-4500 kcal/kg. High ash leads to erosion of boiler burners, coal piping, furnace walls and heat exchange tubing. Moreover, the power plant assets (boiler, turbine, generators, major auxiliaries, etc.) are designed for an operational life of 3,00,000 (3 lakh) operating hours or around 35 years of service under normal operating regime. If the operating regime is deviated, the acceleration of ageing takes place and the operational life gets reduced. The factors which affect the operational life are both the physical running hours as well as cyclic (on/off) operations. Each on/off or start/stop operation can be taken as an expenditure of 20 h of steady operational life. He also said that, typical (normal) number of starts in the life of a unit over 200 MW unit are as 5000 hot starts, 1000 warm starts and 500 cold starts.

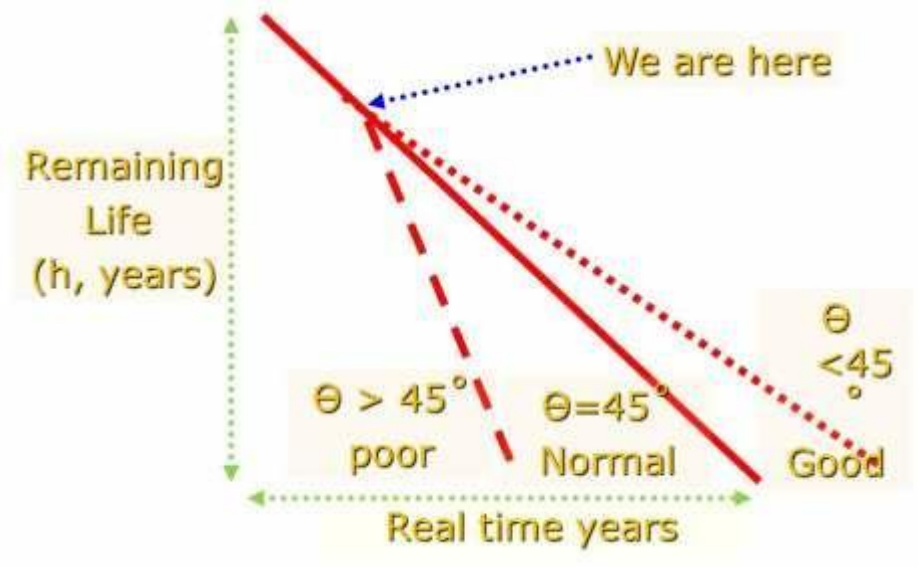


Fig: 1) Remaining life vs. Real time years

In his presentation, speaker concluded that, focused improvements in a few critical areas are conceivable such as, Boiler: Ingress control, Boiler: Steam management, Turbine: Module steam path renewal, Fuel: Monsoon fuel management and Design: Material & technology upgradation.

the main benefits of this talk are students and faculty members of the department got exposure to understanding the biomimetics in real engineering materials design. The talk was specially appreciated by faculty members those are pursuing Ph.D course in the area of thermal engineering. Since the talk was specific to their subject. In conclusion the talk was benefited for U.G and faculty members of the department.

Presentation of memento *to M. Siddhartha Bhatt* **from Prof. K V Suresh (HOD Mech)**

3. Advanced Composite Analysis for Aircraft Structures

Mr. Chandra Naik D
Chief Manager, Quality Assurance Department
Rotary Wing Research & Design Centre (RWRDC), HAL Bangalore

Talk by **M. Chandra Naik D**

Talk by **Chandra Naik D**

A technical talk on the topic "*Advanced Composite Analysis for Aircraft Structures*" was delivered by *Mr. Chandra Naik D, Chief Manager, Quality Assurance Department, Rotary Wing Research & Design Centre, HAL Bangalore* on 07-10-2017.

Speaker initially started with fundamentals and characterisation of composites. It was highlighted that composites are widely used in Aircraft Structures, in which accounting for 30% by weight and 60% by surface area. Carbon Fibre, Glass Fibre, Kevlar and Sandwich structures are used. Further the talk was diverted to analysis Test Aspects and Life Evaluation of Helicopter/ Aircraft Components of Metal and Composites. Ground testing of helicopter systems and components was discussed.

Fig 1: Experimental setup for Static Strength & Fatigue Tests on Components (Sub-assemblies & Full Airframe) located at RWRD Centre, HAL Bangalore

Other novel testing laboratory setups located at RWRD centre are shown in Figure 2.

Fig 2: Main rotor hub test and Main rotor whirl tower

He talked about ground test vehicle (GTV), which is defined as full-fledged helicopter anchored to the ground. It is equipped with all relevant items to test rotor and transmission systems in an integrated manner. GTV is mandatory for the initial flight clearance of prototype helicopters and to establish initial Time Between Overhaul (TBO) and Time Between Inspection as per airworthiness

requirements. He said, the ALH GTV was established in 1990 and a total of 450 hrs. of testing was carried out and the above requirements were met at HAL.
In the cconcluding remarks speaker said, establishment of test facilities, continuously develop expertise in testing and saving valuable foreign exchanges are crucial and necessary.
He also said that every year there are lots of openings at HAL for engineering graduates. For which GATE exam is necessary. He stressed students to apply for the same. The talk was specially appreciated by students. Since the talk was interesting. In conclusion the talk was benefited for U.G and faculty members of the department.

Presentation of memento *to M. Chandra Naik D* **from Prof. Yogish Rao**

4. Health Assessment of Thermal Power Plant Boiler Components

Dr. M. Venkateswara Rao
Joint Director, Materials Technology Division,
Central Power Research Institute (CPRI), Bengaluru

Talk by **Dr. M. Venkateswara Rao**

Talk by **Dr. M. Venkateswara Rao**

A technical talk on the topic "*Health Assessment of Thermal Power Plant Boiler Components*" was delivered by *Dr. M. Venkateswara Rao, Joint Director, Materials Technology Division, CPRI, Bengaluru* on 05th November 2017.

Initially, a video related to the profile of Central Power Research Institute (CPRI) was presented. He said, CPRI has a vast experience and expertise in the areas of material characterization, simulation, diagnostic, calibration, and system analysis. CPRI also provides the consultancy services on various needs of power sector besides offering Customised Training Programmes. It has been extending its services for over five decades to industries in their quest for innovation, new product development, import substitution, quality assurance etc.

In his presentation, emphasis on Health Assessment of coal based thermal plant was highlighted. He said, coal based power generation accounts for over 83% of India's thermal power capacity. There is about 20% short fall of domestic coal supply in the country based on the forecast made by Coal India Ltd for the next 5 years. It was also expressed that, the imported coal is being blended with Indian coals and fired in the thermal power plants. There are crucial issues involved in respect of firing blended coals in existing Indian thermal power plants, as the boilers are designed for Indian coal characteristics.

He said, some of the properties like thermal input and overall ash loading can be predicted from the blend ratio of the constituent coals, but not all the other properties. Some of the qualitative properties like grindability, ash fusion temperature, combustion reactivity, etc are generally non additive. This leads to unexpected problems like reduced mill efficiency, clinker formation, increased unburnts in ash, etc. In this context, fixing blend proportion based only on ash load and heat value is questionable.

Then, the talk was directed towards RLA (Remaining life assessment) methodology and types of tests carried out during RLA. Remaining life assessment is an estimate of the reliability of a product in its life cycle application environment based on health monitoring and prognostics analyses. The purposes of RLA Technology are Escalating cost of new units, Extended lead times in plant construction, Increasingly stringent environment and safety regulations, Increasing awareness of the technological feasibility of extending

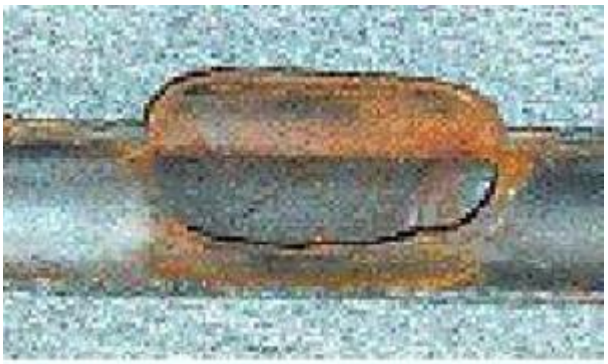
component life, Metallurgical damage through thermally induced, degradation, Service sponsored damage (creep, thermal fatigue, fatigue), Mechanical damages (Fly ash erosion), Metal Oxidation / Corrosion, Chemical damage due to disturbance in feed water quality, Operation outside design limits.

Header –T Weld inspection

Steam pipe

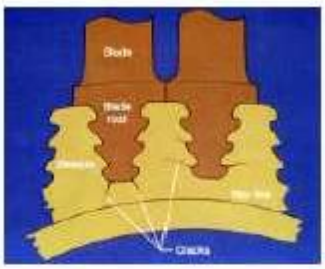
Creep fatigue

Main steam pipe weld failure



Hydrogen embrittlement

Fig : Typical boiler component inspection for RLA study



Turbine Blade steeple

Turbine Casing

Turbine Bolt

Fig : Inspection of turbine components for RLA study

He talked on Assessment of Microstructural Degradation in which the following tests/methods to be followed

Laboratory Evaluation - Destructive in nature
Sampling of tubing required
Limitations – sampling

In-Situ Metallography - No Sampling Is Required
On Site Assessment
By Replication Technique

Result stages of graphitiztion
inspection interval strategies
qualitative assessment

In his presentation he said, oxide scale in boiler tube produced by oxidation of tube metal, (steam side - tube internal), Compound of Complex iron oxides. Due to oxidation , Reduces heat transfer, Increases tube metal temperature, Increases the rate of scale formation, Reduces the effective wall thickness, and hence the operating stress, Promote creep in tube metal

Oxide layer formation in the boiler tube

He spoke on Methodology for Oxide Scale Measurements

Conventional : Destructive Technique, Lab. Evaluation of samples cut and removed from component by Optical or Scanning and Electron Microscopy

Advanced : Non - Destructive Evaluation, Ultrasonic technique using high frequency, special long delay line probes

In concluded that, Comprehensive evaluation of Remaining life of tubes taking into account of fire side corrosion and metallurgical degradation Advanced NDE methods viz. UT using EMATs, Phased array UT for turbine components, Small punch tests for embrittlement studies etc are required.

The main benefits of this talk are students and faculty members of the department got exposure to understanding concept of Health Assessment of Thermal Power Plant Boiler Components. The talk was specially appreciated by faculty members who have registered for Ph.D course (both thermal and materials background) since the talk was specific to their subject. In conclusion the talk was benefited for U.G and faculty members of the department.

Presentation of memento to Dr. Venkateshwar Rao from Prof. K V Suresh (HOD Mech)

5. Waste to Wealth – An industrial case study on converting slag into aggregates

Mr. Satish Kumar Dabbiru
Assistant General Manager, (R & D),
JSW Steel Ltd, Toranagallu, Bellary

Talk by **Mr. Satish Kumar Dabbiru**

Talk by **Mr. Satish Kumar Dabbiru**

A technical talk on the topic "*Mr. Satish Kumar Dabbiru, Assistant General Manager, (R & D), JSW Steel Ltd, Toranagallu, Bellary* was delivered by *Mr. Mr. Satish Kumar Dabbiru, Assistant General Manager, (R & D), JSW Steel Ltd, Toranagallu, Bellary* on 09-11-2017.

Speaker said, slag is a high volume by-product from the metal smelting process. Globally, hundreds of millions of tonnes of molten slags are produced each year. Slag is commonly air-cooled in large pits and used for landfill or used for road-based materials after crushing and screening. In some modern integrated

steelworks, molten blast furnace slag is granulated using water jets — producing a glassy product which can be used as valuable feed in cement manufacturing by replacing ordinary Portland cement and significantly reducing the greenhouse gas emissions associated with the calcinations process. However, water granulation consumes large volumes of water and may generate acid mist causing air pollution. More importantly, the wet process does not recover the large amount of high-grade heat contained in the molten slag. On cooling from around 1500 °C to ambient temperature, one tonne of molten slag releases about 1.8 GJ of heat. This could amount up to 800 PJ of heat globally from blast furnace slags alone and if recovered and utilised, could potentially reduce emissions by up to 60 million tonne each year. So speaker said, by recovering heat and creating valuable waste products are essential.

In the presentation he said that, JSW has developed a new, integrated dry granulation and heat recovery process which promotes sustainability and full value recovery. Molten slag is atomised under centrifugal forces exerted by a spinning disc to produce droplets which are then quenched and solidified using air to recover the heat. This method produces glassy slag for cement manufacturing and simultaneously recovers waste heat as hot air which can then be used onsite for drying, preheating or steam generation.

Compared with the water granulation process, the dry granulation process provides a much more sustainable approach, overcoming major shortcomings of the existing method through saving water, eliminating sulphur emission and recovering high-value waste heat.

He talked about dry granulation; the dry granulation process is destined to replace the conventional water granulation process, delivering sustainable, environmentally friendly and full value recovering process with benefits of:

waste heat recovery

huge savings in water

reduced air pollution

lower capital costs.

By converting low value slow cooled blast furnace slag into a high value material for the cement/construction industry, this process turns a waste product into wealth. He also said that, thick roads are constructed at bellary using waste slag produced from steel plant.

The main benefits of this talk are students and faculty members of the department got exposure to understanding of converting slag into aggregates. The talk was specially appreciated by students and faculty members. In conclusion the talk was benefited for U.G and faculty members of the department.

Presentation of memento *to Mr. Satish Kumar Dabbiru* **from Dr. Satyanarayan**