Summary Report

Annual seminar
on
Material Science & Engineering
Of Malaviya Chair

By
Indian Institute of Technology
Banaras Hindu University/Varanasi
(IIT/BHU)

At
Research Designs & Standards Organization
(RDSO/Lucknow)

16th February 2016

1. Preface:

A Memorandum of Understanding has been signed between RDSO & IIT/BHU on 8th June 2015 for setting up of 'Malaviya Chair for Railway Technology' at IIT/BHU. The MOU aims at collaboration between Indian Railways and IIT/BHU in the field of 'Material Science & Engineering'.

As per para no C-4 of Memorandum of Understanding "*by virtue of its position of eminence, IIT (BHU) would assist Indian Railways towards enhanced vision & learning for design studies, research works, projects, etc. in Materials Science & Engineering, relevant for Indian Railway & publish the same in annual general, bring out the best practices, innovations, improvisations to benefit the rail passengers/users and other rail travel areas. An annual seminar on Materials Science & Engineering would be conducted by IIT (BHU) at nominated/selected premises of Indian Railways for knowledge dissemination & sharing of research results.*

Therefore, this Seminar was organized.

2. Aim of the Annual seminar:

- To disseminate the knowledge of Materials to the Railway Personnel.
- The knowledge of Materials will help Railway personals in proper failure analysis, proper maintenance & hence contribute to increase in reliability of assets.

3. Overview of Annual seminar:

i) Shri P.K. Srivastava, Director General, RDSO inaugurated the annual seminar by lighting the lamp in presence of Professors from IIT/BHU, Adll.Director General/RDSO, and Sr. Executive Directors/Executive Directors of RDSO.

ii) Welcome address and introductory remarks were given by Shri V.K. Agarwal, Executive Director Research. In the Welcome Address he mentioned that:

- Malaviya Chair was set up by Indian Railways in June 2015 at Banaras Hindu University, Varanasi.
- A Chair Core Committee has been formed for monitoring functioning of this Chair. Shri R.K. Verma, Secretary Railway Board is Chairman of this Chair Core Committee and Prof. R.K. Mandal is Co-ordinator from IIT/BHU side.
- One of the mandates of this Chair is to disseminate knowledge about materials.

iii) Prof. R.K. Mandal, Head, Department of Metallurgical Engineering addressed the gathering and explained the scope of Metallurgical Engineering in Indian Railways.

iv) Shri P.K. Srivastava, Director General, RDSO addressed the gathering. In his address DG/RDSO mentioned that-

- It's a matter of great pride that RDSO has signed a MoU with a prestigious and one of the oldest institutions IIT/BHU on 8th June 2015 for setting up of 'Malaviya Chair' on "Material Science & Engineering", which was announced by Hon'ble MR in his Budget Speech 2015-16.
- RDSO is the technical wing of Indian Railways and its key responsibility areas are Research and Development of overall system standards for new or improved designs, framing of specifications, guidelines and best practices, absorption and upgradation of new technologies, which puts IR in the league of leading World Railways.
- RDSO endeavour has always been to attain technological excellence through assimilation of new knowledge and innovations, which has helped RDSO in attaining exponential growth on the Technology Trajectory & the purpose of this seminar is to disseminate the knowledge of Materials to the Railway Officers & Staff which will help them in proper failure analysis, proper maintenance & hence contribute to increase in reliability of assets.

4. Topics of Seminar:

The following topics were covered during the seminar:

A. Micro structural Evolution and Phase Transformations
By Professor R.K. Mandal, IIT/BHU

Course contents:

Introduction, Micro structural evolution (Understanding micro structural features at various length scales of physical metallurgists), Importance of microstructure, Phase transformation (Phase refers to part of system that is chemical homogeneous, physically distinct, mechanically separable), Solidification microstructures, Solidification: Nucleation Types (Homogeneous nucleation, Heterogeneous nucleation), Phase transformation in single component systems, Transformation

with changes in composition and crystal structure, Iron-Iron carbide system, Types of transformation.

B. Heat Treatment of Ferrous Alloys
By Professor S.N. Ojha, IIT/BHU

Course contents:

Introduction, Principle, Heat treatment Processes, Annealing, Normalizing, Hardening & Tempering (Using an effective Quenching medium, Hardenability of steels), Mechanism of Quenching, Hardenability (can be defined as the capacity of steel to develop desired Degree of Hardness), Measurement of Hardenability, Ideal Critical Diameter, Effect of Alloying Elements, Quench Cracks, Tempering of Steels, Heat Treatment Cycles of Tool Steels, Heat Treatment (Heat Treatment Involves Thermal Cycling of a Material that Induces Phase Transformation and Controls the Microstructure and Resultant Physical and Mechanical Properties), Heat Treatment Cycle of Steels, Procedure to Construct TTT Diagram.

C. Mechanical properties of Structural Behaviour
By Professor Vakil Singh, IIT/BHU

Course contents:

Introduction, Tensile Properties, Tensile Testing, Strength, Ductility, Linear Portion of Stress-Strain Curve, Yielding, True Stress-True Strain Curve, Elastic Strain Recovery, Elastic and Plastic Deformation, Schematic Drawing of Slip, Critical Resolved Shear Stress, Hardness, Types of Hardness, Impressions made by indentor, Relation Between Hardness and UTS, Ductile to Brittle Transition Temperature Curve, Effect of stress and temperature on creep curve, Fracture and Failure Analysis, Fatigue, S-N curve, Effect of mean stress and loading pattern, Statistical nature of fatigue, Steps in fatigue failure, Fatigue crack growth behavior.

Case Study:

- Fatigue Crack Growth in A Solid Circular Shaft Under Fully Reversed Rotating Bending
- Failure Analysis of helical compression spring for heavy vehicle's suspension system
- Failure study of railway rail serviced for heavy cargo trains

5. Participants:

- ***From IIT/BHU -***

a) Prof. R.K.Mandal, Head, Department of Metallurgical Engineering.
b) Prof. S.N.Ojha, Department of Metallurgical Engineering.
c) Prof. Vakil Singh, Department of Metallurgical Engineering.

- ***From Zonal Railways & Production units-***
  S/Shri

SN	Participant's Name	Railway
1	Pankaj Pal, ADEE	Northeast Frontier Railway (NFR)
2	Manoj Kumar, ADEE	
3	Vijay Prakash, ADME/D/MLDT	
4	B.R. Meena, SMM	North West Railway (NWR)
5	R.K. Meena, SMM	
6	Ch.V. Ramana, Exe.Mech.Engg(WS)	East Cost Railway (ECoR)
7	S.B.Sahoo, Dy.CE/TM	
8	Atanu Gupta, AWM/Wagon	Eastern Railway (ER)
9	C.K. Mayurnathan, AXEN/TM	South Western Railway (SWR)
10	L. Paneendra, AWM/R	
11	M.N. Jha, Dy. CME	East Central Railway (ECR)
12	D.C. Singh	
13	G.C. Mukherjee, WM	Chittaranjan Locomotive workshop (CLW)
14	Bhawan Meena, AEE	
15	Atul Kumar, AEN	Western Railway (WR)
16	Ashok Kumar Sharma, ACMT/lower panel	
17	Ramprit Maurya, AEE/Rajdhani/BCT	
18	M. Badruddin, SSE/Met	
19	Ravindra Babu, Sr.DME	Southern Railway (SR)
20	V.Vibhooshan, ACMT	
21	J. Chandra Sekhara Rao	Integral Coach Factory (ICF)
22	K. Panneerselvam, ACMT/Fur/ICF	
23	Prashant Kumar, WM/Fur-II	Rail Coach Factory (RCF)/Kapurthala
24	Man Singh Meena, WM /Bogie	
25	V.S. Yadava, Sr. DME/O&F	North Eastern Railway (NER)
26	Satyam Kumar Singh, XEN/TM	
27	Anil Kumar Singh, ASTE	North Central Railway (NCR)
28	Vikas Verma, DME/DSL	
29	R.D. Bhargava, ADEE/TRS	
30	Kunwar Singh Yadav, ADEE/TRS	
31	Nitin Garg, XEN/TP	
32	Jitendra Srivastava, AWM/R/BPL	West central Railway (WCR)
33	Rajesh Patel, ADME/D/ET	

- ***From RDSO/Lucknow -***

  Sr. Executive Director, Executive Directors, Directors and SSE/SEs from Engine Development, Traction Installation, Bridge &Structures, Carriage, Electric Loco, Energy Management, Geo-technical, Metallurgy &Chemical, Motive Power, Power Supply &EMU, Stores, Signal, Telecom, Testing, Track Machine, Track, Urban Transport & High Speed, Wagon etc. attended the annual seminar on 'Material Science & Engineering'.

6. <u>Suggestions</u>:

Participants were asked to give feedback about the Seminar and suggestions for making it more useful in the future for meeting the Zonal Railways' requirements. Participants were happy with the knowledge gained in the Seminar. However, following suggestions were made by participants for making the Seminar more effective in future:

- Inclusion of more case studies (covering cause of failure found, deficiency in failure analysis done by Zonal Railway, corrective action required, etc.) centering on failure analysis of parts, which have been sent by the Zonal Railways to RDSO or which can be sent to IIT/BHU also. It was a good suggestion and was accepted for implementation.
- Concerned Vendors of the failed parts, along with other vendors whose parts have not failed or not failing may also be invited for Participating in the Seminar for giving their view point. It was a good suggestion and was accepted for implementation.
- Knowledge about use of Composite materials may be imparted. It was a good suggestion and was accepted for implementation.

7. <u>Vote of Thanks</u>:

The annual seminar ended with vote of thanks to all concerned who have contributed to making this Seminar a success, especially Professors from IIT/BHU.

Shri T.K. Khare
Director Research/S&T/RDSO

8. Photographs

❖ *Floral welcome by Shri V.K. Agarwal, Executive Director Research* :

Shri P.K. Srivastava
Director General/RDSO

Shri R.N. Misra
Adll.Director General/RDSO

Prof R.K.Mandal
Head,Deptt.of Metallurgical Engg.

Prof Vakil Singh
Department of Metallurgical Engg.

Prof S.N.Ojha
Department of Metallurgical Engg.

Dignitaries

❖ *Dignitaries Lighting the Lamp*

❖ *Dignitaries Addressing the Gathering*

Prof Vakil Singh
Department of Metallurgical Engg.

Prof S.N.Ojha
Department of Metallurgical Engg.

❖ *Group Photographs of Participant :*