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February 2014

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Theme: Green Tribology

17-20 February, 2014

Jaypee Palace Hotel & Convention Centre, Agra, India

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ASIATRIB - 2014

Theme: Green Tribology

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Theme: Green

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ASIATRIB - 2

Theme: Green Tribor

17-20 February, 201

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ANTHONY SOMERS



SATISH KAILAS



IN HAE SUNG















Tribometer Plus

- Nano, Micro, Macro
- High/Low Temperature
- Insitu 3D Imaging/Raman
- Ball/Pin on Disk
- Fretting (500hz)
- Linear Reciprocating
- Block on Ring
- Heavy Duty Platform

generation multi function meter that runs several hard tribological and mechanical tests on same platform. It has a sturdy design, loop force control, vari-situ characterization techniques etc..

High Load Block integrated with profiler

Statistical analysis

Temperature -100 to 1200°C
 nN to 5000N
 Friction, Wear
 Wear Scar, Volume



1810 Oakland Road, San Jose, CA, 95131, USA

Nano Indenter & Scratch Multi Function Tribometer

www.rtec-instruments.com




Profilometer Plus

- White light Interferometer
- Optical Profiler+
- AFM /Contact Profiler+
- Raman+
- Stress+
- Confocal Microscope +..

A multi functional profiler that can measure surface roughness, chemical, magnetic, stress, film thickness etc, properties on same spot without taking the sample out of the tool.




CSM INSTRUMENTS TRIBOMETERS for Friction and Wear Studies

Pin-on-Disk Tribometer

- Nano Tribometer (NTR)
 - > Quartz cantilever beams with normal load control up to 1000 mN
 - > Optional optical video microscope
 - > Rotative and/or linear reciprocating motion
 - > Load cell dependent load control with locking mechanism
 - > Adhesion measurements
- High Temperature Tribometer
 - > From ambient temperature control up to 1000°C
 - > Rotative motion, multiple reciprocating mode included

Vacuum Tribometer

- Primary or secondary vacuum system down to 10⁻⁶ mbar
- Compatible with high temperature tribometer

These tribometers are conform to international standards
 DIN 50324 / ASTM G99 / ASTM G113

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 Phone: +41 78 850 96 80 | Fax: +41 78 957 96 10 | Email: info@csm-instruments.com



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17-20th February 2014

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Large table with 3 columns (18th, 19th, 20th February 2014) and multiple rows of text detailing tribology products and presentations.

Conclusion: Tribology Society of India
17-20th February 2014







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Ferrography provides an early warning of Machinery Components Abnormal Wear Modes

Author
K.N.V.Subrahmanyam
Technical Head-Lubricant Analysis
Petrolabs India Pvt.Ltd

CONCEPTS IN VIBRATION TECHNOLOGIES

- Vibration Analysis
- Shock Pulse Analysis
- Thermography
- Mass Flow Analysis
- Motor Current Signature Analysis
- Used Oil Analysis/Ferrography

Particle Classifications & Types of Wear

Ferrous Analysis Details

Ferrous Analysis & Change Monitoring Photos



Ultrasound Assisted Lubrication

Dinesh Pratap Singh,
For UE Systems, Inc.

60-90% of all bearing failures are lubrication related

Many FA Lube schedules are just guesses

1. Test
2. Identify
3. Diagnosis
4. Lubricate



Time based vs Condition Based Lubrication



Prevent Overheating Temperature Increase

Seal Failures



ASIATRIB-2018

Reliability of Milling Plant in The Rishikesh Kumar & Dr. Shri L&T Power, Engineering & Technology Group

Abstract

Introduction

Problem Major Assembly

Major Assembly

High Speed of Milling Process

Conclusion

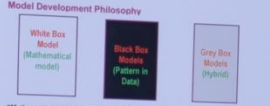
References

ON-LINE MODEL FOR COIL ROLLING HYBRID MODEL

S. RATH, A.K. MARIK, P.P. SENGUPTA, S.K. THAKUR, P. PATHAK AND M.B.S. NAMBOOTHIRIPAD
R & D Centre for Iron & Steel (RDCIS), SAIL, Ranchi, India. *Rourkela Steel Plant, SAIL, Rourkela, India
Email: srath@sail-rdcis.com

Abstract
Coefficient of friction at the roll-strip interface is an important parameter required for prediction of roll force, torque and power for model based operation (level-2 automation) of hot strip mills. As there is no direct method of its measurement, it is being estimated from other measurable parameters like flow stress of material, strip temperature, roll gap, mill speed, and roll force using a mathematical-Artificial Neural Network (ANN) hybrid model developed for the purpose. This paper discusses the methodology of model development and its validation by comparing predicted roll force and measured roll force.

Importance of the Estimation of Coefficient of Friction
Accurate estimation of coefficient of friction at the roll-strip interface during hot rolling of strip is important for two reasons:
1. There is no direct method for measurement of coefficient of friction at roll-strip interface.
2. Estimated value is used for prediction of roll force which is an important component for model based operation (level-2 automation) of the mill. The predicted roll force is further used to predict torque and power requirement.
3. The estimated value is used as a performance indicator for hot rolling sets used in Roll Line Lubrication (RLL) systems.



Mathematical Models are developed using fundamental derived equations. As this is based on simplified assumptions, accuracy of this method is low when applied to industrial conditions. Black box models are developed by finding patterns in data. Artificial Neural Network (ANN) and regression based models are examples of such methods. Problems in convergence and non-repeatability with industrial data are problems associated with this method. SAIL-RDCIS models use hybrid modeling technique combining both Mathematical and ANN model. This method is found to be highly accurate in industrial applications.

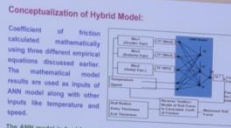


Roll Force derived by Russian scientist Tsakalov is given by:

$$F = \frac{2 \cdot \sigma \cdot L \cdot W \cdot \sqrt{R \cdot \Delta h}}{\sqrt{1 + \mu^2}}$$

where $\sigma = \sigma_0 + K \cdot \epsilon^n$, $\epsilon = \sqrt{\Delta h / R}$ and friction factor $\mu = \frac{2 \cdot \sigma_0 \cdot \mu_0}{\sigma}$

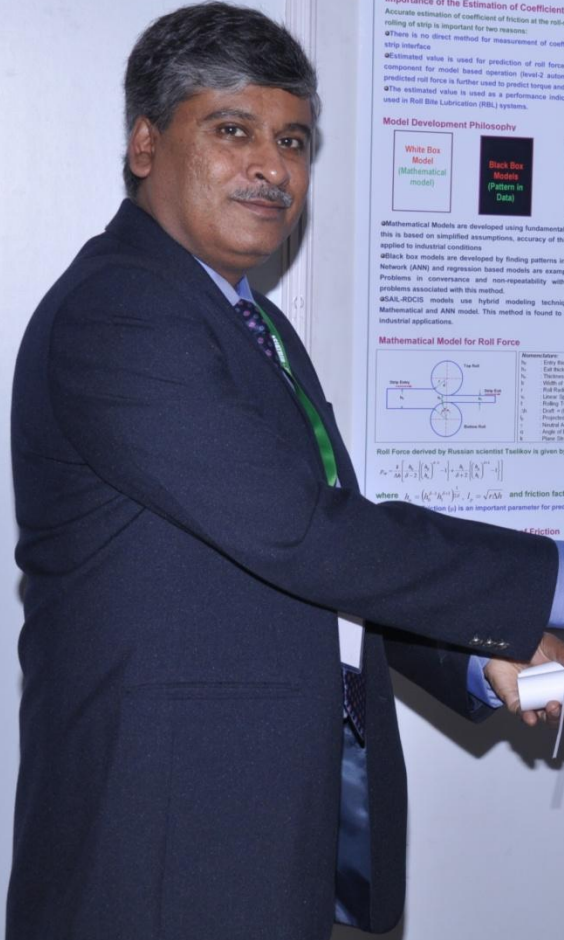
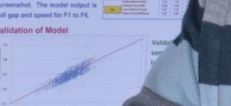
(μ_0) is an important parameter for prediction of roll force.



The ANN model is feed-forward network type with back-propagation algorithm used for training of the network. Coefficient of friction was calculated mathematically from measured roll force using an inverse-Tsakalov's equation. After the training of the model with measured roll force data, the model predicted Coefficient of friction from the train set of input data which in-turn used for prediction of roll force using Tsakalov's method.



On-line Level-2 Model Screenshot



TSI914557

TSI914631

TSI914632

ASIATRIB-2014 **L&T Power**

of Milling Plant in Thermal Power Stations
 Rishikesh Kumar & Dr. Shrikant Bhawe
 Engineering & Technology Group, R&D Dept., Vadodara, India

Introduction - Purpose of Milling Plant, Importance of Milling Plant, Milling Plant in Thermal Power Stations.

Background - Milling Plant in Thermal Power Stations, Importance of Milling Plant, Milling Plant in Thermal Power Stations.

Methodology - Milling Plant in Thermal Power Stations, Importance of Milling Plant, Milling Plant in Thermal Power Stations.

Results - Milling Plant in Thermal Power Stations, Importance of Milling Plant, Milling Plant in Thermal Power Stations.

Conclusion - Milling Plant in Thermal Power Stations, Importance of Milling Plant, Milling Plant in Thermal Power Stations.

Incipient Fault Detection of Rolling Element Bearing Running at Slow speed
 Charanjan Mandal, R.K. Prasad, P.P. Sengupta
 Research & Development Centre for Iron & Steel, SAIL, Ranchi, India
 Email: charanjan@sat.riidc.com

BACKGROUND:

- Bearing failure without warning result catastrophic consequence like production down time, damage to other machine element etc.
- Detection of incipient fault is essential.
- The system available normally is good for the bearing operating at higher speed >1000 RPM.
- No system readily available for monitoring the bearing operating at slow speed (<500 RPM) or at fractional RPM.

INTRODUCTION:

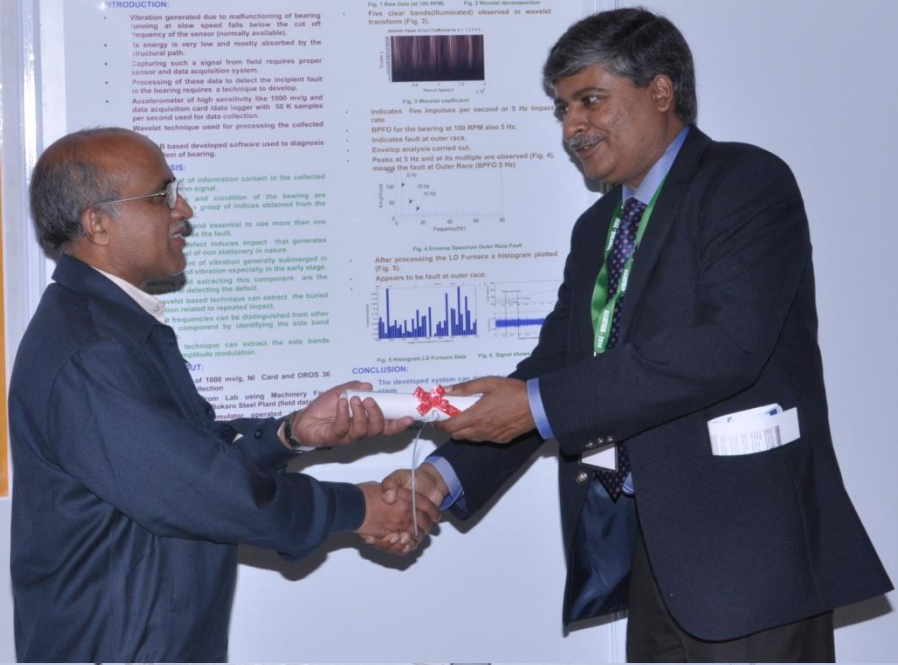
- Vibration generated due to malfunctioning of bearing running at slow speed falls below the cut-off frequency of the sensor (normally available).
- Its energy is very low and mostly absorbed by the structural path.
- Capturing such a signal from field requires proper sensor and data acquisition system.
- Processing of these data to detect the incipient fault in the bearing requires a technique to develop.
- Accelerometer of high sensitivity like 1000 mv/g and data acquisition card data logger with 50 K samples per second used for data collection.
- Wavelet technique used for processing the collected data.

RESULTS:

- Wavelet based developed software used to diagnosis of bearing.
- Wavelet based developed software used to diagnosis of bearing.
- Wavelet based developed software used to diagnosis of bearing.

CONCLUSION:

The developed system can detect the incipient fault in the bearing running at slow speed.



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TSI914688

Performance of CVT Computed Axial Bearing Lubrication with Micrograph Lubrication
 Rishikesh Kumar, Dr. Shrikant Bhawe
 Engineering & Technology Group, R&D Dept., Vadodara, India

ABSTRACT: The present work is aimed to study the performance of constant flow rate CVT (computerized axial bearing lubrication) with micrograph lubrication. The objective of the study is to compare the performance of CVT with micrograph lubrication. The average results are compared with the results of CVT. The average results are compared with the results of CVT.

INTRODUCTION: The present work is aimed to study the performance of constant flow rate CVT (computerized axial bearing lubrication) with micrograph lubrication. The objective of the study is to compare the performance of CVT with micrograph lubrication. The average results are compared with the results of CVT.

RESULTS: The average results are compared with the results of CVT. The average results are compared with the results of CVT.

CONCLUSION: The average results are compared with the results of CVT. The average results are compared with the results of CVT.

ESTIMATION OF COEFFICIENT OF FRICTION AT ROLL-STRIP INTERFACE DURING HOT STRIP ROLLING USING HYBRID ON-LINE MODEL
 S. Rath, A.K. Marik, P.P. Sengupta, S.K. Thakur, P. Pathak and M.B.S. Nambhooripad
 R & D Centre for Iron & Steel (RD-CIS), SAIL, Ranchi, India. "Rourkela Steel Plant, SAIL, Rourkela, India
 Email: sra@sat.riidc.com

Abstract: Coefficient of friction at the roll-strip interface is an important parameter required for prediction of roll force, torque and power for model based operation (level-2 automation) of hot strip mills. As there is no direct method of measurement, it is being estimated from other measurable parameters like flow stress of material, roll gap, roll speed, and roll force using a mathematical Artificial Neural Network (ANN) hybrid model developed for the purpose. This paper discusses the methodology of model development and its validation by comparing predicted roll force and measured roll force.

Importance of the Estimation of Coefficient of Friction: Accurate estimation of coefficient of friction at the roll-strip interface during hot rolling of strips is required for two reasons. If there is no direct method for measurement of coefficient of friction of roll-strip interface, the estimation of roll force, torque and power for model based operation (level-2 automation) of hot strip mills is not possible. The prediction of roll force, torque and power is essential for the design of mill drive system and power requirement. If the coefficient of friction is not known, the prediction of roll force, torque and power is not possible.

Conceptualization of Hybrid Model: The coefficient of friction calculated mathematically using flow stress of material, roll gap, roll speed, and roll force using a mathematical Artificial Neural Network (ANN) hybrid model developed for the purpose. This paper discusses the methodology of model development and its validation by comparing predicted roll force and measured roll force.

Mathematical Model for Hybrid Model: The coefficient of friction is estimated using the hybrid model during rolling of the strip. The coefficient of friction is estimated using the hybrid model during rolling of the strip.

Validation of Model: The coefficient of friction is estimated using the hybrid model during rolling of the strip. The coefficient of friction is estimated using the hybrid model during rolling of the strip.



PREDICTION OF HARDENABILITY OF ALLOY STEEL DURING QUENCHING WITH DIFFERENT OILS THROUGH A CORRELATION ANALYSIS
 M. K. Dubey, R. Mahapatra, S. V. Ramakumar, B. Basu and R. K. Mallick
 D. Saxena, G. K. Acharya, S. S. V. Ramakumar, B. Basu and R. K. Mallick
 Indian Oil Corporation Limited, R&D Centre, Sector 13, Faridkot, Haryana, India
 Email: mahapatra@indianoil.in

Problem Statement: A customer approached the authors of company to develop a suitable quantitative tool to improve the hardenability of alloy steel and determine its performance in an experimental setup.

Objective of the Work: Characterize the alloy steel for heat treatment of steel plates in 80 mm thick x 12 x 12 mm (3 in length). Characterize 80 mm thick plates as satisfactory. Coating characteristics of oil. A new methodology for predicting hardenability of alloy steel. Customer asked for a report of meeting the desired hardness for the customer.

Approaches adopted: Two improved oil samples formulated. A new predictive oil sample. Sample prepared with top treating oil. Coating data generated for oil. Coating data generated for oil. Coating data generated for oil.

Physical chemical properties of quenching oil samples A,B and C:

CHARACTERISTICS	SAMPLE 'A'	SAMPLE 'B'	SAMPLE 'C'
Specific Gravity @ 20°C	0.87	0.87	0.87
Viscosity @ 40°C	120	120	120
Flash Point @ 10°C	170	170	170
Clouding Point @ 10°C	170	170	170
Acid Number	0.05	0.05	0.05
Water Content	0.05	0.05	0.05

Experimental Work: The authors conducted experiments to study the hardenability of alloy steel in different oils. The authors conducted experiments to study the hardenability of alloy steel in different oils.

Comparative Test Results: The authors conducted experiments to study the hardenability of alloy steel in different oils. The authors conducted experiments to study the hardenability of alloy steel in different oils.

Conclusions: Significant increase in quenching characteristics was observed with sample B. Hardenability of alloy steel improved from 0.85 to 0.95 for oil B. Hardenability of alloy steel improved from 0.85 to 0.95 for oil B.



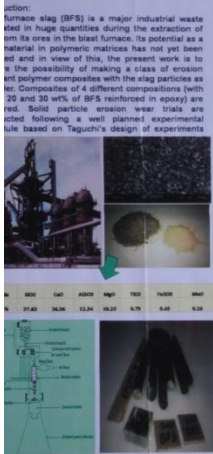
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TSI914714

Friction, Characterisation and Wear Performance Evaluation of Polymer Composites with Blast Furnace Slag Particles as Filler

Prasanta Kumar Padhi, Dr. Alok Satapathy



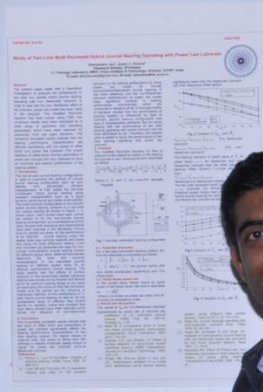
Taguchi Experimental Model:

Taguchi's experimental design is a powerful analysis tool for modeling and analyzing the influence of control factors on performance. The erosion wear tests on the composites were carried out under different operating conditions considering five parameters, viz., impact velocity, erodent size, erodent temperature, impingement angle and filler content, each at four levels, in accordance with Taguchi's $L_{16}(4)^5$ orthogonal array.

Control Factor	Level
Impact velocity	10
Erodent size	100
Erodent temperature	100
Impingement angle	10
Filler content	10



Available for engineering highly erosive environments by filling of micro-sized blast furnace slag particles. The presence of these composites reduces the erosion wear rate.



Influence of the solid particles on Wear and friction of the thermal barrier coating

Kyoung-Soo Kim, Chang-yeol Oh, Kyu-Chul Han and Young-Se Lee
School of Mechanical Engineering, Sungkyunkwan University, Suwon, Gyeonggi-do, Korea
ksoo@skku.edu, gyocho@skku.edu, hoesy@skku.edu, yse@skku.edu

Abstract: Wear tests using ceramic coated alumina were performed to evaluate a tribological behavior of the thermal barrier coating in one of the most important parts to ensure the reliability of hot components operated under extreme environments. The tribological behavior was investigated under various conditions. The wear tests were carried out under various conditions. The wear tests were carried out under various conditions. The wear tests were carried out under various conditions.

Keywords: Thermal barrier coating, wear, friction, solid particles.

TSI914730

TSI914507

TSI914554

Friction and Wear Characteristics of Nitrocarburized 34CrMo4 Steel

Kotán Vass^{1,2}, Csaba Felhő^{1,2}, Mária B. Maros^{1,2}, Andrea Sallayiné Biró^{1,2}

Abstract: The tribological behavior and wear resistance of nitrocarburized 34CrMo4 steel was investigated under various conditions. The tribological behavior was investigated under various conditions. The tribological behavior was investigated under various conditions.

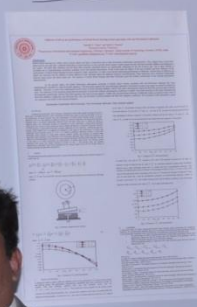
Keywords: Nitrocarburized steel, friction, wear, tribology.

THEORETICAL COMPUTATION OF THE OPERATIONAL CHARACTERISTICS IN A LARGE THRUST BEARING

D.V. Srikanth¹, K.K. Chaturvedi², A. Chenna Keshava Reddy³
¹MLRT, Hyderabad, ²BHEL R&D, Hyderabad, ³ANTUJ, Hyderabad, India

Abstract: Theoretical computation of the operational characteristics in a large thrust bearing is presented. Theoretical computation of the operational characteristics in a large thrust bearing is presented. Theoretical computation of the operational characteristics in a large thrust bearing is presented.

Keywords: Thrust bearing, operational characteristics, theoretical computation.



TSI914725

The University of Sheffield

TRIBOSONICS

Ultrasonic applications in Tribology

Ultrasonic Theory

- ACTRA ULTRASONICS™ generating a sound wave (MHz) can last "forever" (100 years)
- Non-destructive testing (NDT) can be used to detect defects in materials
- Ultrasonic waves can be used to measure the thickness of a material
- Ultrasonic waves can be used to measure the surface roughness of a material
- Ultrasonic waves can be used to measure the internal stress of a material
- Ultrasonic waves can be used to measure the internal structure of a material

Lubricant Film Thickness Measurement

- Ultrasonic waves can be used to measure the thickness of a lubricant film
- Ultrasonic waves can be used to measure the viscosity of a lubricant
- Ultrasonic waves can be used to measure the temperature of a lubricant
- Ultrasonic waves can be used to measure the pressure of a lubricant
- Ultrasonic waves can be used to measure the shear rate of a lubricant

Pin-on-Rail

- Ultrasonic waves can be used to measure the wear of a pin-on-rail
- Ultrasonic waves can be used to measure the friction of a pin-on-rail
- Ultrasonic waves can be used to measure the temperature of a pin-on-rail
- Ultrasonic waves can be used to measure the pressure of a pin-on-rail
- Ultrasonic waves can be used to measure the shear rate of a pin-on-rail

Contact Pressure

- Ultrasonic waves can be used to measure the contact pressure of a pin-on-rail
- Ultrasonic waves can be used to measure the friction of a pin-on-rail
- Ultrasonic waves can be used to measure the temperature of a pin-on-rail
- Ultrasonic waves can be used to measure the pressure of a pin-on-rail
- Ultrasonic waves can be used to measure the shear rate of a pin-on-rail

Wear Measurement

- Ultrasonic waves can be used to measure the wear of a pin-on-rail
- Ultrasonic waves can be used to measure the friction of a pin-on-rail
- Ultrasonic waves can be used to measure the temperature of a pin-on-rail
- Ultrasonic waves can be used to measure the pressure of a pin-on-rail
- Ultrasonic waves can be used to measure the shear rate of a pin-on-rail

TSI914729

Tribological characterization of MWCNT-reinforced Si₃N₄ composites

Z. Konecni, M. B. Maroufi, J. Kuzella

Abstract

Abstract: Tribological characterization of MWCNT-reinforced Si₃N₄ composites was performed using a ball-on-disk tribometer. The results show that the MWCNT-reinforced Si₃N₄ composites exhibit significantly lower friction and wear compared to the pure Si₃N₄ substrate. The tribological performance of the composites was evaluated under various conditions, including different normal loads, sliding velocities, and sliding distances. The results indicate that the MWCNT-reinforced Si₃N₄ composites are a promising material for tribological applications.

Investigated samples

Sample	Si ₃ N ₄ (wt%)	MWCNT (wt%)	Friction Coefficient	Wear (mm ³)
Si ₃ N ₄	100	0	0.15	1.5
Si ₃ N ₄ /MWCNT	90	10	0.10	0.5
Si ₃ N ₄ /MWCNT	80	20	0.08	0.2
Si ₃ N ₄ /MWCNT	70	30	0.05	0.1

Testing equipment

CECTRIMOT - a multi-functional tribometer with testing stations:

- Tribological model
- Surface Tester
- Scanning Laser Microscope

Test parameters

- Counterpart: Si₃N₄ ball, 10-150 mm
- Normal load: 10, 20, 50 N
- Sliding velocity: 10, 100 mm/s
- Sliding distance: 100 m
- Radius of wear track: 1 mm
- Sliding medium: room temp., 10% oil humidity
- Number of measurements: 3 (each)

Test results

Graphs showing friction coefficient and wear volume over time for different samples.

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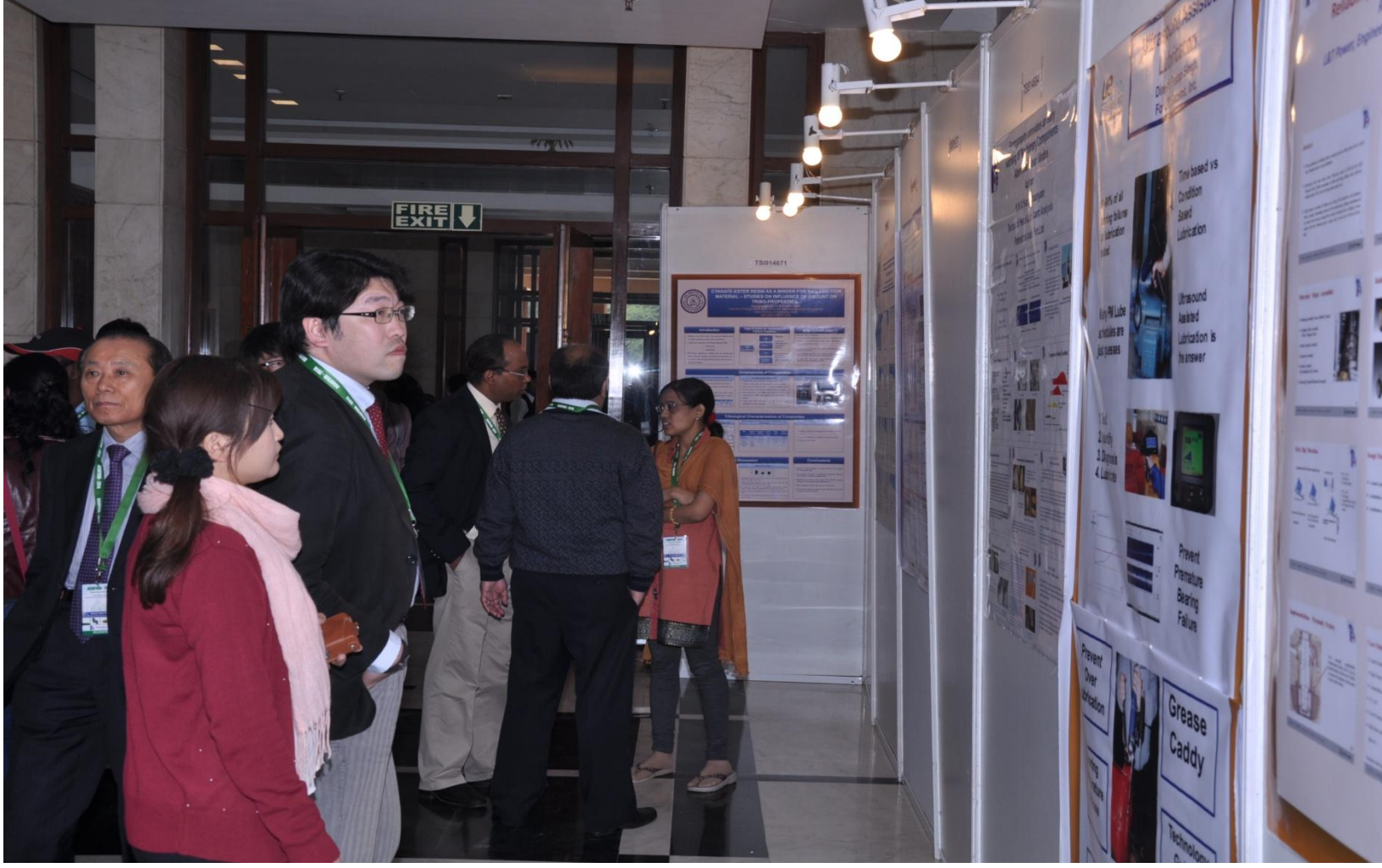
Connection between Tribology and Nanotechnology

Abstract

Abstract: This paper discusses the connection between tribology and nanotechnology. It highlights the importance of understanding the tribological behavior of nanomaterials and the role of nanotechnology in improving tribological performance. The paper also discusses the challenges associated with the tribological characterization of nanomaterials and the need for further research in this area.

Applications: Inter

- Ultrasonic waves can be used to measure the wear of a pin-on-rail
- Ultrasonic waves can be used to measure the friction of a pin-on-rail
- Ultrasonic waves can be used to measure the temperature of a pin-on-rail
- Ultrasonic waves can be used to measure the pressure of a pin-on-rail
- Ultrasonic waves can be used to measure the shear rate of a pin-on-rail



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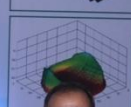
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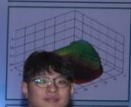
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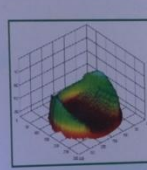
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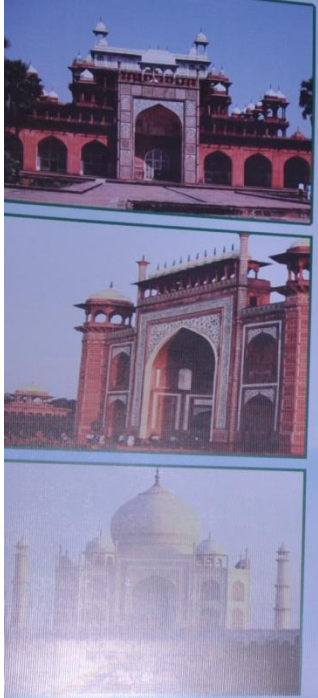




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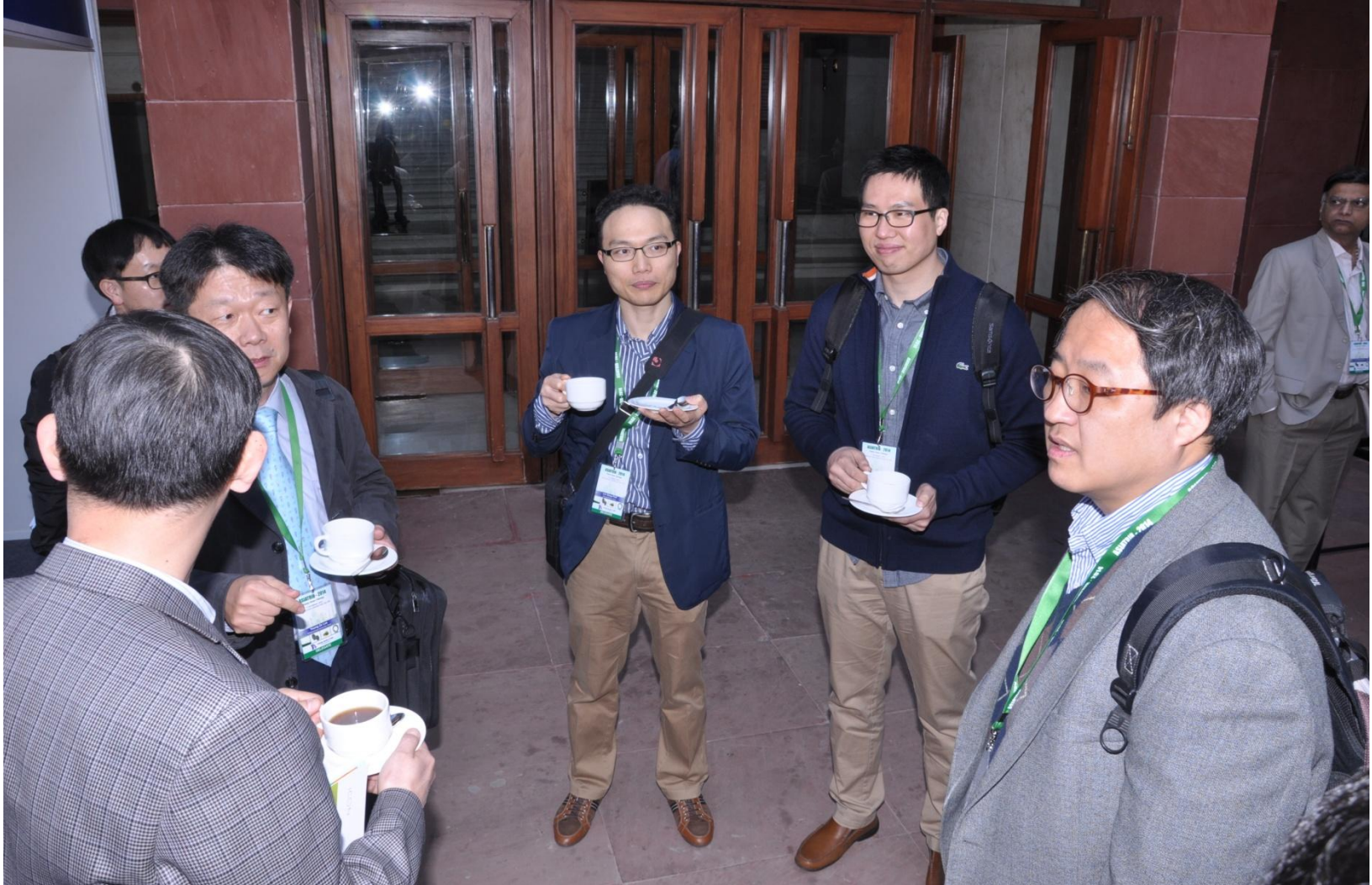


























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