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TSI NEWS LETTER

A Quarterly Newsletter from Tribology Society of India

OCTOBER 2003

SHRI N.R. RAJE JOINS THE BOARD OF INDIAN OIL CORPORATION LTD.



Shri N.R. Raje, Vice President, Tribology Society of India and till now Executive Director (Lube Technology), Indian Oil R&D Centre has joined the Board of Directors of Indian Oil Corporation as Director(R&D).

Shri Raje graduated in Mechanical Engineering from the University of Bombay, did his Post Graduation in Mechanical Engineering from the University of Leeds, UK in the year 1969. He worked with British Petroleum in their research and development centre at Sunburry-on-Thames, UK for three years and joined Indian Oil Corporation's, Research & Development Centre in November 1972.

He has over three decades of rich and varied research experience in the field of tribology, lubricants, fuel quality and emissions. At present, Shri Raje is considered one of the best-known technocrats in India in the field of automotive fuels, lubricants, emissions and tribology. Shri Raje possesses unique expertise in the field of vehicular emissions, evolution of standards and the adoption of new environment friendly and cost effective formulations for fuels and lubricants.

He has published over 50 research papers in journals of international repute and has 14 patents to his credit. Shri Raje is a member of Society of Automotive Engineers (SAE), USA and has served in a number of committees setup by Ministry of Petroleum and Natural Gas, Bureau of Indian Standards, Central Pollution Control Board etc. He had also been a Board Member on the Board of Indian Oil Blending Ltd., a wholly owned subsidiary of Indian Oil Corporation Ltd. He has several recognitions and national awards to his credit.

Shri Raje is very actively involved in many technical societies and is Vice President of Tribology Society of India. He is also President of CIMAC-India Chapter and President of NLGI India Chapter. He had the honour of being the Organizing Secretary, ISFL-2002.

PRESIDENT'S MESSAGE

RF#22 Vol 1



Over the years the Tribology Society of India (TSI) has grown in size. It has provided a common platform to the practising engineers, academicians and research scientists from a large area of activity. The scientific deliberations organized by TSI have helped the industries like steel, oil, cement, automobile, engineering, manufacturing and power etc. in reducing cost substantially through robust Tribology practices. Today Tribology has become one of the most talked subjects as is evident from the increased number of workshops and courses in the area of Tribology that are organized by various societies and organizations.

I am happy that the new issue of TSI Newsletter is being released. For some time now the TSI Newsletter could not be brought out due to some operational problems. The Newsletter features Dr. Asutosh Sharma of IIT Kanpur as an Eminent Tribologist, who is the recipient of this year's Dr. Shanti Swaroop Bhatnagar Award in engineering sciences. The Tribology community of India congratulates him for this outstanding recognition, which will go a long way in propagating the importance of Tribology for our fraternity. The issue also features an article by Dr. S.Sundararajan of ARCI Hyderabad on the new technique of micro arc coating for wear prevention under the feature "Technical Update".

As you are aware the first issue of "Indian Journal of Tribology" was released in Jamshedpur Conference. I understand the second issue is ready and being dispatched to all members of TSI. I solicit the help of each and every member in making publication of this journal ontime by contributing quality technical articles, technical features and items related to Tribology. Also, I appeal to all the manufacturers of Tribology related equipment and products to help finance the journal by advertisements and sponsorship, etc. The advertisements rates are given in the Newsletter.

We have planned to put the profile of each member of our society on our website in a searchable mode. Also, we will make an effort to create a discussion board soon on our website for the mutual benefit of the members having common interest.

We are now in the process of preparation for organization of the ICIT 2004, which would be held this time in the

Western Region. I would request all members to participate in this conference in large numbers both as delegate and by contributing technical papers in the areas of their research.

I look forward to meeting you all in person during ICIT-2004.

With best wishes and warm personal regards,

C. Mishra

EMINENT TRIBOLOGISTS

Dr. Ashutosh Sharma



Dr. Ashutosh Sharma, Professor and Head of Chemical Engineering at Indian Institute of Technology, Kanpur, received the prestigious Shanti Swarup Bhatnagar Award in Engineering Sciences for the year 2002.

Prof. Sharma completed his B.Tech. (1982) at IIT Kanpur, M.S. at the Pennsylvania State University (1984) and obtained his Ph.D. from State University of New York at Buffalo in 1987 with Prof. Eli Ruckenstein—a recipient of the US Medal of Science. After a brief stint (1988-90) at the SUNY School of Medicine and Biomedical Sciences as a research faculty, he joined IIT, Kanpur in 1990. Prof. Sharma was elected a Fellow of the Indian Academy of Sciences, Bangalore in 1999, and has served on the Editorial Board of *Journal of Colloid and Interface Science* during 2000-02. He has also received research awards from the Indian Institute of Chemical Engineers and from the Indian Society for Technical Education.

Prof. Sharma has authored over 100 publications in international journals of repute such as *Physical Review Letters*, *Journal of Chemical Physics*, *Langmuir* and *Journal of Colloid and Interface Science*. His 10 most significant papers have received over 500 citations in the international scientific journal publications. He has been an invited or keynote speaker at 20 international and national conferences and have supervised research of 35 Ph.D. and M.Tech. students. He has been invited to give presentations in seminars and conference in the US, UK, France, Germany, Israel, Bermuda, Netherlands, Belgium and Japan.

In recent years, Prof. Sharma's group has worked on several fundamental aspects of the behavior and properties of soft matter on mesoscales— the twilight zone between the molecular and the bulk where properties depend on the system size. Prof. Sharma and his

students have made significant contributions to the self-organization in thin films and its exploits in creating small-scale patterns for nanotechnology; wetting and dewetting of surfaces; adhesion, friction and peeling of soft interfaces; corneal surface properties and genesis of dry eye syndromes; and nano-scale interactions in membrane separations.

Dr. Sharma's research has direct applications in a variety of settings such as thin coatings, detergency, foams, emulsions, meso-scale patterning of soft materials including polymers for opto-electronic and in micro-electro mechanical systems. His research has also enhanced our fundamental understanding of important phenomena such as adhesion, friction, debonding, wetting/dewetting, heterogeneous nucleation, multilayer adsorption and phase separation.

The focus of Dr. Sharma's group currently is in tailoring of thin coatings by electric fields and other innovative means, nano-scale patterning of soft materials including polymers for opto-electronic applications, and in detergency or the science of cleaning of surfaces. The work in detergency is being funded by the Unilever/Hindustan Lever Research Institute, Bangalore, thus creating a happy synthesis of the fundamental and the practical. These above activities involve theory, complex computer simulations and the experimental support of a laboratory established by Dr. Sharma that houses the state-of-the-art characterization and preparation equipment such as an Atomic Force and Scanning Tunneling Microscope, imaging ellipsometer, contact angle goniometer, optical microscopes, high speed camera, Langmuir-Blodgett deposition system, spin-coater, etc.

A native of Jaipur, Ashutosh is married to Neeti, his wife of 17 years, and they have a daughter, Richa. Prof. Sharma's other hobbies include writing poetry, sketching and computer art, and ancient history and philosophy.

LOOK BACK TO MOVE FORWARD IN TSI

Now Tribology Society of India (TSI) is 14 years old. While it is always possible to list out achievements and contribution of individuals and as groups to build TSI what it is today; but it is also pertinent to pause over whether the organization has met the vision of its founders and whether in its long journey it has met the objectives for which it was setup.

In early formative years, the financial stability is as important as its structure and organization to carry forward the mission. Some remarkable progress was made in early days both on financial front and also by establishing a network of local chapters. In addition to a biennial national/international conference, a News Letter, a TSI Journal, a TSI website(www.tribologyindia.org), but what beyond this?

In industry what we call as "Competitive advantage" is equally well perceived in the context of scientific bodies and organizations like this. A TSI member is also generally affiliated with other scientific bodies and prioritizes his/her activities, contributions and learnings among various scientific bodies depending upon their competitive advantage which depends, inter-alia, on his perceptions

about how vibrant a scientific body is and what opportunity/networking it provides him/her. A biennial International conference in absence of other activities can hardly drive a competitive advantage. We need to adopt a complete new set of strategy to make TSI more throbbing and vibrant to drive competitive advantage for our members.

Through this TSI newsletter, your suggestions are solicited on the type of activities you would like to see enchanted under the aegis of TSI so that Executive Committee of TSI may draw the charter of activities, which meets member's expectations.

As you will read in this newsletter, three of our local chapters, Bhopal, Mumbai and Bangalore are working diligently as flame runners and we expect other local chapters also to get rejuvenated. This issue also carries the listing of salient decisions taken in the EC to apprise our members. We hope that members will be prompt to point out if they notice something amiss. Of course, a little of appreciation is also welcome. If neither happens at larger base of our membership, we will get the hint: Miles to go before (you wake up from) the sleep.

Conference Review

WEAR OF MATERIAL -2003

The 14th International Conference on Wear of Materials was organised by Elsevier Publishers at Renaissance Hotel, Washington DC, USA from March 30th to April 3, 2003.

The Steering Committee comprised of Dr.Hsu, NIST, Gaithersburg, MD as Conference Chair, Dr.A.Wang of Howmedica Osteonics, NJ, as Program Chair, J.Hawk, Albay Research Centre, Oregeon as Secretary and Poster session Chairman, Prof.Peter Blau, Oakridge National Laboratory as Editor, Full papers, Prof.D.A.Rigney, Ohio State Univ., as Associate Editor for Full Papers.R.G.Bayer, Vestel, New York, as Editor, Communication and Case Studies, Prof. K.G.Budinski, Buds Labs, New York as Commercial Exhibit Chair and Prof.K.C.Ludema as Editor Emeritus.

There were Three Plenary Lectures, around 200 Oral Presentations and 50 Poster presentations. Around 250 delegates participated in this conference. Only two were from India. Plenary Lectures were delivered by Prof.Ian Hutchings, Cambridge Univ., UK, Mark Robbins of John Hopkinson Univ., and John H.Dumbleton, Stryker Howmedica, Osteonics, NJ.

Prof.Hutchings discussed Wear as manufacturing process. Highlighting all the beneficial effects of wear Prof. Robbins emphasised the urgent need for computer simulation in tribology. Prof. Dumbleton enlightened all the participants with his vast and rich experiences in human joint replacements and their tribological behaviour.

The oral and poster sessions included topics on Biotribology, Wear of Metals, Wear of Ceramics, Nanotribology, Lubricated wear, Wear of Coatings, Erosion, Wear of polymers and Composites, Fretting, wear monitoring. All the presented papers will be published in Wear Journal and some of them have already been published.

Dr.C.S.Ramesh, Professor & Director, R&D, Mech Engg., Ghousia College of Engineering, Ramanagaram, Karnataka presented a Paper "Tribological Characteristics of Nickel Composite Coatings". The other delegate from India, Prof. Pal Tapan Kumar, Metallurgy Department, Jadavpur Univ., India presented the paper "Wear behaviour of Hard Facing Deposits on Cast Iron."

The Exhibitors included A.K.Steels, OH, USA, Buds Labs, New York USA, Hysitronn, Inc, MN, USA, Falex Corporation, IL, USA, Centre for Tribology, CA, USA, IIMS/Tetra GmbH, Germany, Microphotonics Inc., CA, USA, Phoenix Tribology, U.K., Taber Instrument Corporation, NY, USA, Elsevier Publishers. The highlights of the exhibition was display and demonstration of the recently developed tribometer and in particular the nanotribometer.

Overall, it was felt that more need to be done to model the tribological behaviour of materials and

there is a gradual shift to nano levels of observation of friction and wear phenomenon.

In coming years it is the nanotribology (nanolevel wear in computer hard disk drives may lead to a very serious problem of huge data loss) and the biotribology with respect to the successful replacement of human joints will be the areas of interest to many researchers working in the field of friction, wear and lubrication.

Contributed by **Dr. C. Ramesh**

Message from Secretary

There has, unfortunately been long lull in the activities of the Society and a disconnect in communication. The Newsletter is now being resumed, under the leadership of Dr. G.K. Sharma of IOC R&D with invaluable support from Shri V. Martin, Shri Ajay Harinarain and others. This should help re-establish the communication amongst us. The Executive Committee and the team that is reviving the newsletter are determined to see that the Newsletter is brought out regularly.

A meeting of the EC was held at Delhi on 26th July, 03. Amongst the decisions taken was one to reactivate and provide financial support to the various chapters. Communications have been sent to the Chapter secretaries requesting them to arrange holding of elections for the various chapter-level positions, wherever these have not been done during the last one year and to communicate the list of Chapter office-bearers to the Society's President and Secretary. On behalf of the EC, I request all the members in the Chapter territories to participate in the Chapter activities.

The next conference of ICIT is proposed to be held in the Western India in April, 2004. The dates and venue will be fixed after finalisation of the organisation that would arrange the Conference. As you know, the responsibility for arranging our biennial Conference is assigned to a specific organisation which could be a corporate body or a research/academic institution. While the Conferences are financially self-sustaining, we look up to the organising Company/Institution to provide the leadership in the effort that is needed in arranging a successful Conference. The

EC is actually in the process of identifying the leader organisation for the next conference. All those intending to present papers at the forthcoming Conference may take this as an advance intimation and get them ready.

An educational course is proposed to be held ahead of the Conference, tentatively in December this year. Details will be available at the TSI website and also communicated separately shortly.

We look forward to the cooperation and support of all members and well-wishers of TSI in gearing up the activities of the Society. Another area where all members can contribute is in increasing the membership base of the Society. We would like to double the present strength within the next year. This can be achieved if each member brings in at least one new member. Can we gather good momentum in the membership drive before the next Conference?

The list of present members is being made available at the TSI website. We may have inadvertently left out some of our members. In case of any omission please inform us. We also request each member to check his/her entry in the list for details like postal address, organisation, designation/title, e-mail ID etc. and let us know if the information needs to be corrected/updated. Your communication in this regard may be addressed to Shri V. Martin at martinv@iocrd.co.in

With greeting for the festive season.

V. N. Sharma

MICRO ARC OXIDATION COATING TECHNOLOGY : A RECENT INNOVATION

G. Sundararajan and L. Rama Krishna

International Advanced Research Centre for Powder Metallurgy and New Materials (ARCI)
Balapur (P.O), Hyderabad – 500005, Contact e-mail: arcint@hd1.vsnl.net.in

Micro Arc Oxidation (MAO) is a novel, electrochemical coating technology aimed at depositing the oxide based ceramic coatings on metals like Al, Ti, Mg and their alloys. The MAO process radically differs from the traditionally known anodizing/hard-anodizing in several ways: employs AC power at high voltages (100-700V) and high current densities (0.1-0.3 A/cm²), utilizes alkaline electrolyte and electrolyte temperatures around room temperature. In addition, MAO process is capable of depositing dense and ultra-hard ceramic coatings on all kinds of aluminium alloys without any restriction on the concentration of the alloying elements. Yet, another important difference between the aforementioned traditional processes and MAO is the latter's eco-friendliness. Because of these special features, the MAO process gained global attention, and the research groups in countries like USA, UK, Russia, France and China are actively working on MAO technology development. In India, ARCI has taken the lead to develop this technology concurrently with the rest of the world.

In the MAO process, coating deposition is primarily due to the plasma environment created in the discharge channels formed due to dielectric breakdown of the oxide film in the discharge channels, aluminium ions react with the oxygen ions to form alumina. Since the prevailing plasma temperatures are much higher than the melting temperature of alumina, the molten alumina ejected on to the surface of the component in the form of pancakes. Such pancakes are built one over the other to form the thick coating. Coating quality in terms of coating density and hardness are determined by the characteristics of the discharge channels and the pancakes.

The MAO coatings developed at ARCI exhibit excellent bonding with the substrate, a peakhardness value as high as 1800 kg/mm², and uniform distribution of α and γ -Al₂O₃ phases. The proportion of α to γ -Al₂O₃ phase is very high i.e., about 90:10 close to the substrate-coating interface and gradually becomes about 10:90 at the coating's surface. Since α -Al₂O₃ is harder than γ -Al₂O₃, the result is an increase in microhardness from surface regions to the substrate-coating interface. Such a distribution of hardness across coating thickness imparts excellent mechanical and tribological properties even at relatively higher stress levels.

In addition, the machinability/grindability of MAO coatings is also good due to such phase distribution, thus making it possible to obtain the surface finish close to 0.1-mm Ra, essential for many critical applications. Investigations under diverse wear modes like abrasion, erosion and sliding have demonstrated that the MAO coatings have outstanding tribological properties. The property enhancement in terms of abrasive wear resistance is 40-70 times higher than that of bare substrate, depending on the alloy used as the substrate. The tribological performance of MAO coatings are found to be superior to that of hard-anodized coatings and thermal spray coatings. The erosion resistance of MAO coatings is found to be much superior than that of hot iso-statically pressed and sintered alumina. In recognition of the success achieved in terms coating density, coating microhardness and the superior tribological performance, ARCI is in the process of patenting its MAO technology in U.S.A.

A remarkable feature of MAO coating technology developed at ARCI is that it allows for deposition of dense coatings on commercial purity aluminium and all kinds of aluminium alloys including Al-Si, Al-Cu alloys, which are difficult to treat by anodizing techniques. Several industrial applications requiring superior wear/corrosion/di-electric properties in widely differing fields like automobile, oil exploration, textile, aerospace, food processing, PCB and bulb manufacturing, printing, refrigeration & air-conditioning have already been explored at ARCI and received over whelming performance reports from the industry.

With the technology scale-up in advanced stage, very soon the Indian industry can enjoy the benefits of indigenously available world class MAO technology. For a comprehensive technical detail on the MAO process, its unique features and performance of MAO coatings, the following publications may be accessed.

- L. Rama Krishna, K.R.C. Somaraju and G. Sundararajan, "Tribological Performance of Ultra-Hard Ceramic Composite Coatings Obtained through Micro Arc Oxidation", *Surface and Coating Technology*, Vol.163-164, 2003, 484-490.
- G. Sundararajan and L. Rama Krishna, "Mechanisms underlying the formation of thick alumina coatings through the MAO coating technology" *Surface and Coatings Technology*, Vol.167, 2003, 269-277.

TSI Local Chapter Activities

1. Bangalore Chapter :



Dr. Ramesh speaks amongst avid listeners

TSI Bangalore chapter organised a talk by Dr. Anand of JFWTC (John F Welch Technology Center) Bangalore and Dr. C.S. Ramesh, Head Research Center, Ghousia Engineering College, Ram Nagar. The function was well attended by existing life members and others enthusiasts. At the end of the talk an election to the existing committee was held and following office bearers were declared elected.

- 1) President : Prof. S.K.Biswas, IISc.
- 2) Vice President : Dr. Sitaramu, CPRI
- 3) Secretary : Wg. Cdr. S.K. Sharma(Retd.)
- 4) Treasurer : Shri N.M.Dube, Ducom
- 5) Members : Dr. Martin Jebraj,
Dr. Nanjunda Rao
Shri Chandra Sagar,
Dr. Uma Shankar

2. Mumbai Chapter :

A one day Brainstorming Session on Tribology and Maintenance was organized by Mumbai local chapter on 5th April 2003 at IIT Mumbai. The session was attended by above 48 delegates from industries and educational institutions in and around Mumbai. During the conference a lively brainstorming ensued among the delegates which was efficiently moderated by Shri Mukesh Gupta of Castrol India and Prof H Irani of IIT Mumbai. The members had a discussion on the topics related to Basics of Tribology, Maintenance and Lubrication, Fuel efficient Engine oils, CNG Oils, Ethanol Blended fuels and Biodegradable lubricants. The delegates lauded the efforts of TSI Mumbai Chapter for organizing such an interactive Brain Storming Session on Tribology and thanked the

organizer for the same. Some of the feed backs from the member participants are listed below:

Shri N Ambalagan suggested organizing seminars for design executives on regular basis. Shri S Ajith Kumar suggested that a list of experts may be made available to TSI members through TSI website for expert advice. Shri B Bhaskaran suggested for a training programme for Basic Engineers on Tribology.

The meeting ended with a vote of thanks from Shri Mukesh Gupta

3. Bhopal chapter :

A workshop on "Materials & Technologies for reducing corrosion, maintenance & cost in sugar mills" was organised by the Tribology Society of India Bhopal Chapter in association with Regional Research Laboratory, Bhopal and Sugar Technology Mission-TIFAC, New Delhi at Regional Research Laboratory (RRL), Bhopal on July 12, 2003.

The objective of the workshop was to provide a platform for active participation, interaction and dissemination of knowledge pertaining to reducing the problems being faced by sugar mills during production. The aspects dealt in the workshop was related to problems faced in terms of inferior performance of components used in the sugar mills and suggestions regarding minimising the problems through the development and use of cost and energy effective components and methods.

Over sixty delegates belonging to R&D institutes, Sugar Technology Mission (STM), Sugar Mills, Oil Companies, National Sugar Institute and Krishak Sahakari Sanghs attended the workshop.



Inauguration of Workshop

There were three technical sessions at the workshop which followed the inaugural session.

In the inaugural session, Dr. N.Ramakrishnan, Director, Regional Research Laboratory, Bhopal welcomed the delegates. In the address, he mentioned RRL's endeavour to take the R&D findings directly into actual practice. Dr. A.H.Yegneswaran, Scientist RRL Bhopal and President of the local TSI Chapter focused on the activities of TSI which has seven local chapters in the country. He dealt with the aim of the workshop which was to provide a common platform to address problems being faced by the Sugar Mills and R&D efforts being made to overcome the problems. Shri J.J.Bhagat, Mission Director, STM, New Delhi, in his presidential address talked about sugar mills which

have a total turnover of Rs.30,000 Crore and contribute more than Rs. 2000 Crore in the form of taxes to the government. He mentioned that sugar mills incur Rs.800-1000 Crore on repairs, maintenance and replacement annually. Shri Bhagat lauded the R&D efforts in the country in general and RRL Bhopal in particular in making superior materials which have proved their worth in the sugar mills. Prof. R.B. Nigam, Director, National Sugar Institute delivered the keynote address. Dr. Rupa Dasgupta, Scientist RRL, Bhopal and Secretary of TSI-Bhopal Chapter proposed the vote of the thanks.

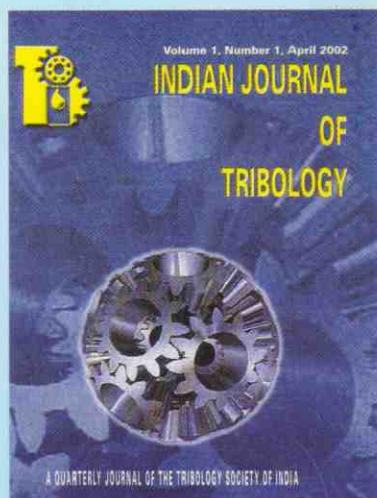
Forthcoming meeting and conferences

1. International Workshop on "Recent Trends in Lubrication Engineering"
24-28 November 2003,
Contact: Dr B S Prabhu, Director, Manipal Institute of Technology Manipal-576119, Karnataka, India.
Phone: +91-8252-571060, 571940,
Fax: +91-8252-571071
Email: office.mit@manipal.edu
Website: http://www.manipal.edu / manipal/lnk-announcements / int_workshop/introduction.html
 2. 8th International Tribology Conference,
Presented by the South African Institute of Tribology,
24th - 26th March 2004, University of Pretoria
Conference Centre, Pretoria, South Africa,
Tel: (011) 802-5145,
Fax: (011) 804-3484, Email: secretary@sait.org.za
 3. NORTRIB 2004, 11TH Nordic Symposium on Tribology, Late June 2004 (Exact time to be announced), Contact, Professor Kristian Tønder, Dept. of Machine Design and Materials Technology, NTNU, Rich. Birkelandsv. 2B, 7491, Trondheim, Norway,
Tel: +47-73592893, Fax: +47-73594129
Email: Kristian.Tonder@immtek.ntnu.no
 4. AITC 2004, 4th AIMETA international Tribology Conference, 14th - 17th September 2004, Rome, Italy,
Contact: Prof. Nicola Pio Belfiore,
Email: belfiore@dma.ing.uniroma1.it
 5. ITC (International Tribology Conference) 2005,
May 29-June 2, 2003, Kobe, Japan
Contact: Dr M Tagawa, Secretary General,
Department of Mechanical Engineering,
Faculty of Engineering, Kobe University, 1-1,
Rokkodai-Cho, Nada-ku, Kobe, 657-8501, JAPAN,
FAX: +81-78-803-6126,
Email: itc.kobe2005@pac.ne.jp,
URL: <http://www.crossroad.jp/itc/>
 6. World Tribology Congress III, The 2005 World Tribology Congress & Exhibition,
12th - 16th September 2005, Washington DC, USA,
Contact: Mr Edward Selek, Executive Director,
840 Busse Highway, Park Ridge, IL 60068-2376, USA.
Tel: + 847 825 5536
E-mail: esalek@stle.org,
Web Site: <http://www.stle.org>
 7. 14TH International Colloquium, Tribology 2004 Tribology and Lubrication Engineering, 13-15th January 2004, Technische Akademie Esslingen, Ostfildern, Germany.
Contact: Prof Dr Ing, W J Bartz, Tribologie und Schmierungstechnik, Muhlhaldenstrasse 91, 73770, Denkendorf, GERMANY.,
Telefax: +49-711 34008-43
Email: Hedwig.Neuhoff@tae.de
Web: <http://www.tribologie.org>
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Achievements

Dr. Harprasad, Senior Deputy General Manager, BHEL Corporate & R&D has been honoured with a Certificate of Merit by the Institution of Engineers, Kolkata. The honour was bestowed on him for his excellent paper "Determination of Capacitance, Resistance and Dynamic Coefficient of Four Journal Bearings Through Electrical Analogy". Hearty congratulations Dr. Harprasad from all members of Tribology Society of India.

Indian Journal of Tribology



Dear members

As you all are aware, the first issue of Indian Journal of Tribology was launched during ICIT 02 at Jamshedpur. Due to certain unavoidable reasons the subsequent issue of the journal could not be released on schedule. The next issue of the journal is in the final stage of release and would be sent to each member very soon. I appeal to all members of our society to send technical articles for publication in the journal. Members help in this regard is highly solicited.

All your Correspondence and articles should be addressed to:

Dr. M. R. Tyagi

Editor, Indian Journal of Tribology, Indian Institute of Petroleum,
P.O.: Mohkampur, Dehradun, India. E-mail : mrtyagi@iip.res.in

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Advertisement in Indian Journal of Tribology

Following are the advertisement rates for inserting advertisements in Indian Journal of Tribology :

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Inside and Outside Cover	Rs. 12500 US\$ 625
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Inside Half Page	Rs. 2500 US\$ 125

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V Martin

Treasurer TSI

C/o Indian Oil Corporation Limited

R&D, Sector-13, Faridabad,

Haryana-121007.

E-mail : martinv@iocrd.co.in

Phone : 0129-2269853

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