



TSI Newsletter

A Quarterly Newsletter from Tribology Society of India

HIGHLIGHTS OF 26th EXECUTIVE COMMITTEE MEETING OF TSI

The 26th Executive Committee Meeting of TSI was held on September 10th, 1998 at ITMMEC, IIT, New Delhi. The meeting was presided by **Prof.D.V.Singh**, President TSI. The meeting was attended by **Shri A.K.Mehta** (Secretary), **Shri V.N.Sharma** (Treasurer), **Dr.M.R.Tyagi** (Joint Secretary) and **Dr.Har Prashad** (Joint Secretary) and four executive committee members: **Shri Sudhir Singhal**, **Shri G.S.Ravi**, **Dr.A.K.Jha** and **Prof.Kshitij Gupta**. **Prof J.S.Rao** and **Shri R.A.Rao** were special invitees. The followings were discussed and decided:

1. Review of ICIT '99

Dr.Har Prashad, Organizing Secretary, briefed the present scenerio of the conference and mentioned that 95 abstracts have been received which are under review by the technical committee. Also, requested the executive committee members for the sponsorship drive for the conference.

2. Pre-conference Educational Courses

It was decided to organize four parallel one-day courses on December 1, 1999 on :

(i) Automotive Lubricants (ii) Metal working Lubricants (iii) Steel Mill Lubrication and (iv) Maintenance of Rotating Machines. **Mr.Sudhir Singhal**, **Mr.G.S.Ravi** and **Prof.J.S.Rao** have given their consent to be the course designers and main faculty of the courses. The details of the courses are given in the second brochure of ICIT '99.

3. Plenary sessions

The scope of the plenary sessions were discussed and has been included in the second brochure.

4. TSI Journal

The need for two TSI Journals, one containing research papers and the other

containing technical articles for practising tribologists, were proposed to be taken up. For the purpose of registration address of the journals, the address of registered office (BHEL, Corp R&D,Hyderabad) has been decided to be used. **Prof.J.S.Rao** will coordinate the activities of the journal and will constitute an editorial board in consultation with President TSI and also finalize other details of the journal.

5. Review of TSI Funds

Shri V.N.Sharma informed that the audited statement of ICIT '97 will be made available at the earliest. He further informed that an amount of Rs.7.40 Lakhs is likely to be available for transfer to TSI account. Executive committee appreciated the efforts put by the organizers of ICIT '97 and the concerned organisations. Also, the Treasurer indicated that TSI accounts available at IOC R and D, BHEL R and D and Balmer Lawrie will be consolidated by January, 1999.

6. Consideration of National Raters Forum (NRF)

Shri Sudhir Singhal agreed to circulate a note on NRF to all members of EC for consideration to take National Raters Forum under the field of TSI.

7. ICIT 2001 and 2003

It was agreed that ICIT 2001 will be organized by **TSI Mumbai Chapter** at Mumbai. For ICIT 2003, the city of Bangalore was proposed. **Shri G.S.Ravi** from **M/S Standard Oil Additives Pvt Ltd** will prepare suitable proposal for further discussions in the next EC meeting of TSI.

The meeting ended with thanks to the chair.

MINUTES OF SECOND MEETING OF TRIBOLOGY SOCIETY OF INDIA (Dehra Dun Local Chapter)

The Second Meeting of TSI Dehra Dun Local Chapter (DLC) was held on November 16, 1998 at IIP. The meeting was presided by **Mr.Sudhir Singhal**, President TSI (DLC). The meeting was attended by **Dr.Mahendra Pal**, **Dr.S.K.Goyal** and **Mr.V.K.Chhibber**.

Dr.Mahendra Pal, Regional Secretary DLC, informed that the Colloquiums were organized every month after the formation of DLC in August 1998. **Mr.V.K.Jain**, **Dr.O.S.Tyagi** and **Mr.R.L.Mendiratta** were the prominent speakers in the colloquiums organized in August, September and October 1998, respectively. Two seminars on **Recycling of used Lubricants in India** and **Engines Deposits** planned by DLC to be organized in April and October 1999, respectively. **Dr.S.K.Goyal** was identified as convenor of the seminars.

As decided by DLC in the first meeting, the family get-together is being planned in December 1998, and subsequently technical tours to industries for TSI members. These activities will be coordinated by **Shri V.K.Chhibber** and **Dr.R.P.S.Bisht** of IIP, respectively. Modus operandi is being worked out by **Dr.Mahendra Pal** in consultation with TSI, Secretary to organize meeting of all TSI Chapters in Dehra Dun. It is worth mentioning that by the efforts of the regional Secretary, members of DLC have increased to 30.

TSI News Letter congratulates DLC for the keen interest in TSI activities.

CREATION OF DELHI CHAPTER OF TSI

Prof.K.Gupta of ITMMEC, IIT, Delhi invited all the members of TSI in Delhi region on 28th August 1998 to create Delhi TSI Chapter. 17 TSI members of Delhi region attended the meeting.

Prof.J.S.Rao, IIT, Delhi was elected to preside over the meeting and **Shri A.K.Mehta**, Secretary, TSI assisted him. Unanimously, **Dr.C.R.Jagga** was elected as the Secretary, TSI-Delhi Chapter. **Dr.(Mrs) Jayashree Bijwe** was elected as a Chapter Treasurer. Names of **Shri S.K.Gupta** and **Shri Prashant Gupta** were proposed and elected as executive members. The general body suggested that Secretary and Treasurer can co-opt upto 5 more executive committee members. Also, a suggestion was given that the representatives from important industries: **NTPC**, **Maruti Udyog Ltd**, **Escorts Ltd**, **Eicher Tractors** and other industries around Delhi may be considered while co-opting members for TSI-Delhi Chapter.

All the participants expressed keen interest in TSI activities.

The meeting ended with a vote of thanks. TSI News Letter congratulates Delhi Chapter and wishes success in the TSI activities.

CONGRATS

Dr.Har Prashad, Dy.General Manager, BHEL, Corporate R&D, Hyderabad has received **The Corps of Engineers Medal Award-1998 of the Institution of Engineers (I)** for his distinguished research and development work in the area of Tribology on his research paper entitled **Assessment of Electrical Parameters of Three-Lobe Journal Bearings - An Approach** published in Mechanical Engineering Journal of Institution of Engineers in Volume 78 of August 1997 issue.

The Medal along with a certificate of excellence and a cash prize is to be presented to **Dr.Har Prashad** in the Thirteenth Indian Engineering Congress to be organized by Institution of Engineers (India).

TSI Newsletter congratulates **Dr.Har Prashad** on his achievement!



Dr.Har Prashad

POLYMER TRIBOLOGY - A GENERAL REVIEW

Dr. Har Prashad, BHEL, Corporate R&D, Hyderabad

With the increase of application of polymers for tribological purposes specifically for seals, bearings, gears, brakes, clutches, giant instruments and audio visual machinery research has been carried out on tribology of polymers. A lot of work has been reported on the tribological properties of plastics and polymer composites and their applications. A general review in this area will serve as a valuable source of technical information for the tribologists.

Plastics

The friction behaviour of virgin polyether ether ketone (PEEK) of different molecular weights and of PEEK blends with polytetra-fluoroethylene (PTFE) was investigated under dry conditions against hard steel. It was found that the spherulite size and hardness of PEEK play a significant role in tribological performance. Also, the investigations show that the friction behaviour/coefficient of friction of PTFE at the initial stages of sliding depends to a greater extent on the molecular-kinetic processes taking place in the contact zone. The friction has a viscoelastic origin under certain conditions; the friction parameters at the initial stage and after the formation of a transfer film are associated with the rheological properties of the polymer.

The surface layer structure of ultra-high molecular weight polyethylene (UHMWPE) with steel forms the triboinduced/transfer layer (up to 2nm) to contain fewer oxidized fragments after sliding. From this, it is apparent that the transfer of iron, which forms cluster structures in the transfer layers, seems to play an active role in the tribochemical processes. Specific structural features were found to dominate in tribological properties of crosslinked polymers depending on their physical state. It has been found that the coefficient of friction in the glossy state depends on the hydroxyl content in the intermolecular segments and on the network density in the high elastic state. To a large extent, the friction of polymers generally depends upon interfacial adhesion.

An increase in molecular weight did not improve the sliding wear resistance of the UHMWPE significantly but the addition of fillers did. The UHMWPE was found to exhibit a significant drop in wear rate under low pressure conditions at high velocity. The wear mechanisms are in general considered as a function of the type of lubricant and topography of the counterface. Since high-density polyethylene (HDPE) and PTFE are widely used as bearing materials, the studies indicate that humidity influences the wear behaviour of both HDPE and PTFE. However, electrical field does not influence measurably the sliding wear of PTFE as compared to that of HDPE. Concerning the wear property of PEEK/PTFE blends, the wear rate of blends with a PTFE is found to be lower than that virgin PEEK. In general, the wear behaviour of polymers could be predicted on the basis of a morphological investigation of wear debris.

The rolling contact behaviour of polymers has received much less attention. It has been investigated that the main mode of failure of PEEK in rolling contact

was plastic flow, not fatigue. The limit of the rolling contact performance of a polymer seems to be defined by its ability to dissipate the energy generated at a particular combination of contact pressure and rolling velocity in order to avoid excessive softening.

Polymer Composites

Different types and amounts of fibre reinforcements and/or lubricants were investigated for the tribological performance as a function of steel counterface roughness and testing temperature under dry sliding conditions. It was observed that the effect of steel counterface roughness on the wear rate for short-fibre-reinforced PEEK is not as pronounced as for the virgin matrix. An increase in testing temperature results in high specific wear rates and lower coefficient of friction. Moreover, the wear rates are affected greatly by the type and amount of lubricant incorporated. It has been found that the incorporation of carbon fibres proves to be more beneficial than glass fibres with respect to both friction and wear performance.

Recently, PEEK composites with different reinforcement phases have been processed with plasma using argon gas to improve their tribological behaviour. This improvement occurs because of increase in interface strength of carbon-fibre reinforced PEEK composites. The wear rate of a composite depends on its ability to form transfer films on steel counterfaces. The tribological properties of PEEK filled with nanometer-sized Si_3N_4 and SiO_2 particles by sliding against carbon steel ring indicated much lower frictional coefficient and wear rate than pure PEEK sliding against carbon steel ring. Also, correlation between the wear behaviour and microstructure of graphite/PTFE composites has been studied over a wide range of graphite content. It has been established that the wear behaviour of graphite/PTFE composites corresponds to the physical behaviour of imperfections in a macro and microscopic sense.

A type of PTFE-based multilayer self-lubricating composite, comprising of a steel backing, a sintered porous bronze middle layer and a surface layer consisting of a mixture of PTFE and lead powders, has been developed. Investigations indicated that the friction and wear behaviour of this composite can be significantly improved through appropriate lubrication.

Conclusions

The observations reported and discussed/analyzed as above indicate that the effectiveness of particulate fillers i.e. solid lubricants, metal powders etc, and a conclusive statement concerning tribological behaviour of filled polymers is yet to be established. However, with so many advantages, polymers are now utilized for numerous tribological purposes, still the basic understanding of polymer tribology needs intensive research to fill the know-how gap for a more efficient use of polymers in the engineering industry.

ICIT '99 - TECHNICAL COMMITTEE

Chairman: Dr. Har Prashad, BHEL, Corporate R&D, Hyderabad

SESSION ORGANISERS

1. Lubrication Basics:

Prof.D.V.Singh
All India Council for Technical Education
Indira Gandhi Sports Complex
I.P.Estate
New Delhi-110002
Tel : (+91 11) 3378491
Fax : (+91 11) 3379002 / 3379044

2. Lubricants

Dr.J.Bhatia
Balmer Lawrie-Fuch Ltd
5, J.N.Herdia Marg
Ballard Estate
Mumbai-400038
Tel : (+91 22) 2618106 / 2612106
Fax : (+91 22) 2615781 / 2673461

3. Lubricants :

Mr. Sudhir Singhal
Indian Institute of Petroleum
P.O.Mohkampur
Dehradun-248005
Tel : (+91 135) 660099, 674481
Fax : (+91 135) 674481 / 671986

4. Surface Engineering :

Dr.A.Sethuramiah

ITMMEC, IIT
Hauz Khas
New Delhi-110016
Tel : (+91 11) 6857658 / 666979
Fax : (+91 11) 6862037

5. Tribology of Materials :

Dr.A.K.Jha
Regional Research Laboratory
Near Habibganj Naka
Bhopal-462026
Tel : (+91 755) 587600
Fax : (+91 755) 587042 / 580985

6. Condition Monitoring :

Dr.B.S.Prabhu
Professor
Mechanical Engg
IIT, Chennai
Tel : (+91 44) 235 1365 (Ext 3057)
Fax : (+91 44) 2350509

7. Tribotesting and Analytical Techniques :

Mr.A.K.Mehta
IOC, R&D Centre
Sector 13
Faridabad-121007

Tel : (+91 129) 286216
Fax : (+91 129) 286221 / 283709

8. Dynamic Fluid Sealing, Seals and Rotodynamic Coefficients :

Prof.M.K.Ghosh
Banaras Hindu University
Institute of Technology
Department of Mech Engg
Varanasi-221005
Tel : (+91 542) 316651
Fax : (+91 542) 316428

9. Tribology in Power Sector and Allied Industries :

Dr.Har Prashad
BHEL, Corp R&D
Vikasnagar
Hyderabad-500093
Tel : (+91 40) 3079494, Ext : 242
Fax : (+91 40) 3078320

10. Special Topics in Tribology :

Prof.M.C.Dwivedi
IIT, Dept of Chemical Engg
Mumbai-400076
Tel : (+91 22) 5782545, 5786530 (Ext 2229)
Fax : (+91 22) 5783480

MEET OUR EMINENT TRIBOLOGISTS



Prof. B.C. Majumdar

Professor Bankim Chandra Majumdar obtained his B.M.E. degree with first class from Jadavpur University in 1963. He obtained his M.Tech, Ph.D. from IIT, Kharagpur in the years 1967 and 1970, respectively. Since then, he is working in IIT, Kharagpur. **Prof. Majumdar** has made significant contributions to engineering profession in teaching, research and consultancy to industry. His research contributions are in the area of lubrication of bearings and include theoretical and experimental work, accurate methods of prediction for performance characteristics of hydrodynamic oil and gas bearings, externally pressurized bearings, surface roughness effect in elastohydrodynamic lubricated contacts, effect of velocity slip on the stability of porous, oil and gas journal bearings, conical whirl instability of hydrostatic bearings, non-linear transient method to study the stability of submerged oil journal bearings considering the prehistory of film. He has done pioneer work for the development of gas bearings in high speed machinery based on consideration of theoretical prediction and experimental verification. His current research interests include the effect of

surface roughness on the stability of dynamically loaded bearings, effect of turbulence on these bearings, stochastic FEM model of rough surface bearings, etc.

Prof. Majumdar worked on a number of industrial consultancy projects and guided a large number of Masters and Doctoral theses. **He is the author and co-author of more than 100 technical publications and one text book in Tribology and he has been a reviewer of Journal of Tribology, Transactions of ASME and Tribology Transactions, STLE (USA), Wear (U.K.), Tribology International (U.K.), Journal of Institution of Engineers (India) and Indian Journal of Science and Technology (New Delhi).**

Prof. Majumdar was a nominated member of the general assembly for the International Union of Theoretical and Applied Mechanics (IUTAM). **In recognition of his work in the field of mechanisms and machines he was admitted as a honorary life member of the Association of Machines and Mechanisms and elected as a fellow of the Indian National Academy of Engineering recently.**

TSI Newsletter congratulates **Prof. Majumdar** for his commendable achievements in Tribology.



Prof. M.K. Ghosh

Prof. Mihir Kumar Ghosh did his Bachelor of Science (Mechanical Engineering) from Banaras Hindu University, Varanasi in 1966 and subsequently obtained his M.Tech. in Mechanical Engineering in 1968 from IIT, Kharagpur. He joined as a faculty member in the Department of Mechanical Engineering, BHU in 1969. He obtained his Ph.D. degree in Mechanical Engineering in 1979 from IIT, Kharagpur. His Ph.D. Thesis work was on evaluating the **Dynamic Behaviour of Multirecess Externally Pressurised Oil Journal Bearing.**

Professor Ghosh was a visiting Fellow of the U.S. National Research Council at the NASA Lewis Research Centre, Cleveland, OH during 1982-84. During this period he worked on **Elastohydrodynamic and Hydrodynamic Lubrication of Non-conformal Contacts** and published several NASA Technical Memorandums and international journal papers. He was a senior U.S. National Research Council Fellow at the NASA Lewis Research Centre, Cleveland, OH during 1989-90. During this period he worked on **Thermomechanical Analysis of Coated Media** and published NASA TM. He has about forty research publications to his credit. He has been a

professor in the department of Mechanical Engineering at IIT, Kharagpur during 1987-88 and is currently a professor of Mechanical Engineering at Banaras Hindu University since 1993. His biography has been published in the Marquis **Who's who in the world and who's who in Finance and Industry** of USA. He is a reviewer of papers for the Transaction of ASME, Journal. Of Tribology, Tribology International etc. He is a recipient of UGC's career award in engineering in 1984.

Professor Ghosh has made significant contribution in the area of **Hydrostatic and Hybrid Bearings and Elastohydrodynamic Lubrication of Concentrated Contacts.** He has incorporated recess volume fluid compressibility and fluid acceleration effects in the evaluation of rotordynamic coefficients of high pressure, high speed hybrid bearings. He has also contributed significantly towards evaluating thermal effects on film thickness, temperature rise and traction in concentrated contacts as applied to rolling element bearings and proposed empirical relationships for their estimation at the design stage. His current research interests are in **Bearing Seals and Rotordynamics and Vibration Control in Vehicle Systems.**

TSI Newsletter congratulates **Prof. Ghosh** for his commendable achievements in Tribology.

ABSTRACTS OF SOME OF THE LATEST SIGNIFICANT PUBLICATIONS BY THE TSI MEMBERS IN THE REPUTED JOURNALS

Thermal Elastohydrodynamic Lubrication of Heavily Loaded Line Contacts - An Efficient Inlet Zone Analysis.

Published in ASME, Journal of Tribology, Vol.120, issue 1, 1998, pp119-125. Authored by **Professor Mihir K. Ghosh** of BHU, Institute of Technology, Varanasi and **Raj K. Pandey** of Research and Engg Division, Kirloskar Brothers Ltd, Pune.

Abstract

An inlet zone analysis of TEHD lubrication of heavily loaded line contacts has been done using a computationally efficient and accurate numerical method based on Lobatto quadrature developed by Elrod and Brewe (1986). The results under extremely heavy conditions of dimensionless load $W=5.2 \times 10^{-4}$ ($P_H=2.0GPa$) and dimensionless rolling velocity $U=2 \times 10^{-10}$ (50 m/s) are presented. **Significant reduction in thermal reduction factor (film thickness) at high rolling speeds relative to isothermal conditions have been observed.** The results of the present work have been compared with the results of Wilson and Shen (1983) and Hsu and Lee (1994). A correction formula of the thermal reduction factor for the minimum film thickness has been derived for a range of thermal loading parameters, loads, and slip ratios.



The Deterioration of Lithium Greases under the Influence of Electric Current - An Investigation.

Published in International Journal of Lubrication Science, Volume 10-4, August 1998, pp 323-342. Authored by **Dr. Har Prashad** and **Dr. T.S.R. Murthy** of BHEL, Corporate R and D, Hyderabad.

Abstract

In the present work, we report on the analysis of the deterioration of lithium greases used in rolling-element bearings by X-ray diffractometry (XRD), X-ray fluorescence

spectrometry (XRFs), and atomic absorption spectrometry (AAS). These techniques give reproducible, reliable data with which to establish the severity of deterioration of greases recovered from the active zone of bearings. XRD appears more suitable for diagnosing quickly the chemical changes that have occurred in the soap residue of greases, even in small quantity, than other analytical and performance evaluation techniques.

Fresh lithium greases, their chemical composition, and the formation of new compounds in the greases have been investigated after use in rolling-element bearings run in the presence of electric fields, and also under pure rolling friction conditions without electric fields on a roller-bearing test rig. The deteriorated greases recovered from various motor bearings have also been analysed and the results are compared with those for the greases from the test bearings.

X-ray diffraction analysis shows that the chemical composition of the soap residue of the fresh lithium grease, lithiumstearate ($C_{18}H_{35}LiO_2$), does not change in bearings operated without the effect of electric fields, under pure rolling friction. However, lithium iron oxide (Li_2FeO_2) peaks were detected after prolonged operation of the bearings. On the other hand, under the influence of electric fields, the chemical composition of the grease changed to lithium palmitate ($C_{16}H_{33}LiO_2$), and peaks of gamma lithium iron oxide ($\gamma-LiFeO_2$) and lithium zinc silicate ($Li_{3.6}Zn_{0.2}SiO_2$) were detected. The surface of the bearings was found to be corroded after operation under electric fields. AAS showed a considerable increase in the lithium percentage, as lithium carbonate and lithium hydroxide in the used greases in aqueous solution, compared to the fresh grease.

The investigations reported in this paper, together with study of damaged/corrugated bearing surfaces, offer potential in diagnosing the cause of bearing failure in the presence of electric fields, and also in establishing the severity of deterioration of the lithium greases used in the bearings.

PRECISE NOMENCLATURE IN TRIBOLOGY

Compiled by: **Dr. Har Prashad** BHEL, Corp R&D, Hyderabad

Some terms commonly used, especially in lubrication engineering are ambiguous and misleading. Tribology terms should be precise and scientific. Followings are some Tribology terms that need to be discontinued for better precision.

(i) Thin, Thick, Heavy and Light to indicate oil viscosity

Thick and Thin are an indication of a dimension, not viscosity. These are applicable to an oil film thickness. The terms **heavy** and **light** are an indication of weight, mass or density. Tribologists should be specific and use the word viscosity with modifying adjectives such as low, medium or high.

(ii) Saybolt Universal Seconds SUS

SUS, SSU or **seconds** is a measure of viscosity from a particular apparatus, under particular conditioning. It is obsolete and not an internationally acceptable expression of viscosity. The international standard (SI) unit of kinematic viscosity is meters square per second (m^2/s). Since the number is very small for lubricating oils, e.g., ISOVG 32 = $32 \times 10^{-6} m^2/s$ is used, which is equivalent to centistokes (cSt).

(iii) Viscosity Index, VI

As stated in ASTM D 2270-93, VI is a single number indicating the change in viscosity between 40°C and 100°C. The determination of VI is based on several equations, depending on viscosity range. The use of viscosity temperature coefficient is suggested which is the ratio of change in viscosity at 40°C and 100°C to that of viscosity at 40°C in cSt. The viscosity temperature coefficient is also parallel to viscosity pressure coefficient.

(iv) Thickener

Thickener should be replaced by gelling agent. **Thickener** implies an increase in a dimension rather than an increase in consistency whereas a gelling agent gels the oil.

(v) Extreme Pressure (EP)

EP lubricants contains chemically active additives which form a metallo-organic or inorganic film on a metal surface that prevents scuffing. In place of EP, antiscuff is suggested. Extreme pressure is an ambiguous parameter since pressures are not required to cause scuffing as in the case of elastohydrodynamic lubrication. Scuffing occurs due to high loads,

temperatures and speeds, lack of lubricants, abrasive wear and metallic contaminants. Antiscuff avoids the confusion between EP and antiwear additives. An anti-wear additives such as Zinc dialkyldithiophosphate controls wear but has limited antiscuff properties as against sulfur/phosphorous compounds and gear oil additives which prevent scuffing.

(vi) Film Strength

Meaning of film strength is not clear. The important parameter of an oil film is its **thickness** in relation to the roughness of the bearing surfaces i.e. the lambda factor. That is needed to be used.

(vii) Oiliness

The term **oiliness** is vague, non-specific. It suggests oil-like. The term **lubricity** to be used. This indicates a lubricant which gives low friction.

(viii) Dry Lubricant

Dry indicates the **absence** of water and should not be used for solid lubricants. Dry should be used for the **absence** of moisture or a water-free environment.

(ix) Antifriction Bearings

The use of term **antifriction** for **rolling-element** bearings originated because at one time, the start up torque of these bearings was lower than sliding bearings. This difference is now obscured due to the use of low viscosity oils, low shear strength surface films and lubricity additives for sliding bearings. The term **Antifriction** should not be used.

(x) Mechanical/Chemical Wear

Tribologists should be more specific and state one of the numerous kinds of wear described in the literature than to use broadly mechanical wear and chemical wear.

(xi) Scoring

Scoring is often used instead of **scuffing** or **galling**. The word **scoring** suggests scratching or abrasion by hard particles or a hard rough surface. Scuffing is rough, irregular streaks of torn, locally melted and transferred metal. **Scoring** instead of **scuffing** causes confusion and should not be used for **scuffing**.

INTERNATIONAL CONFERENCE ON INDUSTRIAL TRIBOLOGY (ICIT '99)



More than 75 papers are likely to be presented in the conference. The plenary lectures will be given on the following topics:

1. Gear Lubricants as Design Elements - A Tool for Gear Designers.
Prof. Dr. Ing. Wilfried J. Bartz
Technische Akademie Esslingen
Germany
2. Lubricants of 21st Century.
Dr. Manfred Fuchs
Fuchs Petrolub A.G.
Germany
3. Bearings in 2000 and Beyond.
Prof. B. C. Majumdar
Indian Institute of Technology
Kharagpur
4. Tribology in Electrical Environment.
Dr. Har Prashad
BHEL, Corporate R&D
Hyderabad

Other plenary lectures are planned on

Macro and Nano Tribology
Tribology in Steel Plants
Tribology in Power Plants

1st LUBRICATING GREASE CONFERENCE

National Lubricating Grease Institute, India Chapter, announces **1st Lubricating Grease Conference** to be held at Nainital (U.P.) from 10th to 12th February 1999. Engineers, Scientists, Manufacturers, Users of lubricating grease and gear oil are invited to share their experiences and present papers.

For further details, please contact :

Mr. N. R. Bhoopatkar

Chief Executive - Industrial Cils,
Apar Ltd.,
Apar House,
Corporate Park, Sion-Trombay Road,
Chembur,
MUMBAI-400071
Tel: (+91-22) 5242371-76
Fax: (+91-22) 5246326
Email: aishmby@bom3.vsnl.net.in

LET'S THINK IT OVER

- ★ All laws being nothing more than unity in diversity, harmony in heterogeneity, and unison in variety.
- ★ Forget the past, for it is gone from your domain! Forget the future, for it is beyond your reach! Control the present! Live supremely well now! It will white-wash the dark past, and compel the future to be bright!

- Whisper from Eternity

To our readers : TSI Members are requested to send short technical communications for Publication in TSI Newsletter to the Editor.