



TSI Newsletter



A Quarterly Newsletter from Tribology Society of India

TSI Salutes Motherland in the 50th year of its Independence

FROM THE DESK OF CHAIRMAN, ORGANIZING COMMITTEE OF ICIT '99



Dr. P. JAGANNATHAN

BHEL, Corporate R&D division under the aegis of Tribology Society of India is organizing the Second International Conference on Industrial Tribology (ICIT '99) at Hyderabad, India from 1st to 4th of December 1999, **Tribology in 2000 and Beyond**, as the theme.

It is my privilege to approach all office bearers; executive committee members, life members, members, engineers, scientists, academicians and practitioners in Tribology and their respective organizations to participate in this International Event of this century in India by way of contribution of technical papers, sponsoring / co-sponsoring / assisting the conference, by participating in the exhibition, by contributing to the Conference Souvenir and by being a distinguished delegate of the conference to make it a memorable and successful event. Efforts are being made to bring to this forum experts from engineering industries, giant and small oil industries, steel industries, research & academic institutions, marketing groups, instrument manufacturers, suppliers, testing agencies and consultants from India and abroad for close interaction in order to visualize the technological requirements of the 21st Century.

All the Tribologists and their Organizations are requested to consider this as their own event and make it successful by their active participation and sincere efforts.

MINUTES OF THE TRIBOLOGY SOCIETY OF INDIA (TSI) MEETING HELD AT PUNE

The meeting of TSI members and others interested in joining TSI was convened at Pune on June 19, 1998 with the objective of creating a Pune Chapter of TSI. The meeting was attended by four life members of the TSI as also around 20 other representatives from Industry, R&D and Academic Institutions who were interested in joining TSI.

Dr. J. Bhatia, Vice President TSI, briefed the gathering about the objective and activities of TSI, after which the gathering finally voted in favour of formation of the Pune Chapter of TSI and unanimously elected the following office bearers:

- (1) Dr. Sudhir Rashingkar - Regional Secretary (RCG Instruments)
- (2) Mr. Ajit S. Bhamura - Treasurer (Ponawalla Group of Engineering Companies)

Additionally the following were nominated as members of the Executive Committee (subject to their becoming members of TSI, in case they are not already members) :

- (a) Mr. S.G. Chitnis (Kirkoskar Oil Engines Limited)
- (b) Prof. C.B. Malvadkar (Vishwakarma Institute of Technology)
- (c) Dr. Vikram G. Nabar (Vishwakarma Institute of Technology)
- (d) Mr. Sandeep Sawant (Balmer Lawrie - Fuchs Limited)
- (e) Prof. S.K. Ponde
- (f) Prof. R.P. Kate
- (g) Mrs. Sunita Phadkule

All those present expressed keen interest in participating in the activities of the local Chapter of TSI.

The meeting ended with a vote of thanks.

MINUTES OF MEETING OF TRIBOLOGY SOCIETY OF INDIA (DEHRA DUN LOCAL CHAPTER)

The TSI Dehra Dun Local Chapter meeting was held on August 6, 1998 at Indian Institute of Petroleum, Dehra Dun. The meeting was presided by **Shri Sudhir Singhal**, Ex-President of TSI and President, Dehra Dun Local Chapter (DLC). All members of executive committee including Regional Secretary, **Dr. Mahendra Pal**, Regional Treasurer, **Dr. S.K. Goyal** and members **Dr. R.P.S. Bisht** and **Mr. V.K. Chhibber** were present.

After welcoming the members, the Regional Secretary, presented a brief report on the activities of the DLC since it came into existence on November 12, 1997. The colloquiums by eminent tribologists **Dr. Alex Alliston Greiner**, Director, Plint and Partner, U.K. (February, 1998) and Professor **S.K. Biswas** of IISc, Bangalore (April 1998) were highlighted in the report.

DLC has taken various decisions and made creative plans to focus the tribological activities at Dehra Dun till the second ICIT '99 to be held at Hyderabad. This includes periodic meeting of EC members to organize monthly colloquium, to organize **two workshops in November 1998 and June 1999**, to organize family get-together on contributory basis, technical tours of TSI members to tribology related industries, to hold meeting of all TSI chapters EC members at Dehra Dun, contribute to TSI membership drive and to organize annual general body meeting of DLC in November 1999 to elect the new executive committee.

TSI News Letter congratulate the DLC for the commendable efforts to strengthen the TSI activities at Dehra Dun.

PLANNING AND ORGANIZING COMMITTEE OF INTERNATIONAL CONFERENCE ON INDUSTRIAL TRIBOLOGY (ICIT) - 1999

Dr. P. Jagannathan
BHEL, R&D, Hyderabad
Chairman, Organizing Committee

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Secretary, TSI
I.O.C., R&D, Faridabad

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Professor, I.I.T.,
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Mr. V. Narayan Sharma
Treasurer, TSI
Balmer Lawrie & Co
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Mr. Sudhir Singhal
Immediate Past President
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Dr. M.R. Tyagi
Jt. Secretary, TSI
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Mr. K. Balasubramanian
Fidelity Industries Ltd
Chennai

Dr. J. Bhatia
Vice President, TSI
Balmer Lawrie-Fuchs
Mumbai

Dr. A.K. Bhatnagar
I.O.C., R&D Centre
Faridabad

Dr. Har Prasad
Jt. Secretary, TSI
Convener & Organizing
Secretary, BHEL,
Corp R&D, Hyderabad



Prof. S. K. Biswas of Indian Institute of Science delivering plenary lecture on Sliding Wear - A Review of Generalities and Challenges in ICIT '97

TURBINE LUBRICATION - AN USER VIEW

Dr. Har Prashad, Dy. GM (Tribology), BHEL, R&D, Hyderabad

Turbine oils are in continuous use and spend little residence time in storage tanks or reservoirs. The type of lubrication involved is in the hydrodynamic region, so the choice of the correct viscosity is of great importance. **However, efficient trouble free service also demands good oil stability and resistance to deterioration, brought about by the long and continuous use of the oil.**

Essential Requirements and Causes of Degradation of Turbine Oils

Turbines possess relatively complicated lubrication systems, which include equipment for forced feed oil circulation including pump, filters, coolers etc, and oil operated governors. Highest demands are placed to circulate oil by steam pressure of approximately 175 bar and line steam temperature of 600 degree centigrade. The service life of oils depends on the design of lubrication system and the quality of oil. **It is essential to maintain the oil free from contaminants and high standards of cleanliness are required during the handling of turbine oils.**

When in service, the oil is in circulation and its primary tasks are to lubricate and cool the main bearings and governor control gear. The selection of the correct viscosity of the turbine oil grade is an essential requirement and lubricant must be viscous enough to build up a hydrodynamic lubricating film but at the same time must be thin enough to be able to carry out efficient cooling. **The viscosity of the turbine oil must also not vary in service and to minimize any change with temperature, it is essential to use an oil of high viscosity index.**

The simultaneous presence of steam, condensation water, air, oxygen and chemically active substances as well as occurrence of leakage currents increase the requirements with respect to aging stability of the oils. Hence, the oil must also have good oxidation resistance in service because any deterioration, with the production of **corrosive organic acids and sludge**, would considerably shorten the life of the turbine oil. Turbine oils are expected to have lives of many years, in some cases the same period as the life of the turbine. The use of high quality well refined **solvent treated oils, reinforced with oxidation inhibitors**, is essential for turbine applications. Tests may also be carried out to determine the **level of oxidation inhibitor** present in the used oil, so that an adequate additive level can be maintained during service. Oxidation inhibitors in the oil prevent oxidation by destroying peroxides that are formed in the oil during use. In so doing, the inhibitors are consumed. Also, in some

cases, volatile inhibitors are stripped from the oil. **When the inhibitors are depleted, oil failure occurs and the peroxides and free radicals promote rapid oxidation with formation of sludges, varnish and corrosive acids.**

In addition to good oxidation stability, the turbine oil must also be able to separate readily any water which may contaminate it during service in the system. Due to the possible presence of water, the oil must also be able to **prevent rusting** and are reinforced with **rust inhibitors**.

Another essential requirement of a turbine oil is that it must possess good antifoam characteristics and it must also be able to release quickly any air trapped in the body of the oil. **Anti-foam additives are sometimes included in turbine oils but care has to be taken in their selection so that they do not impede rapid air release from the oil.** The requirements for steam turbine oils are therefore very exacting. Most major turbine machinery designers, manufacturers and users detail their own rigid specification for such oils. Only approved oils are therefore normally used in steam turbines.

In order to provide a sufficient settling time for the separation of dirt, water and air, the amount of oil circulated must be calculated so that it is circulated **about 8 times per hour**. Very fine dirt and aging particles are removed from the oil by filtration and occasional centrifuging. Oil coolers prevent the oil temperature from rising too high and thus the viscosity from dropping below tolerable levels and premature aging of the oil. When transmissions are lubricated with turbine oils from the same circulation system, they should be designed for oils without antiwear additives. However, service lives of more than 25 years (as demonstrated in several power plants) can be achieved in critical gears when they are lubricated with turbine oils containing selected **antiwear additives which must be resistant to hydrolysis** and have no negative effects on the other oil properties.

In order to improve the safety of operation of turbine circulating systems, **fire resistant phosphoric acid esters** have been tried out, particularly for nuclear power stations, for the control circuits and also for lubrication of the turbine. In spite of their relatively good hydrolytic stability, these fluids require more attention in order to guarantee trouble-free operation than conventional turbine oils.

In the turbine oil lubrication system, all the requirements for bacterial growth are present: **water, warm temperatures, food (hydrocarbons and additives), and bacterial sources (dirt, air)**. Blockage of oil filters caused by water-in-oil emulsions stabilized

by bacteria and fungi can occur. Maintenance programs to keep the oil clean and dry prevent bacterial growth. Circulating oil system designs that provide good oil flow and adequate drainage eliminate anaerobic, stagnant pockets in which bacteria grow and degradation products accumulate. The turbine oils are produced from highly refined, paraffinic base oils with the addition of **phenolic oxidation inhibitors** and corrosion protection agents. The resistance to water entrainment is achieved by the addition of small amounts of **surfactants**. The additives present must not have a negative effect on air entrainment.

Turbine Oil Grades

The most usual viscosity classes are ISO VG 32 and 46. Turbine oil in class ISO VG 68 are recommended for lubricating marine Turbines.

ISO VG 100 are only used in special cases for Turbine lubrication. ISO VG 46 with EP turbine oil are used for geared turbines for ships. Manufacturers recommend fire-resistant hydraulic fluids with code HFDR as hydraulic fluids in control and regulating systems such as **phosphoric acid triaryl ester** in viscosity classes ISO VG 32 and 46. EP turbine oil of viscosity class ISO VG 46 is used for gas turbines.

Turbine Oil Test Requirement

Keeping in view of long life of turbine oils, the following tests are to be carried out to establish the characteristics as per the relevant standards:

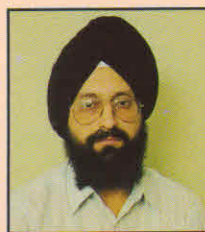
1. Testing of General properties like **viscosity, viscosity index (VI), total acid number (TAN), pour point (PP)** and also specific properties like **demulsibility, foaming characteristics, air release, four ball antiwear and weld load test**.
2. The oxidation stability of fresh and used turbine oils through **RBOT (Rotary Bomb Oxidation Test) and TOST (Turbine Oil Stability Test)** as per ASTM D 2272 and ASTM D 943, respectively.
3. **Degradation kinematics with RBOT ageing.**

The above tests are required since the oxidation stability characteristics of turbine oils manufactured and marketed worldwide vary over a wide range. This is due to the wide variety of base oils and additives used. Also, **oxidation characteristics of an oil depend on its crude source, degree of refining and additive treatment**. There is an optimum additive package for each base oil. One package may not be suitable for all base oils. The choice of **suitable base oils for turbine application is an existing problem that is why RBOT, TAN, TOST, tests are required for the acceptance of the oils in turbine lubrication in industry.** Industry also insist the data of oil life with time and operating parameters. This is because besides various other reasons batch to batch variation of RBOT value of the same brand is observed.



A section of foreign delegates during the launch trip on river Hoogly during ICIT '97

OUR YOUNG TRIBOLOGIST



Dr. G.S. KAPUR

Dr. G.S. Kapur did B.Sc(Hons) and M.Sc(Chemistry) from University of Delhi in 1985, followed by M.Tech and Ph.D. from I.I.T., Delhi in 1990. After doing **post doctoral research work as an UNESCO fellow at Institute of Macromolecular Chemistry, Prague, Czech Republic** and later

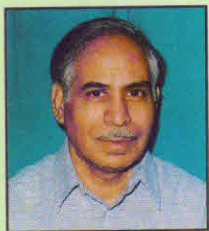
working as research associate at IIT, Delhi, Dr. Kapur joined R&D centre of IOC in 1992.

He has more than 50 papers and 20 technical reports to his credit.

He has been engaged in characterization of various petroleum products using NMR spectroscopic methods and correlating their properties to the tribological characteristics. Other research interests of Dr. Kapur include: establishing structure (spectral) property correlations using chemometric technique, microstructure determination of polymers using multi-pulse one and two dimensional NMR technique and broadening the understanding of additive-additive interactions (synergistic and antagonistic effects) in lubricants through variable temperature phosphorous NMR/IR and to establish their correlation to tribological studies.

TSI News Letter congratulates Dr. Kapur for his commendable consistent in depth involvement in the unexplored area of Tribology.

MEET OUR EMINENT TRIBOLOGISTS



Prof. J.S. RAO

Professor J.S.Rao obtained his Bachelor's degree in Mechanical Engineering with a first class Honors from Andhra University in 1960. He obtained his M.Tech, Ph.D. and D.Sc. from the Indian Institute of Technology, Kharagpur in the years 1963, 1965 and 1971 respectively. He was with the Indian Institutes of Technology at Kharagpur and New Delhi for over 30 years. He has also taught at the University of Surrey, England; National Institute of Applied Sciences, Lyon; Concordia University, Montreal; Rochester Institute of Technology, USA, Gesamthochschule, Kassel, Germany, National Chung Cheng University, Chia Yi and the University of New South Wales, Sydney. **Professor Rao started a new center on Industrial Tribology, Machine Dynamics and Maintenance Engineering center at IIT Delhi in 1976 and served as Science Counselor at the Indian Embassy in Washington, DC. Professor Rao is appointed to the first BHEL chair at the Indian Institute of Technology, Delhi.**

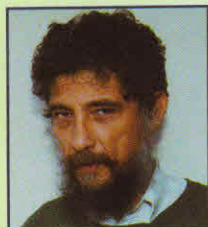
Professor Rao is a member of the Board of Governors of IIT Delhi since 1998. He has been the chairman of IFToMM Rotor Dynamics committee from 1983-90, a member of IFToMM executive council from 1987-91 and Nominating committee from 1991-95 and chairman of the IFToMM permanent commission on Conferences from 1994-97. He is also a member of the ASME IGIT Structures & Dynamics Committee. Professor Rao has been the founder president of Association of Machines and Mechanisms in India and has been the president of Indian Society of Theoretical and Applied Mechanics. He is also a member of the Indian National Academy of Engineering and American Society of Mechanical Engineers. Further, he is chairman of Indian Aeronautical Research and Development Board Rotor Dynamics working group. He is a member of advisory committees in India for several R&D institutions and helped them start new programs of research. He is also a member of the Editorial Board of Mechanism and Machine Theory and Board of International Advisers of Wiley Series in Design Engineering. Several conferences were organized by him, e.g., 19th congress of Indian Society of Theoretical and Applied Mechanics in Kharagpur in 1974, V IFToMM world congress in 1983 and chairman of the IFToMM committee on Rotordynamics to run the II International conference in Tokyo in 1986. He continues to act as a member of several international conference steering or organizing committees. Professor Rao is an active reviewer for various journals and bodies across the world notably amongst them are Institution of

Engineers (India), Aeronautical Society of India, Indian Society of Theoretical Applied Mechanics, American Society of Mechanical Engineers, Shock and Vibration Digest, Mechanism Machine Theory, National Science Foundation (USA), Defense Science Journal, Journal of Sound and Vibration.

Professor Rao produced 30 Ph.D.'s, published eight text books and authored over 250 papers. He has been a consultant to several industries in India such as Bharat Heavy Electricals Ltd, Gas Turbine Research Establishment and Indian Railways and abroad such as Washington Metro Authority, Stress Technology Inc. in USA and Twyflex Couplings in England. He has been the leader of teams that were responsible to make successful investigations of major technical problems, e.g., the nuclear power plant accident that occurred in Narora in March 1993 and the annoying break squeal problems in the underground metro trains of Washington DC in USA in 1981. He is also member of the Review Committee for C-12 Cryogenic Engine Turbine Pump for GSLV 3rd Stage of the Liquid Propulsion Systems Center of Indian Space Research Organization.

Professor Rao received best paper award for his contribution to Defense Science Journal in 1984, the Association of Scientists of Indian Origin in America recognized him with an award for Outstanding Scientific Contributions in 1985, American Society of Mechanical Engineers, Washington, DC awarded him for significant contribution to Mechanical Engineering in 1988 and was adjudged outstanding in Instruction of Mechanical Engineering by IIT Delhi from 1989 to 1992. He also received Glimpses of Engineering Eminent Personality award from Institution of Engineers (India) in 1994, Distinguished Leadership Award from American Biographical Institute in 1996, Silver Medal of Honour 20th Century Award for Achievement from International Biographical Center, Cambridge, England in 1997 and honored by Association of Machines and Mechanisms (India) for Distinguished Services in the Area of Theory of Mechanisms/Mechanical Design and Technical Education and Honorary Life Membership of 1997. He has now recently received ISROMAC-7 award for outstanding contributions in the field of Dynamics of Rotating Machinery. His biographical sketch is reviewed by Marquis Who's Who, Men of Achievement, International Who's Who in Commonwealth, Leaders in Education & Educationists Who's Who International, Reference Asia, Learned Asia and Indo-American Who's Who, Indo-European Who's Who and International Directory of Distinguished Leadership.

TSI News Letter congratulates Prof.Rao for his commendable achievements. **Tribology Society of India is proud for his close association with TSI activities and honoured by his guidance for broadening horizon of Tribology in India.**



Prof. S. K. BISWAS

Prof. Sanjay Kumar Biswas did his B.Tech, in Mechanical Engineering from IIT, Kharagpur in 1966, M.Sc. from University of Strathclyde (Glasgow, UK) and Ph.D. from University of Birmingham, UK in 1972. After doing his post doctoral work in forging design at University of Birmingham he joined the Department of Mechanical Engineering, Indian Institute of Science in 1976. He is now a Professor of Mechanical Engineering at the Indian Institute of Science.

He is a regional editor of the Tribology International and associated with all major international journals in tribology as well as some applied physics and mechanics journals in the capacity of a reviewer. He is also a member of an international advisory group on Wear of Materials Conference. He was one of the invited speakers at the First World Tribology Congress held in London in September 1997 and is an invited speaker at the Gordon Research Conference in Tribology held in June 1998 in New Hampshire, US. He has been associated with many major projects supported by government agencies as well as industries in India. He is one of the leaders of the Advanced Materials Section of

Technology Development Mission of the Planning Commission, Government of India. He has collaborative association with the Imperial College and University of Oxford in UK and Georgia Tech., Atlanta, US. **He was a senior academic visitor in the Department of Materials at Oxford University and a member of the St.Cross College, Oxford in 1995-1996. He has about 120 research publications to his credit.**

His work in the early part of his career was on large scale plasticity in metal working operations. He has been engaged for 15 years in Wear research. While he has been involved in looking at the mechanism of wear of a range of materials from soft polymer to very high strength CMC composites each with a certain industrial end, his major contribution has been in understanding the sliding wear of metals. **He proposed that wear of a metal is fundamentally related to strain rate response and demonstrated that when this response leads to microstructural instability, cracks nucleate to initiate the wear process. His interest in the fundamentals of tribology has led him to take interest in nano contact mechanics and he is presently engaged in a number of projects to understand tribology and contact at the atomistic and molecular levels.**

TSI News Letter congratulates Prof.Biswas for his commendable achievements in Tribology.

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

Determination of Time Span for the Appearance of Flutes on the Track Surface of Rolling Element Bearings under the Influence of Electric Current.

Published in Tribology Transactions, Vol.41, issue 1, 1998, pp. 103-109. Also presented as a Society of Tribologists and Lubrication Engineers paper at the World Tribology Congress held in London, United Kingdom, September 8-12, 1997. Authored by **Har Prashad**, BHEL, Corporate R&D Division, Hyderabad.

Abstract

A theoretical approach is developed to determine the time span for development of flutes after the appearance of slip bands on the track surface of rolling element bearings operating under the influence of electric current. **A theoretical model has been developed using the continuum theory of Griffith to determine the energy per unit area required for the development of corrugations after the appearance of slip bands on the track surfaces.** Also, an expression is deduced for the net energy input per unit area on the track surfaces by the amount of electric current passed through the bearing at the measured shaft voltage in a given span of operation.

By the formulation of pitch of corrugations derived using bearing dimensional and operational parameters along with the developed model and expressions, the time span for the development of corrugations has been determined. A similar time span has been ascertained experimentally. Theoretical and experimental values of time span, thus determined, have been compared and found to match closely.

The analysis can also be used for the determination of the shaft voltage or bearing current if the time for the formation of corrugation is known.

Development of a ¹³C-NMR Spectroscopic Method for Estimation of Heavy Alkylated Benzene (HAB) in Industrial Oils Using Stepwise Multiple Linear Regression.

Published in Lubrication Engineering, Vol.51, issue.5, May 1998, pp.21-28. Authored by G.S.Kapur, S.Mukherjee, A.S.Sarpal and S.K.Jain, Indian Oil Corporation Ltd., R&D Centre, Faridabad-121007.

Abstract

The chemometric procedure, stepwise multiple linear regression, was used for the analysis of a complex hydrocarbon mixture of lubricating basestock components. The method allows the use of ¹³C-NMR spectroscopy for the precise estimation of heavy alkylated benzenes (HAB) in industrial oils. Two separate models were developed: one applicable for the estimation of HAB in paraffinic mineral oils and other in naphthenic base stocks (refrigeration oils). The two models can predict the percentage of HAB with a standard error of 3 and 2.6% in the respective blends of paraffinic and naphthenic mineral base oils.

12TH INTERNATIONAL COLLOQUIUM TRIBOLOGY TRIBOLOGY 2000 - PLUS

The above conference will be organized at Stuttgart / Ostfildern, Germany from 11-13 January 2000. For full details, please contact :

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Scientist, Indian Institute of Petroleum,
Dehra Dun

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Scientist, Regional Research Laboratory,
Bhopal



Participants relax during the launch trip on river Hoogly during ICIT '97

INTERNATIONAL CONFERENCE ON INDUSTRIAL TRIBOLOGY 1999



BHEL, Corporate R&D Division under the aegis of Tribology Society of India is proud to announce the **International Conference on Industrial Tribology to be held at Hyderabad, India from 1st to 4th of December 1999 at Hotel Holiday Inn Krishna.**

The second International Conference on Industrial Tribology of the Century is being organized in India with the theme of **Tribology in 2000 and Beyond**, to bring to focus the achievements of Tribology by 2000 and the future advancement of this discipline in the 21st Century.

Engineers, Scientists, Academicians and Practitioners in Tribology are invited to present papers in line with the theme of the conference. Prospective contributors are requested to forward 3 copies of the abstracts of about 300 words in double spacing not later than November 1, 1998 to the Organizing Secretary.

Exhibition space along with basic infrastructural facilities is being offered to the exhibitors. Limited space is available for exhibitors at the conference venue. Also, Industries, Reputed Companies, Institutions are invited to sponsor/co-sponsor/support ICIT '99. Due publicity and recognition will be given to all such supporters besides other concessions. Souvenirs to be published on the occasion would also offer opportunities for advertisements. Please contact for further details:

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2nd WORLD TRIBOLOGY CONGRESS 2001

2nd World Tribology Congress 2001 will be held in Vienna at Messe and Congress Centre Vienna, during September 3rd - 7th, 2001. The Congress will be organized by Austrian Tribology Society. The Chairmen of this Congress will be Prof.Dr.-Ing.W.J.BARTZ and Prof. Dr. FRIEDRICH FRANEK. For further details, please contact :

International Tribology Council (ITC)
Floragasse 7/2, A-1040 WIEN

LET'S THINK IT OVER

- Great works are performed not by strength, but by selfless perseverance, honesty, purity and above all by God's grace.
- Learning without thinking is a labour lost. And thinking without learning is perilous.

- Whisper from Eternity

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

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