



The Finnish Society for Tribology was founded 31.8.1977 to promote the research, technical development and education of tribology in Finland. The society publishes the quarterly journal *Tribologia* and arranges conferences, seminars and special events on tribology. The society celebrated its 40 years existence by arranging an international commemorative seminar in the Finnish Labour Museum Werstas located in the former buildings of Finlayson factories in Tampere.

Tribology studies the interactions (friction, wear and lubrication) between two surfaces compressed against each other and in relative motion. In mechanical engineering tribological contacts exist, e.g., in gear wheels, different bearings, cylinders of combustion engines and in compression joints. Friction has also a great significance in many everyday actions like walking.

The seminar was attended by 38 participants from four countries. The chairman of the society **Helena Ronkainen** from VTT Technical Research Centre of Finland Ltd (VTT) opened the seminar and wished all participants welcome. Professor **Kenneth Holmberg** from VTT gave a historical review of the activities of the society and of the tribological research in Finland. The first three academic licentiate theses on tribology

were published in 1970 and during the same year Dr.Tech. **Kauko Aho**, afterwards professor in Tampere University of Technology, wrote a chapter on tribology in the Finnish Handbook of Technology on the basis of his own studies. In 1976 professor **John Halling** from Salford University in England was invited to Helsinki University of Technology to give a two-day course on tribology.

Inspired by his presentations the Finnish Society for Tribology was founded next year. Tribology-journal was established in 1982. Altogether 35 volumes and 135 numbers containing over 7 200 pages have been published until now. More than 1200 scientists from 35 countries have participated in writing the current 600 articles in the journal.

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The society has put a great effort in organizing the biannual Scandinavian NORDTRIB conference in Finland in years 1984, 1992, 2000, 2008 and 2016 as well as the international EUROTRIB conference in Helsinki University of Technology, Otaniemi 12.-15.6.1989. The latest NORDTRIB conference had 202 participants and the 1989 EUROTRIB conference collected 432 attendees from 35 countries.

Professor **Roland Larsson** (Luleå University of Technology, Sweden) treated in his presentation the influence of surface roughness and texturing on lubrication. Texturing, the controlled manipulation of surface profile, has a beneficial influence in the case of parallel gliding surfaces when the removal of wear debris is important or when the lubrication must be improved under boundary lubrication conditions. The efficiency of texturing diminishes with increasing thickness of lubricant film. Professor Larsson also discussed the modeling of boundary lubrication conditions and subsequent wear.

Professor **Arto Lehtovaara** (Tampere University of Technology, Finland) studied the relations between fretting and fatigue in quenched and tempered steels. Fretting is a wear phenomenon occurring in compression, bolt and wedge joints, when the surfaces compressed against each other are in a small amplitude (micrometer scale) vibrating relative motion. Fretting wear may lead to increasing surface roughness and eventual nucleation of fatigue fracture. The studies on this subject have clearly shown that the fretting reduces the fatigue strength of the studied high strength steels. The current theories do not sufficiently take this relation



Professor Arto Lehtovaara gave a presentation on the relations between fretting wear and fatigue.

between fretting wear and fatigue into account.

Anssi Laukkanen (VTT) presented the modeling of microstructure in martensitic steels and the use of developed structural models in wear and fatigue studies. The models enable the studies of local deformations in contacting areas and the determination of their influence on the microstructural changes leading to wear and fatigue. Via combining the models and machine learning the tailoring of a material and its microstructure for the best resistance against definite wear and fatigue types can be explored.

Guillermo E. Morales-Espejel (SKF Engineering and Research Centre and LaMCoS, INSA-Lyon, France) discussed the tribology of ball and roll bearings. Bearings are becoming more and more challenging parts in machine constructions due to decreasing lubricant film thicknesses



The lecturers of the seminar: from the left Guillermo E. Morales-Espejel, Marke Kallio, Anssi Laukkanen, Aki Linjamaa, Arto Lehtovaara, Helena Ronkainen, Thomas Norrby, Elina Huttunen-Saarivirta, Roland Larsson and Kenneth Holmberg.

(even to nanometer scale) and increasing loading intensity, rotational speed, temperature, and component size. These challenges can be responded by modeling the bearing lubrication, by applying these models to the modeling of bearing damage types and by proceeding finally to the modeling of bearing service life. The current trend is to extend the modeling to include different combinations of the basic tribological factors and their interactions and to take more and more into account the influence of actual material properties like inhomogeneity.

Dr.Tech. **Marke Kallio** (Metso Minerals Oy) presented the requirements set for the glide bearing materials in Metso's product assortment. The search of substitutes for the conventional lead-containing metal alloys is in progress and solutions are being sought among both non-lead metal alloys, metal alloys with low surface energy, composite materials and metal-polymer hybrid materials. The trend seems to be propagating more and

more towards application-oriented bearing material selection.

Aki Linjamaa (Tampere University of Technology) has studied the behavior of metal-polymer hybrid materials in slide bearings. He has paid special attention to the limits set by temperature and to the modeling of temperature distribution under different loading conditions. Temperature distribution in a hybrid material seems to be one of the key factors determining the durability of a slide bearing. Optimization of this distribution enables the development of hybrid materials to very potential alternatives for glide bearing materials in many applications.

Professor **Thomas Norrby** (Nynäs Ab, Sweden) discussed the development on oil-based lubricant markets in the light of both forthcoming regulations and the changes in the electric vs. fuel-based car competition. The Dieselgate of the year 2015, the entering of synthetic oils into car markets and the increasing number of electric cars influence



The coffee break was used for active discussion.

strongly the markets and delivery chains of base oils.

In the last presentation of the seminar Dr.Tech. **Elina Huttunen-Saarivirta** (VTT) introduced a study on the combined influence of corrosion and wear in both passivating (stainless steels) and non-passivating (aluminum bronzes and leaded tin bronzes) metals under loaded sliding conditions. In passivating metals the introduction of load to the sliding contact reduced significantly the open circuit potential, prevented the actual passivation and increased strongly the anodic current density (corrosion rate). Simultaneous increase in friction coefficient revealed the evolving local damage of sliding surfaces.

In non-passivating metals the open circuit potential did not change significantly with the introduction of load to the sliding contact. The sliding surfaces showed active dissolution, formation of corrosion products and increased friction coefficient. At more positive potential values the synergistic significance of combined corrosion and wear in the formation of the total weight loss increased in both metal alloy groups (passivating vs. non-passivating). The smaller weight loss of aluminum bronze originated almost totally from corrosion whereas in leaded tin bronze also wear contributed to the formation of larger weight loss.

After seminar the participants had a guided tour in the adjoining steam engine museum where the massive steam engines serving in their days as the main power source of Finlayson factories are now located. Friction, wear and lubrication had formerly a significant role also in these applications. The commemorative seminar culminated in jubilee dinner served in nearby Finlayson palace.



On a guided tour in the steam engine museum. The two engines served in their time as the main power source of Finlayson factories. Behind the engines is the massive flywheel, from which the power was transmitted to different parts of the comprehensive factories via trapezoidal belts.