Society of Tribologists and Lubrication Engineers

66TH ANNUAL MEETING & EXHIBITION PROGRAM GUIDE
MAY 15-19, 2011 • ATLANTA, GEORGIA

Technical Sessions
Exhibitors
Education Courses
Special Events
Commercial Marketing Forum
Networking Opportunities
Student Posters
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Local Section Leader Workshop

Plus: Your Personal Itinerary Planner – Pages 6-10

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The 2011 STLE Annual Meeting & Exhibition is sponsored by the Society of Tribologists and Lubrication Engineers, an international organization headquartered at 840 Busse Highway, Park Ridge, Illinois (USA) 60068-2376. Telephone: (847) 825-5536. Fax: (847) 825-1456. E-mail: information@stle.org. Web: www.stle.org.

STLE is a not-for-profit professional society founded in 1944 to advance the science of tribology and best practices in lubrication engineering.

Daily Schedule at a Glance

All room numbers refer to Hilton Atlanta.

Sunday, May 15, 2011

Registration
7 am – 6 pm – 2nd Floor Foyer

Speakers Breakfast
7 – 7:45 am – Salon A-C

Education Courses (8 am – 5 pm)

Basic Lubrication 101 – 302

Bio Fuels and Lubes – 305

Condition Monitoring – 306

Hydraulics – 303

Synthetic Lubricants 203 – 304

Education Courses (1:30 – 5 pm)

Nanotribology Special Session – 309/310

Local Section LeaderWorkshop (5 – 6:30 pm)
"Committee Meetings that Work," by Drs. Jean & Ed Becker – 309/310

Monday, May 16, 2011

Registration
7 am – 6 pm – 2nd Floor Foyer

Speakers Breakfast
7 – 7:45 am – Salon A-C

Technical Sessions (8 –10 am)

1A Rolling Element Bearings I: Erwin V. Zaretsky Symposium – 202

1B Nanotribology I: Nanomaterials and Applications I – 203

1C Lubrication Fundamentals I – 204

1D Biotribology I: Skin Tribology, Modeling – 205

1E Wear I – 206

1F Fluid Film Bearings I – 209

1H Metalworking I: Fluid Health, Safety & Longevity Session 1 – 211

1K Condition Monitoring I – 214

Commerical Marketing Forum I – Salon D/E

Keynote Address (10:30 am – Noon)
"Biological Principles and Biomimetics of Tribologically-Active Materials," presented by Stanislav N. Gorb – Grand Ballroom C/D

Lunch
Noon – 1:30 pm (on your own)

Exhibits and Student Posters
Noon – 5 pm – Exhibit Hall

Technical Sessions (1:30 – 6 pm)

2A Rolling Element Bearings II: Erwin V. Zaretsky Symposium – 202

2B Nanotribology II: Nanomaterials and Applications II – 203

2C Lubrication Fundamentals II – 204

2D Coatings I – 205

2E Wear II – 206

2F Fluid Film Bearings II – 209

2G Aerospace I – 210

2H Metalworking II: Fluid Health, Safety & Longevity Session 2 – 211

2I Engine & Drivetrain I – 212

2J Synthetics & Hydraulics I – 213

2K Condition Monitoring II – 214

Commercial Marketing Forum II – Salon D/E

Welcome Reception
6:30 – 8 pm – Grand Ballroom C/D

Tuesday, May 17, 2011

Speakers Breakfast
7 am – 7:45 am – Salon A-C

Registration
6:30 am – 5 pm – 2nd Floor Foyer

Exhibits and Student Posters
9:30 am – 5:30 pm – Exhibit Hall

Technical Sessions (8 am – Noon)

3A Rolling Element Bearings III – 202

3B Nanotribology III: Nanomechanics – 203

3C Lubrication Fundamentals III – 204

3D Ceramics/Composites I – 205

3E Wear/Seals Panel I – 206

3F Fluid Film Bearings III – 209

3G Biotribology II: Orthopaedic Tribology – 210

3H Metalworking III: Testing & Modeling Fluid/Additive Performance – 211

3I Engine & Drivetrain II – 212

3J Practical Lubrication I – 213

3K Condition Monitoring III – 214

Commercial Marketing Forum III – Salon D/E

President's Luncheon/Business Meeting
Noon – 2 pm – Grand Ballroom C/D

Daily Schedule at a Glance

All room numbers refer to Hilton Atlanta.

Tuesday, May 17, 2011/continued

Technical Sessions (2 – 6 pm)

4B Nanotribology IV: Nanolubricants I – 203

4C Lubrication Fundamentals IV – 204

4D Material Tribology I – 205

4F Fluid Film Bearings IV – 209

4G Biotribology III: Ocular Tribology – 210

4H Metalworking IV
Workpiece & Tool Effects on Metalworking – 211

4I Engine & Drivetrain III – 212

4J Practical Lubrication II – 213

Commercial Marketing Forum IV – Salon D/E

Wednesday, May 18, 2011

Registration
6:30 am – 5:00 pm – 2nd Floor Foyer

Speakers Breakfast
7 – 7:45 am – Salon A-C

Exhibits and Student Posters
9:30 am – Noon – Exhibit Hall

Education Courses (8 am – 5 pm)

Advanced Lubrication 301 – 302

Basic Lubrication 102 – 305

Metalworking – 309/310

NLGI Grease Course 101 – 303

Synthetic Lubricants 204 – 301

Technical Sessions (8 am – Noon)

5B Nanotribology V: Nanolubricants II – 203

5C Lubrication Fundamentals V – 204

5D Material Tribology II – 205

5E Seals I – 206

5F Tribotesting I – 207

5G Fluid Film Bearings V – 209

5H Gears I – 210

5I Surface Engineering I – 211

5J Environmentally Friendly Fluids I: EFF Applications – 212

5K Non-Ferrous Metals I: Biobased Lubricants Options for Industry – 213

5L Power Generation I – 214

Commercial Marketing Forum V – Salon D/E

Technical Sessions (1:30 – 6 pm)

6A Wind Energy I – 202

6C Lubrication Fundamentals VI – 204

6D Materials and Nanotribology Joint Session
In-Situ Techniques, Modeling and Multi-Scale Phenomena – 205

6E Seals II – 206

6F Tribotesting II – 207

6H Gears II – 210

6I Surface Engineering II – 211

6J Environmentally Friendly Fluids II: Panel Discussion
Biodegradability, Environmentally Friendly Certification for Biobased Lubricants in the US and Europe and USDA Bioacceptability – 212

6K Non-Ferrous Metals II: Surfaces and Chemicals – 213

6L Power Generation II – 214

Commercial Marketing Forum VI – Salon D/E

Thursday, May 19, 2011

Speakers Breakfast
7 – 7:45 am – Salon A-C

Registration
7:30 am – 2 pm – 2nd Floor Foyer

Technical Sessions (8 am – Noon)

7A Wind Energy II – 202

7B Contact Mechanics – Materials Tribology and Nanotribology Joint Session I – 203

7C Grease I – 204

7D Tribotesting III – 205

7E Seals III – 206

7F Surface Engineering III – 211

7G Environmentally Friendly Fluids III: Base Oils for EFF – 212

Technical Sessions (1 – 5:30 pm)

8A Wind Energy III – 202

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8C Grease II – 204

8E Seals IV – 206

8G Environmentally Friendly Fluids IV
Additive Studies in EFF – 212

Beverage Breaks are scheduled at 10 am and 3 pm daily.

NANOTRIBOLOGY V – NANOLUBRICANTS II

Session 5B • Room 203

Session Chair: A. Erdemir, Argonne National Laboratory, Argonne, IL

Session Co-Chair: J. W.,Choo, Petronas Research Sdn Bhd, Selangor, Malaysia

8 – 8:30 am

Active Nanoparticles-Based Novel Lubricant Additives to Improve Energy Efficiency and Durability

D. Demydov, A. Suresh, NanoMech, Inc., Springdale, AR, A. Malshe, University of Arkansas, Fayetteville, AR

Systematic investigation of modified nanoparticles with additional functional groups that positively impact friction and wear behaviors will be discussed. These nanoparticles were specially designed for addition to oils/greases as additives to improve energy efficiency and durability. The temperature- and pressure-sensitive architecture of the nanoparticles enabled them to deliver a stable transfer tribofilm that reduced the extent of adhesive wear and solid-phase welding between sliding surfaces and provided better lubrication resulting in better reliability of mechanical integrity and lower energy consumption. The nanometric size allowed the entrapment of the particles at the asperity-to-asperity contacts and reduced asperity friction. The research efforts were focused on tribological testing of nanoparticles, improvement of their dispersion, and investigation of their behaviors in the presence of other additives in formulated oils/greases.

8:30 – 9 am

Experimental Studies on the Tribological Behaviour of Engine oil (SAE15W40) with the Addition of CuO Nanoparticles

R. Krishnan, M. Thottackkad, P. Nair, National Institute of Technology Calicut, Calicut, India

Experimental studies on the influence of Copper oxide (CuO) nanoparticles utilised as an additive in lubricating oil (SAE15W40) under boundary lubrication conditions have been carried out using a pin-on-disc machine in accordance with ASTM D4052 standard. The variation of viscosity, coefficient of friction, wear and settling of nanoparticles has been studied as a function of particle concentration in the lubricant.

Results show that the frictional force and specific wear rate decrease with an increase in concentration of nanoparticles, comes to a minimum at a specific concentration and then increases, showing the presence of an optimum concentration. With the increase in concentration of nanoparticles the kinematic and dynamic viscosities, and the flash and fire points are found to increase. Thus, the use of CuO nanoparticles as additives to a moderate level, is a very efficient means of improving the tribological properties of lubricating oils.

9 – 9:30 am

Nanodiamond-based Nanolubricants

M. Ivanov, Ural Federal University, Yekaterinburg, Russian Federation, S. Pavlyshko, Institute of Engineering, Science Ural Branch RAS, Yekaterinburg, Russian Federation, I. Denis, Ural Federal University, Yekaterinburg, Russian Federation, I. Petrov, SKN, Snezinsk, Russian Federation, G. McGuire, O. Shenderova, International Technology Center, Raleigh, NC

Recently, certain nanomaterials in powder and colloidal forms have emerged as potential anti-friction and wear additives to a variety of base lubricants. Highly purified detonation nanodiamonds (DND) with small aggregate sizes are a relatively new nanomaterial additive [1,2]. In the current work, we report results of the comparative analysis of the colloidal stability and tribological performance of DND-based additives as well as other commercial additives based on detonation soot, boron nitride and PTFE, nano-oxides (TiO_2) and their combinations in mineral engine oil 15W40 (API CF/CC). Testing has been performed on these formulations using ring-on-ring (friction coefficient) and four ball tests (extreme pressure (EP) failure load and diameter of wear spot). Effects of different parameters of the formulations on their tribological properties will be discussed.

References: [1] M. G. Ivanov, et al, Mater. Res. Soc. Symp. Proc,1203, 1203-J17-16, 2010; [2] M. G. Ivanov, et al, JVST B, 28, 869, 2010.

9:30 – 10 am

Experimental Analysis of Stable CuO Nanoparticle-Enhanced Lubricants

H. Ghaednia, R. Jackson, L. Fan, J. Khodadadi, Auburn University, Auburn, AL

The goal of this paper is to investigate the effect of different concentrations of nano-lubricants on the friction and wear of a disk-on-disk test setup. The uniquely developed nanoparticles used in this study are CuO and have been proven to be exceptionally stable. Existing literature also suggests that CuO particles may be able to enhance lubricant performance in the boundary lubrication regime. A disk-on-disk test setup used in this study can measure the friction coefficient and wear using torque and load sensors. The tested samples are submerged in a small reservoir of the nano-lubricant. The wear and possible mending of the surfaces is evaluated by a surface profilometer and weighing the samples before and after testing. Experiments have been carried out for lubricants with different concentration of additives in various rotational velocity and loads.

10 – 10:30 am • Break

10:30 – 11 am

Single Asperity Friction and Temperature Dependent Properties of Boundary Lubricant Additive Films

J. Bares, University of Pennsylvania, Philadelphia, PA, T. Haque, M. Webster, D. Yablon, ExxonMobil Research and Engineering Company, Annandale, NJ, R. Carpick, University of Pennsylvania, Philadelphia, PA

Automotive lubricants are designed to form low friction, wear resistant layers through interactions between additives and the steel surfaces during tribological contact. Atomic force microscopy (AFM), which simulates single asperity sliding contacts, was used to investigate local properties of additive films. Samples were produced in a high frequency reciprocating sphere-on-flat geometry using single additive and multi-additive lubricant blends. Films generated from these tests were characterized using AFM. To simulate macroscale test environments for the single asperity friction measurements, the probe and sample were immersed in a polyalphaolefin liquid. A heated stage was used to investigate local film properties at different temperatures. We will discuss the ways in which the nanoscale friction response can be related to macroscale friction behavior.

11 – 11:30 am
Evolution of ZDDP-derived Reaction Layer Morphology With Rubbing Time

A. Naveira-Suarez, SKF Engineering and Research Centre, Nieuwegein, Netherlands, A. Tomala, Vienna University of Technology, Vienna, Austria, R. Pasaribu, SKF Engineering and Research Centre, Nieuwegein, Netherlands, R. Larsson, Lulea University of Technology, Lulea, Sweden, I. Gebeshuber, Universiti Kebangsaan Malaysia, Bangi, Malaysia

Functional additives, particularly extreme-pressure and antiwear additives, in formulated oil will compete to adsorb and function in tribological contacts. A low polarity commercial base oil, poly- -olefin (PAO), blended with zinc dialkyl dithiophosphates has been studied. The tribological performance was evaluated using a ball-on-disc test rig under mixed rolling-sliding conditions in the boundary lubrication regime. An adapted in-situ interferometry technique was used to monitor the additive derived reaction layer formation. The thickness of the reaction layer evolves with rubbing until reaching a limiting thickness value of approximately 70nm. The evolution of the topography and mechanical properties of the ZDDP-derived reaction layer with rubbing time were studied using Atomic Force Microscopy. A constant roughening and hardening of the additive-derived layer with rubbing time is observed and related to the different tribological performance of the layer at different rubbing times.

11:30 am – Noon
Exploratory Research Work on Tribological Effects of Nanofluids

G. Molina, M. Rahman, V. Soloiu, C. Walker, M. Hulett, Georgia Southern University, Statesboro, GA

Nanofluids are fluids containing engineered colloidal suspensions of nanoparticles in ordinary base fluids, as water and organic liquids. Simulations of nanofluids dynamics predicts large enhancement in transport properties, especially in thermal ones, as compared to those of the base fluids. The authors have built and tested an erosion-test instrument for nanofluids, which allows control of a fluid jet impacting a material target for "accelerated testing" of cooling-system materials. Results of preliminary experiments are presented for suspensions of alumina and copper oxide nanoparticles in coolant fluids (i.e., weight concentrations of up to 2% in distilled water and its solutions of ethylene glycol). Erosion effects on material targets and changes of viscosity are assessed and discussed, and most relevant recent literature is reviewed.

LUBRICATION FUNDAMENTALS V
Session 5C • Room 204

Session Chair: A. Spencer, Luleå University of Technology, Lulea, Sweden

Session Co-Chair: S. Pei, Theory of Lubrication and Bearing Institute, Shaanxi, China

8 – 8:30 am
Grid Generation in HL and EHL Using AMG

T. Lubrecht, M. Noutary, INSA Lyon, Villeurbanne, France, K. Venner, Twente University, Enschede, Netherlands

The solution of lubrication problems involves the solution of the Reynolds equation describing the fluid flow, integrated over the gap height. For certain cases the pressures are so high, that important elastic deformation occurs, and the fluid flow has to be coupled with an elastic deformation calculation. In those cases the lubricant viscosity varies as a function of the pressure aswell. This paper uses Algebraic MultiGrid (AMG) to study the coarse grids generated, in order to optimise algorithm robustness and efficiency. A similar quest can be observed in the FEM solvers, which use non-structured grids in order to optimise the fine grid, and to limit the number of points used. The paper analyses two HL applications, the circular HL contact and the long elliptical contact. A third EHL application highlights the strong coupling in the high pressure zone.

8:30 – 9 am
A Simplified Mass-Conservating and Continuous Cavitation Model

N. Brunetiere, Institut Pprime, Futuroscope Chasseneuil cedex, France, J. Wang, Northwestern University, Evanston, IL

This paper presents a simplified continuous cavitation algorithm. The first cavitation model consisted in replacing negative pressure given by the incompressible Reynolds equation with a constant value generally equal to zero. However these models are not able to deal with film reformation. This was solved by the well known JFO or Elrod's model with the use of a variable density in the cavitation area. The problems are that there are two distinct areas where the equations to be solved are different. More recent papers proposed to describe the fluid as a liquid contaminated with gas bubbles. Even if more realistic, these models are however complicated to implement. The model proposed in this work considers the fluid as a homogenous mixture of an incompressible liquid and a perfect gas. For a low gas concentration, the model behaves as the JFO model; and for a high concentration value, the results are similar to those obtained with a gas flow model.

9 – 9:30 am
Collision and Surface Interactions of Particles in Lubricated Interfaces

C. Barbosa, Q. Wang, Northwestern University, Evanston, IL

Sliding surfaces in machines are usually lubricated with oil to reduce friction and wear. Ideally, the oil is clean and free from impurities. In reality, oils are often contaminated with dust, debris, and wear particles. These loose particles may damage the interface surfaces, causing overall failure of lubricated applications such as gears, roller bearings, and pistons. The present study attempts to shed light on the behavior of contaminant particles in shear flow using fundamental physical modeling. The contamination model numerically solves the Navier-Stokes equations for fluid-solid flows, incorporating both particle collisions and particle contact with the interface walls. These transient particle interactions enter the governing Navier-Stokes equations through an additional force term. Resulting pressure and velocity fields are presented and validated against existing theoretical and experimental studies in the literature.

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Preliminary Program-at-a-Glance as of March 30, 2011

Wednesday, May 18, 2011

Session 5B: Nanotribology V - Nanolubricants II

Session Chair: A. Erdemir, Argonne National Laboratory, Argonne, IL
Session Co-Chair: J. W. Choo, Petronas Research Sdn Bhd, Selangor, Malaysia

11 - 11:30 am

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A. Naveira-Suarez, SKF Engineering and Research Centre, Nieuwegein, Netherlands, A. Tomala, Vienna University of Technology, Vienna, Austria, R. Pasaribu, SKF Engineering and Research Centre, Nieuwegein, Netherlands, R. Larsson, Lulea University of Technology, Lulea, Sweden, I. Gebeshuber, Universiti Kebangsaan Malaysia, Bangi, Malaysia

Functional additives, particularly extreme-pressure and antiwear additives, in formulated oil will compete to adsorb and function in tribological contacts. A low polarity commercial base oil, poly-α-olefin (PAO), blended with zinc dialkyl dithiophosphates has been studied. The tribological performance was evaluated using a ball-on-disc test rig under mixed rolling-sliding conditions in the boundary lubrication regime. An adapted in-situ interferometry technique was used to monitor the additive derived reaction layer formation. The thickness of the reaction layer evolves with rubbing until reaching a limiting thickness value of approximately 70nm. The evolution of the topography and mechanical properties of the ZDDP-derived reaction layer with rubbing time were studied using Atomic Force Microscopy. A constant roughening and hardening of the additive-derived layer with rubbing time is observed and related to the different tribological performance of the layer at different rubbing times.