STLE’s Annual Meeting is the industry’s most respected venue for the latest technical information, professional development and international networking opportunities. STLE’s conference showcases some 400 technical presentations, application-based case studies, best practice reports and discussion panels on technical or market trends.

Education courses support professional development and prepare qualified individuals for STLE’s three certification programs: Certified Lubrication Specialist™, Oil Monitoring Analyst™ and Certified Metalworking Fluids Specialist™. Our annual trade show and popular Commercial Marketing Forum spotlight the latest products and services of interest to lubrication professionals. Typical attendance at an STLE Annual Meeting is about 1,300.

2013 presentations are being sought in the following areas:

• Aerospace
• Biotribology
• Ceramics/Composites
• Condition Monitoring
• Engine & Drive Train
• Environmentally Friendly Fluids
• Fluid Film Bearings
• Gears and Gear Lubrication
• Grease
• Lubrication Fundamentals
• Metalworking Fluids
• Materials Tribology
• Nonferrous Metals
• Power Generation
• Rolling Element Bearings
• Seals
• Surface Engineering
• Synthetic and Hydraulic Fluids
• Tribotesting
• Wear
• Wind Turbine

Abstract Submission

If you are interested in presenting at STLE’s 2013 Annual Meeting & Exhibition, submit a 100-150-word abstract at www.stle.org. Abstracts are due Oct. 1, 2012. Notification of acceptance will be sent in December 2012. While you do not need to prepare a full manuscript to be included on the meeting’s technical program, you are invited and encouraged to submit a manuscript for review and possible publication in STLE’s peer-reviewed journal, Tribology Transactions.

For more information, please contact:

Merle Hedland
mhedland@stle.org
630-428-3400
90%—That’s the percent of industry professionals who gave a positive rating to education courses at STLE’s 2011 Annual Meeting in Atlanta. Here’s what survey respondents have to say about the value of education at STLE.

- STLE’s education courses have been very beneficial in providing the training required for people seeking to become CLS certified.
- This was my first time taking a basic lubrication course at STLE. The course is setup perfectly to give you a firm understanding of the basic principles of lubrication.
- The presenters were very willing to answer questions, and the course book was great because it included notes for future reference.
- The instructors don’t speak from a script, they speak from experience.
- The STLE Annual Meeting is our industry’s place to learn, experience, network and grow.
- The presentations were very diverse and provided a good knowledge base.
- As always STLE puts on a great show providing educational and networking opportunities.
- All the course modules presented something of value and I took away a lot of good information.
- I consistently found things in the course that were relevant to me and will be applied to my business when I get back.
- Coursework was great and informative.

STLE EDUCATION

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The courses below are offered Sunday and Wednesday here in St. Louis. Sign up for any of them at the Registration Desk in the America’s Center. The education course lineup includes:

- Basic Lubrication 103: Lubrication Fundamentals and Basic Applications
- Bearings and Their Lubrication (Co-sponsored with ABMA)
- Condition Monitoring 301: 21st Century Condition Monitoring
- Metalworking Fluids 115: Metal Removal Fluids
- Synthetics Lubricants 203: Non-Petroleum Fluids and Their Uses
- Advance Lubrication 301
- Automotive Lubrication: Diesel 201
- Metalworking Fluids 125: Health, Safety and Microbiology
- Principles of Metallurgy (Co-sponsored with ASM International)
- Synthetic Lubricants 204: Fluid Formulation and Application

Visit www.stle.org for regular program updates and to register for the 2012 STLE Annual Meeting & Exhibition.
Thursday Overview

Please check the errata in your registration bag to verify course times. Some times might change slightly.

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

Thursday, May 10, 2012

Registration (7:30 am – 2 pm)
Lobby Area Registration – Room 106

Speakers Breakfast (7 – 7:45 am) – 240-242


Technical Sessions (8 am – Noon)
7A Surface Engineering I – 224
7B Ceramics Composites II – 225
7C Practical Lubrication I – 226
7D Fluid Film Bearings III – 230
7E Rolling Element Bearings IV – 231
7F Materials Tribology II – 232
7G Wear III – 220
7H Condition Monitoring II – 221
7I Non-Ferrous Metals III – Lubrication – 222

Technical Sessions (1:30 – 5:30 pm)
8A Surface Engineering II – 224
8C Practical Lubrication II – 226
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## Thursday, May 10, 2012

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SURFACE ENGINEERING I

Session 7A • Room 224

Session Chair: T. Scharf, University of North Texas, Denton, TX
Session Vice Chair: P. Liu, Northwestern University, Evanston, IL

8 – 8:30 am
Surface Texturing for Reduction and Control of Friction
O. Rashwan, V. Stolov, A. Alpas, University of Windsor, Windsor, ON, Canada

Laser surface texturing (LST) is utilized to generate surface patterns consisting of variety of circular craters. The effect of artificial texturing on the friction/wear during sliding was investigated in order to determine the optimum surface morphology. Different circular grooves’ sizes, which range from 5µ to 20µ, were studied while the spacing between the adjacent holes was varied. Albeit, the depth of the grooves has a major effect on the traction in wet condition due to the hydrodynamic pressure, this effect was found not significant in dry condition. Therefore, the depth was kept constant at 5µ. A scratch tester is used to measure the frictional force. The most significant texturing parameter is found to be the ratio between the hole’s diameter (D) and the spacing between the centers of adjacent holes (L), which represents the holes’ surface density. It has been demonstrated that friction and wear are significantly reduced with proper selection of the surface patterning design.

8:30 am – 9 am
Effect of Surface Textures on Hydrodynamic Pressure Generation in a Flat-flat Interface
P. Liu, S. Xiong, Z. Wang, Q. Wang, Northwestern University, Evanston, IL

Hydrodynamic lubrication of a textured flat-flat interface was analyzed based on a revised Payvar-Salant mass-conservation model. The effect of texture geometry, size and coverage density on the pressure generation, load capacity and friction was studied. For single texture design, distinctively different results are observed for the two types of periodic boundary treatments considered. An optimized texture design was reached when prescribing pressure in perpendicular to flow direction. However, textures with a symmetric cross section always generate a negative effect on the load capacity when prescribing pressure in flow direction. For multiple texture design, non-periodic boundary conditions in both directions were also considered. While the optimized texture geometry resembles that of single texture design, the size of the textures depended on the number of textures in the non-periodic direction.

9 – 9:30 am
ANS Triboconditioning: In-Manufacture Running-in Process for Improving Tribological Properties of Mechanical Parts Made of Steel or Cast Iron
B. Zhmud, Applied Nano Surfaces, Uppsala, Sweden

The ANS triboconditioning is a dedicated metalworking process for improving the tribological performance of various mechanical components exposed to high tribological stress. The ANS process combines extreme-pressure mechanical treatment of the component surface with a tribochemical deposition of a low-friction antiwear film based on tungsten disulfide. The mechanical treatment is essential for burnishing of the component surface by leveling off asperities, for building up compressive stresses within the underlying material layer, and for initiating the triboreaction that leads to the in-situ formation and interfacial nucleation of WS2 onto the said surface. Thereby a smoother surface with a significantly reduced coefficient of boundary friction and improved wear-resistance and load-carrying capacity is created. The present communication summarizes results of experimental studies into the tribology and surface chemistry of triboconditioned surfaces.

9:30 – 10 am
Study Into the Effects of Various Surface Treatment Processes on the Surface Roughness, Topography and Dimensional Changes of Medical Implant Materials
Y. Soydan, Sakarya University, Sakarya, Turkey

Surface treatment processes applied onto the surface of material surfaces in different ways cause changes in surface roughness, surface topography, as well as in dimensions of the product. Such changes primarily affect the behavior of the material in terms of friction, wear, lubrication characteristics, and therefore service life of the devices. In the present study, different diffusion and coating processes have been applied for the Ti-6Al-4V and 316L bio-medical implant materials, and the changes in surface roughness, topography and dimensions were ascertained. The results showed that considerable texture and topographical changes that would affect the material service life could come out.

10 – 10:30 am • Break

10:30 – 11 am
Micromechanical and Tribological Characterization of Polymeric-based Coatings
S. Yeo, A. Polycarpou, University of Illinois at Urbana Champaign, Urbana, IL

One of the approaches towards reducing (or eliminating) lubrication in machinery is the use of inexpensive and versatile advanced polymeric coatings as solid lubricants. Such coatings include PTFE-Pyrrolidone, PTFE/MoS2, Fluorocarbon, PEEK/PTFE, PEEK/Ceramic and ATSP-based coatings, which were thermally spray coated on cast iron substrates and were characterized. Using a tribometer, these coatings were tribologically tested underarth operating conditions to measure their frictional and wear performance. Subsequently their micromechanical properties such as modulus and hardness were measured using a high-load indentation technique, which showed that the structure of the coatings had a critical effect on their properties and consequently on their tribological performance. Finally, through SEM examination on the coating surfaces, general conclusion could be drawn correlating the tribological, mechanical and structural properties of PTFE, PEEK, and ATSP-based polymeric coatings.

11 – 11:30 am
Quantitative NanoMechanical Property Mapping with the Atomic Force Microscope
S. Minne, Bruker, Goleta, CA

The AFM has long been recognized for its ability to either image surfaces at the nanoscale, or to determine mechanical properties at the nanoscale. However, until recently, the combination of these two capabilities was often a compromise between achievable imaging rate, and amount or quality of material property data collected. Here, we present advances in AFM technology that allow the collection of mechanical data (modulus, adhesion, deformation, dissipation) at normal AFM imaging rates. The new method, which we call Peak Force Tapping (PFT), was used to compare PFT control with conventional tapping. In contrast to tapping mode, which responds to both short range and long range interactions, PFT uses only short range interaction force for controlling feedback, but records the full range of interaction. In a study of poly(n-butylacrylate) molecular brushes we have found the short range interaction control is the key to achieve molecular resolution in collapsed molecules.
11:30 am – Noon  
**Surface and Near Surface Material Characterisation of M10, A Historic Military Tank Destroyer**  
Z. Khan, A. Saeed, M. Hadfield, R. Smith, Bournemouth University, Poole, United Kingdom

Energy X-Ray Dispersive Spectroscopy and Scanning Electron Microscopy were deployed to obtain surface and near-surface material characterisation of M10. The material was processed in the US during Second World War and was subsequently used in its manufacture. Results illustrate low carbon constituents in the steel, with chloride and silicon as surface contaminants. A detailed analysis of the material is comparable to ASTM A945-06(11)/A945M-06(11). Coatings have effectively failed resulting in surface corrosion. The incipient corrosion propagated sub-surface over ~400 μm deep. Material characterisation on the corroded surface demonstrates Fe decay remaining to 52.66 wt%. Experimental results at near surface reveal alloying agent manganese. Although sulphur has been added to facilitate welding, it is acting as a corrosion-enhancing contaminant decomposing Fe to a significant 68.223wt%. Sub-surface corrosion pits of various sizes and manufacturing defects as slags were also detected.

### CERAMICS COMPOSITES II

**Session 7B • Room 225**

**Session Chair:** C. Korach, Stony Brook University, Stony Brook, NY  
**Session Vice Chair:** K. Wang, Argonne National Laboratory, Argonne, IL

**8 – 8:30 am**  
**A Study on Hot Extruded Al6061-SiC Tubes**  
K. Sridhar, C. Ramesh, G. Praveen, R. Keshavamurthy, PESIT, Bangalore, India

Among all the various types of tubes produced (seamless, cast, electric-resistant weld) seamless tubes exhibit better mechanical strength since it is produced as an integral unit and has outstanding homogeneity in the circumferential direction.

In the light of the above, the present investigation is aimed at development and characterization of hot extruded tube of Al6061-6wt%SiC reinforced composites. Cast composites were produced by liquid metallurgy route. Tubes are produced by hot extrusion. The produced tubes are then tested for their mechanical properties such as strength, ductility, hardness and for corrosion and slurry wear resistance. Al6061-6wt%SiC composites tubes exhibited improved microhardness, tensile strength and slurry erosive wear resistance when compared with extruded Al6061 alloy. However, composites showed inferior corrosion resistance when compared with base alloy.

**8:30 – 9 am**  
**Force-Controlled Molecular Structure & Conductivity Through Gold Nanoparticles**  
K. Wang, S. Kundu, H. Liang, Texas A&M University, College Station, TX

A mechanical force has significant advantages in controllability on any materials it is loaded on. Here we discuss about the controllability of molecular structures and conductivities of a citrate molecule. Approaches were made in experimental study assisted by molecular simulation of citrate capped on and linked between gold nanoparticles (AuNPs). We found that the molecular conductivity depends on the pathways of electrons that were controlled by the applied mechanical stress. Under stress, we could turn the conductivity up and down for about ten-fold.

9 – 9:30 am  
**Development of Innovative Al 6061-SiC Composite by Hybrid Technique**  
C. Ramesh, H. Adarsha, H. Guddi, N. Iyengar, PES Institute of Technology, Bangalore, India

This work focuses on the development of Al 6061 based Metal Matrix Composites by innovative method. Circular compacts of Al 6061 -SiC powder preforms of diameter 30 mm and height 25 mm were placed within cylindrical cast -iron mould. SiC content in the preforms was varied from 20 wt% to 60 wt%. Liquid Al6061 alloy was poured into the mould with these preforms. These castings were then hot extruded using a 200 ton hydraulic press at a temperature of 520°C adopting an extrusion ratio of 4:1. These hot extruded composites have been subjected to metallographic studies, micro hardness and mechanical tests such as tensile testing and the results will be discussed at length.

### PRACTICAL LUBRICATION I

**Session 7C • Room 226**

**Session Chair:** D. McCoy, The Elco Corporation, Cleveland, OH  
**Session Vice Chair:** W. Needelman, Filtration Science Solutions, Huntington Bay, NY

**8 – 8:30 am**  
**The Effects of Water Quality on Metalworking Fluids and Manufacturing Processes**  
J. Burke, Houghton International, Valley Forge, PA

Many types of metalworking fluids are diluted with water to provide additional benefits to manufacturing processes. The primary benefits are additional heat transfer from the metal and tool interface as well as a more cost-effective fluid applied to the metalworking process. In many cases, tooling performance actually increases with the addition of water to the metalworking fluid. However, contamination from salts and organic substances in the diluting water can have serious detrimental effects on tooling performance and part quality finish. This paper will discuss the advantages and disadvantages of untreated and treated water on metalworking fluids and related manufacturing processes.

**8:30 – 9 am**  
**Effect of Ashless Friction Modifier Under Mixed Lubrication**  
M. Diew, D. Mazuyer, J. Martin, Laboratoire de Tribologie et Dynamique des Systèmes (LTDS), LYON, France, M. El fassi, Peugeot Citroën Automobiles, PARIS, France

This work deals with understanding the tribological behaviour of ashless friction modifier additives. The use of these additives in engine like piston rings and cylinder contact reduces friction. Two ashless friction modifiers (FM1 and FM2) containing carbon, oxygen, nitrogen and hydrogen were used with base oil and formulated lubricant for ball-on-flat contact. To get closer to the kinematics of piston rings, the experiment were done using reciprocating tribometer. Under mixed lubrication conditions for various temperatures. The results showed that the addition of friction modifiers above into base oil and formulated lubricant has improved its properties in terms of both friction and wear. Acceleration induced by sinusoidal speed and pressure seem to have an effect on the film formation with FM1. FM2 improves the tribological behavior with a low friction and little wear. These tests allowed us to understand the mechanism action of these friction modifiers.
A Sensitive Method to Evaluate Tribological Properties of Aqueous Metal Working Emulsions
S. Achanta, D. Drees, Falex NV, Rotselaar, Belgium

Water based metal working emulsions are typically used in a large volume closed circuit system in metal working operations such as cutting, forming, drawing etc. These lubrication and cooling baths are often refreshed by purging a certain volume and replacing it by fresh emulsion. In this way, the functional additives are replenished and the quality of the lubricating properties does not vary widely. In order to optimize the purging-refreshing cycles for large volume baths, and avoid production problems, a very sensitive method is necessary to determine a threshold for refreshing the emulsion. In this work, we describe the search for such a method, to evaluate a good versus a bad emulsion. The Falex Ball on Three Disk lubricity test method was proposed, improved and adapted for aqueous emulsions. Eventually, the BOTD method was further optimized to a precision level necessary for quality control tool in a production environment.

Methods of Application for Open Gear Lubricants and Their Selection
L. Ludwig Jr, Schaeffer Mfg, Saint Louis, MO

Open or semi-enclosed gear drives, which are also known a heavy-duty gear drives or girth gears have been one of the most common methods of power transmission since the beginning of the Industrial Revolution. Open gear drives are often the most economical type of gear drive alternative for use in applications where high load carrying capacity, long service life under severe shock load conditions are required. Though there are different types of open gear lubricants that can be used in the lubrication of an open gear drive system the particular type of application method must always be considered in order to ensure that the right amount of open gear lubricant in the right place at the right time is properly applied in order to prevent wear and catastrophic failure. In this paper the different methods of application, selection criteria and procedures for applying open gear lubricants will be discussed.

Development of a Durable Bearing Lubricant for Coal Pulverizing Equipment
J. Vinci, E. Akucewich, Lubrizol Corporation, Wickliffe, OH

Global energy production relies heavily upon coal, and several decades may pass before more cost-effective renewable fuels are developed. Coal remains an economically indispensable but ultimately finite resource, and maximizing its effectiveness as an energy source is therefore important; to that end, the pulverizing operation reduces the coal to a fine particle size, thereby increasing its potency as a fuel. Unfortunately, given the harsh environment of a mining site, bearings in the crushing equipment are vulnerable to the ingress of abrasive coal dust; this contamination leads to premature equipment failure and costly periods of interrupted production. As described herein, lubricants can be designed with the express capability of protecting pulverizer bearings under severe conditions of coal dust contamination.

Efficient Removal of Water from Lubricant Fluids Using a Membrane Dehydrator
S. Nemser, S. Majumdar, Compact Membrane Systems, Wilmington, DE, K. Farooq, K. Benninghoff, Pall Corporation, Port Washington, NY

Fluids in lubrication systems get contaminated with water. Water changes the lubricity, film thickness, load carrying ability and viscosity of the lubrication fluid. The contamination level of lubrication fluid affects the service life of the associated components and the fluid itself. Accelerated metal surface fatigue in bearings can be promoted even if all the water present in the fluid is in dissolved state. We have developed a compact, lightweight and robust membrane-based system to dewater lubricating fluid. The system can be installed easily into a lubrication circuit. By removing free, dispersed and dissolved water, the membrane dehydrator can extend the reliability and life of the machinery, reduce maintenance costs, and increase uptime. The paper will discuss the novel membrane-based dewatering technology. Results from various field evaluation studies for the continuous removal of water from lubricant and hydraulic fluids to well below saturation levels will be presented.

Quantifying Contaminant By-Pass Around Filters During Cold Starts in Mobile and Industrial Equipment
W. Needelman, M. Barris, P. McPhail, Donaldson Company, Inc., Minneapolis, MN

Oil filters are sized to allow fluid passage with minimum flow restriction at operating temperatures. However during cold starts high viscosity fluid may cause excessive differential pressure across a filter, restricting flow and damaging components. To avoid these problems most systems employ a bypass valve that shunts cold viscous fluid around the filter. Unfortunately bypass flow allows unfiltered fluid to reach and possibly damage critical components. The amount of contamination reaching critical components during bypass is often unknown. This paper presents a method for quantifying the amount of particulate contamination bypassing filters during cold starts. Results for representative mobile and industrial systems are presented, and the extent of damage caused by bypassing contaminants discussed. The paper concludes by demonstrating how negative consequences of cold start contaminant bypass are minimized by installing new generation filters with lower flow restrictions.
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### FLUID FILM BEARINGS III

**Session 7D • Room 230**

**Session Chair:** B. Benyebka, INSA of Lyon, Villeurbanne, France

**8 – 8:30 am**

**Influence of Texture Geometry on the Hydrodynamic Performances of Parallel Bearings**

A. Gherca, P. Maspeyrot, M. Hajjam, A. Fatu, Université de Poitiers, Poitiers, France

It has been proven experimentally that surface texturing represents a viable solution for increasing the load carrying capacity of parallel bearings. Along with several load-supporting mechanisms that have already been identified in the existing literature, the texture geometry remains an important feature. In order to evaluate the effects of texture shape, dimension or density, a mass-conserving model is employed. While avoiding the use of the bulk modulus â, due to potential convergence problems, the model also deals with the cavitation phenomenon and provides rapid and accurate results. With the purpose of validating the algorithm, several comparative analyses are performed between the model and other numerical and analytical studies. More appropriate texture geometries are proposed. It is shown that for given operating conditions (e.g. sliding speed, lubricant viscosity or supply pressure), the chosen patterns supply better hydrodynamic performances.

**8:30 – 9 am**

**Flow Visualization in a Dimpled Thrust Washer**

A. Cross, F. Sadeghi, Purdue University, West Lafayette, IN

The paper focuses on experimental visualization of the oil flow in a dimpled thrust washer. A thrust washer test rig was designed and developed to visualize the lubrication mechanism of thrust washers under various load and speed combinations. A small window in the reservoir’s bottom allows a mirror and camera to be placed beneath the bearing. The bearing is oriented such that one of the pockets is located directly over the reservoir window; the oil flow in the pocket can then be observed through the glass substrate of the specially designed thrust bearing. The results indicate that the dimples of the thrust washer provide lift, separating the mating bearing surfaces with a hydrodynamic oil film and cavitation occurs in the diverging region of the thrust washer. ANSYS Fluent software was used to corroborate the experimental results. A comparison of experimental and analytical results indicates that there is good correlation between the two.

**9 – 9:30 am**

**Impact of Surface Texturing on the Performance of Journal Bearings Lubricated with a Contaminated Fluid**

A. Dadouche, M. Conlon, J. Bédard, R. Payette, B. Liko, National Research Council Canada, Ottawa, ON, Canada

Lubricant contamination can adversely affect the performance of oil-lubricated mechanical components and may result in excessive wear and sudden failure. Hydrodynamic plain journal bearings represent one component that may suffer performance issues due to the various contamination modes. Surface engineering techniques such as texturing, which involves creating micro dimples on the active surface of the component, result in improved tribological properties such as reduced friction coefficient and increased wear resistance. This study investigates the effect of spherical-shaped dimples on the steady-state performance and wear resistance of journal bearings lubricated with a solidly-contaminated lubricant. Rig tests have been performed on plain smooth and textured surface journal bearings where variable-size Test Dust was introduced into the lubrication system upstream of the test bearing. The ability of the dimples to capture contaminant particles has also been evaluated and studied.

**9:30 – 10 am**

**Microstructure and Porosity Effects on the Load Carrying Capacity of a Variable Geometry Thrust Bearing: Hybrid Rayleigh Step and Sinusoidal Geometries**

F. Horvat, M. Braun, The University of Akron, Akron, OH

This paper studies numerically the microstructure and porosity effects on the steady state development of flow patterns, pressure profiles and the load carrying characteristics of a three dimensional hydrostatic thrust bearing utilizing: (i) a hybrid Rayleigh step (HRS) and (ii) a sinusoidal wave (SW) type geometries. This parametric study integrates microstructure infused etchings with that of porous feeding effects to determine the performance of the multi geometry hydrostatic thrust bearing. The parameters used in this study consist of two geometric parameters: (a) the microstructure etched geometries and (b) the porosity/permeability characteristics as defined by Darcy law and two operational parameters, (c) the upper plate angular velocity and (d) the inlet supply feed. The analysis will be conducted with both low and high (shaft) rotation speeds.

**10 – 10:30 am • Break**

**10:30 – 11 am**

**Waved Pistons – An Innovative Way to Reduce Energy Dissipation in Piston Machines**

M. Alemi, M. Ivantysynova, M. Pelosi, Purdue University, West Lafayette, IN

Although the fluid film between piston and cylinder ensures proper operation of piston machines, it forms one of the major power loss sources due to energy dissipation in fluid film. In this paper, the effect of waved piston shapes on the load carrying ability of the fluid film and reduction of power loss in piston/cylinder interface is investigated. The waved piston shape influences the film thickness distribution of piston/cylinder interface and due to this, the pressure field and all other related parameters like viscous friction and leakage. The presented results are the summary of a wide simulation study using an in-house developed fully coupled nonisothermal fluid-structure interaction model, which considers surface deformation due to pressure and temperature. The model allows studying fluid film behavior and calculating of film thickness, energy dissipation and load carrying ability. Simulated results of waved and standard pistons are compared for different operating parameters.

**11 – 11:30 am**

**The Design and Optimization of a Gerolor Pump using Enhanced Fluid Film Lubrication: Microstructure Profiling, Hydrostatic Pockets and Surface Coating**

F. Horvat, M. Braun, The University of Akron, Akron, OH

This paper compares the overall performance characteristics of a commercially available Gerolor pump to a custom modified one where various component modifications allow for lubrication enhancement and friction mitigation through the implementation of (i) microstructure profiling, (ii) hydrostatic pockets and (iii) surface coatings. This is a parametric type study which evaluates both numerically and experimentally the general effectiveness of each of the three proposed modifications. The ultimate goal is to increase mechanical efficiency, optimize clearances, and increase volumetric flow while reducing friction and the Hertzian stresses. The fluid used for this study is ‘thin’ and has a dynamic viscosity range of 2 – 8cP differing from the recommended 50-100cP as indicated by the manufacturer.
ROLLING ELEMENT BEARINGS IV
Session 7E • Room 231

Session Chair: V. Bakolas, Schaeffler, Herzogenaubach, Germany

8 – 8:30 am
Work Hardening Response of M50-NiL Case Hardened Bearing Steel in Rolling Contact Fatigue
A. Pandkar, N. Arakere, G. Subhash, University of Florida, Gainesville, FL

The qualitative features of localized subsurface metallurgical changes induced in bearing steels in rolling contact fatigue (RCF), leading up to spallation, has been widely studied. Despite decades of research, bearing life estimation still largely relies on Lundberg-Palmgren life model from 1947 that results in large discrepancies in predicted vs. observed life. The work hardening response for RCF-tested case hardened M50-NiL steel rods are presented. Micro-Vickers indentation mapping of RCF-affected subsurface zone is used to measure initial hardening. The objective of this research is to understand the cause of this increase using finite-element simulation of RCF test. The stress concentration due to carbide inclusions allows plastic strain accumulation via Ratcheting. Cyclic hardening parameters are extracted by matching measured hardness data to FE modeling results. Results will be used for RCF life prediction models.

8:30 – 9 am
Characterizing Localized Material Properties of RCF-Affected Bearing Steels

Bearing surfaces subjected to rolling contact fatigue (RCF) experience highly localized microplastic deformation, eventually leading to fatigue crack nucleation. The inability to measure and characterize localized material degradation due to RCF is an important reason why current life prediction models continue to rely on extensions of the Lundberg-Palmgren model which leads to wide discrepancy between observed and computed RCF life. We present micro-hardness measurements within the RCF zone of RCF-tested balls. Furthermore, micro-compression specimens were extracted via EDM from the RCF zone and stress-strain response of the material characterized. The hardness/yield stress data and stress-strain response of the RCF-affected material presented represents the first meaningful attempt at characterizing elastic-plastic cyclic response of high strength bearing steels. Results will be used towards identifying cyclic constitutive response and RCF life prediction of bearing steels.

9 – 9:30 am
A Statistical Tool for Effects of Material Cleanliness on RCF Lives of Bearing Elements
B. Jalalahmadi, N. Bolander, Sentient Corporation, Idaho Falls, ID

Using a physics-based microstructure simulation approach, Component Life Prediction (CLP) was previously developed to simulate fatigue crack initiation and propagation in bearing elements. It has been recognized that material inclusions in form of hydrogen embrittlement, carbides, etc. are occasionally present in bearing steel and can significantly affect bearing fatigue lives. In this work, material inclusions are introduced to our CLP tool to investigate their effects on bearing fatigue lives. Some smaller grains are simulated between normal bearing steel grains and their material properties are determined from non-uniform experimentally-obtained distributions. Effects of stiffness, size, depth, and number of inclusions are studied. Results predict Weibull slopes and L10 lives which are in good agreement with previous experimental results. It is observed that as inclusions become larger or occur at shallower depths, they cause a larger decrease in fatigue lives and their scatter.

9:30 – 10 am
Rolling Contact Fatigue Response of M50NiL Case Hardened Bearing Steel as a Function of Cycles
A. Bhattacharyya, G. Subhash, N. Arakere, University of Florida, Gainesville, FL

Ball and roller bearing raceway subsurface material experience cyclic micro-plastic strain when subjected to rolling contact fatigue (RCF). The accumulation of cyclic plastic strain within the RCF-zone results in localized work hardening of the subsurface material. The rate of cyclic fatigue damage accumulation induced by RCF continuously evolves due to microstructural changes throughout the bearing life cycle. In the current study we use coordinated micro and nano-indentation to quantify the cyclic hardening behavior of M-50 NiL case carburized steel as a function of RCF cycles. Results from instrumented nano-indentation reveal the texture changes within the RCF zone, and hardness and stress-strain behavior of the material within the white etching bands (WEB). Results represent the first meaningful quantification of localized material property changes within the RCF zone and will help towards a mechanistic description of RCF-induced material degradation.

10 – 10:30 am • Break
Solid lubricants have been shown to form ultra-thin (of the order of 10 nm) tribofilms at sliding interfaces. These films are consistently observed during low wear and low friction sliding, and are believed to have a significant impact on friction and wear. With molybdenum disulfide as a model solid lubricant, preliminary experiments show that single asperity, nanotribological properties of the tribofilms formed through macro-scale sliding differ greatly from the pristine coating. The present research effort extends these findings to correlate tribofilm nanotribology with tribofilm surface morphology, microstructure and the prevailing sliding conditions using non-invasive and spatially sensitive lateral force microscopy techniques.

The role of water on the tribological behavior of molybdenum disulphide (MoS2) lubrication remains a largely misunderstood interaction. The strong effect of humidity on friction behavior of MoS2 is well documented, although there remains no clear correlation between friction and wear. An experimental study correlating water sorption, friction response, and wear rate is presented. A quartz crystal microbalance (QCM) is used to measure the mass of water being sorbed by both pure MoS2 and MoS2/Sb2O3/Au coated crystal substrates at partial pressures of water in the range of 1.4 Pa to 1.4 KPa (RH ~ 0.05% to 50%). The effect of the film’s surface area and orientation on the quantity of water uptake is analyzed as well.

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Polytetrafluoroethylene (PTFE) has a unique combination of low friction, large thermal range, and chemical inertness, but its use as a tribological material has been limited by its exceptionally high rate of wear. Certain nanofillers have been shown to reduce the wear rate of PTFE by up to four orders of magnitude. Although the mechanisms responsible for this dramatic improvement remain unclear, there is substantial evidence that transfer films play a dominant role. In this study, we use a wear resistant PTFE nanocomposite reported previously in the literature by two independent groups. This material is known to exhibit a period of transient wear that is followed by a transition to steady state. Significant morphological trends are found which accompany wear and friction transitions. Additionally, results from in-situ observations at the friction interface will provide further insights into causal relationships and the mechanisms of transfer film development and wear reduction.

We have utilized a Laser Engineered Net Shaping process to fabricate a novel bulk, hybrid composite for applications that combines three important properties: graphite (C) phase for solid/self-lubrication and titanium carbide (TiC) phase for high hardness in a high fracture toughness nickel (Ni) matrix. Novel insights into surface and subsurface deformation processes and solid lubrication mechanisms were revealed by 3-D focused ion beam serial cross-sectioning and precession electron diffraction inside the worn surfaces. These include stress-induced structural transformations from microcrystalline graphite to amorphous carbon and the formation of a nanocomposite mechanically mixed layer consisting of predominately nanocrystalline Ni grains (~10 nm grain size) in an amorphous carbon matrix. This presentation will discuss the relationships between interfacial structure, chemistry and shear strength to determine the mechanisms responsible for the observed friction and wear behavior.

Interest in electro codeposition of nickel-based composite coatings has increased in recent years due to their unique combination of wear, magnetic, electrical, and mechanical properties. Many of these outstanding properties can be best exploited by incorporating the carbon nanotubes into metal matrix. In the light of the above, the present work focuses on development of nickel –carbon nano tube composite coatings on mild steel substrate by Sediment Co-deposition technique. A maximum of 6.32Vol% of carbon nanotubes (CNTs) has been successfully dispersed in nickel matrix.

Micro hardness and ductility of nickel composite coatings increased, while yield and ultimate tensile strength decreased with increased volume percent of CNTs in the nickel matrix. Further, the ultimate tensile strength of the nickel-6.32Vol%CNT is lower by just 16% when compared with uncoated mild steel.
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Exploring the Tribocohemical Mechanisms Responsible for the Ultra-low Wear Behavior of PTFE Composites

B. Krick, J. Ewin, University of Florida, Gainesville, FL; C. Junk, DuPont Central Research and Development, Wilmington, DE; G. Blackman, DuPont Nanocomposite Technologies, Wilmington, DE; W. Sawyer, University of Florida, Gainesville, FL

The wear resistance of polytetrafluoroethylene (PTFE) can be increased by orders of magnitude with the inclusion of fillers; in some systems, the wear rate of PTFE can be reduced from around 5x10⁻⁴ mm³/Nm to less than 1x10⁻⁸ mm³/Nm with the inclusion of a few weight percent of filler. This reduction in wear has been consistent with the development of a thin, robust transfer film, however the exact mechanism of wear reduction has not been determined. Experiments suggest that a unique combination of mechanical and tribochemical mechanisms are responsible for this exceptional reduction in wear. This work investigates chemical changes believed to be the source of the ultra low wear phenomenon in low wear PTFE composites.

WEAR III
Session 7G • Room 220

Session Chair: Q. Zou, Oakland University, Rochester, MI
Session Vice Chair: K. Zhou, Nanyang Technical University, Singapore

8 – 8:30 am
Modeling of Preferential Patterns Found During the Abrasive Wear of Random Surfaces
P. Dougherty, D. Stonestrom, C. Higgs III, Carnegie Mellon University, Pittsburgh, PA

As the operating conditions of state-of-the-art machinery have progressed in severity, wear of contacting surfaces has become a monumental issue. It has been estimated that 70% of material failure in the US is due to wear, resulting in costs of up to 100 Billion dollars per annum by 1983. Although abrasive wear at the asperity scale is generally modeled as a random process, best represented by probability factors, the resulting surface topographies often display a preferential pattern which may suggest otherwise. This study focuses on modeling the abrasive wear of real surfaces through purely deterministic contact mechanics. A sphere-on-voxel (SOV) approach is used to model the contacting asperities of two random surfaces as the interface evolves over time. Comparisons between predicted topographies and that taken from an optical interferometer are made in order to display how two completely random surfaces can produce a preferential pattern by tracking the contacting asperities.

8:30 – 9 am
Experimental Investigations on the Coefficient of Friction and Wear of Single Particles
M. Marinack Jr., P. Dougherty, C. Higgs III, Carnegie Mellon University, Pittsburgh, PA

Understanding granular flows from both a tribological and classical perspective is important in several industries, including bulk solids processing, space, and fossil fuel energy. Inherently important is the study of granular flows as the interactions between both the individual particles and the particles and the boundaries. Two essential interaction (collision) parameters are the coefficient of restitution and the coefficient of friction (COF). The current work experimentally studies the COF of various individual particle-disk material combinations during periods of sliding wear. A pin-on-disk tribometer is used to obtain COF values for individual particles sliding against a disk, while wear data is acquired by means of a linear variable differential transformer (LVDT). After data acquisition, optical interferometry is used to conduct detailed surface analysis of the worn contact interfaces in order to provide further insight into their COF and wear behaviors.

9 – 9:30 am
New Opportunities for Wear Evaluation in Rolling Contacts
K. Topolovec Miklozic, G. Miklozic, Powertrib Ltd, Oxford, United Kingdom

Fatigue performance of transmission fluids plays an important role in predicting not only durability but also efficiency of transmission systems. In the past, rolling contact fatigue of the fluids proved challenging to explore. However, newly presented test methodologies, using the bench pitting and micropitting screener (MPR), offer great new possibilities to study fatigue performance of fluids, and herewith predict fatigue life of rolling contacts, such as gears and bearings. New innovative ways of testing of gear oils are explored and presented, with examples on how the testing is employed to evaluate pitting performances of transmission fluids, as well as micropitting wear of wind turbine gear oils. It can be shown, that the new methodologies, do not only enable rather fast and well differentiated screening of fluids, but also enable insights into underlying mechanisms by which fluids perform in rolling contacts.

9:30 – 10 am
Erosive Wear Characterization of Materials for Lunar Construction
J. Mpagazehe, Carnegie Mellon University, Pittsburgh, PA; K. Street, Jr., L. Delgado, NASA Glenn Research Center, Cleveland, OH; C. Higgs III, Carnegie Mellon University, Pittsburgh, PA

NASA's Apollo missions revealed that exhaust from retro-rockets of landing spacecraft acts to significantly accelerate lunar dust on the moon's surface. A recent study by Immer et al. (2011) investigated coupons returned to Earth from the Surveyor III lunar probe which were subjected to lunar dust impingement by the Apollo 12 Lunar Module landing. Their study revealed that even with indirect impingement, the spacecraft sustained erosive damage from the fast-moving lunar dust particles. In this work, results are presented from a series of erosive wear experiments performed on 6061 aluminum, 1045 steel and acrylic using JSC-1AF lunar dust simulant to erode the test specimens. Scanning electron microscopy, optical profilometry and visible spectrophotometry were used to investigate the surface after the erosion process. It was found that even short durations of lunar dust simulant impacting at low velocities produced significant changes in the surface roughness and optical performance.

10 – 10:30 am • Break

10:30 – 11 am
Examining and Predicting Wear in Ionic Solids with In Situ Scanning White Light Interferometry
K. Marchman, B. Krick, W. Sawyer, K. Harris, University of Florida, Gainesville, FL

This study focuses on forming a model for the prediction of wear of ionic solids based on their molecular Coulombic interactions. Furthermore, wear progression is examined in order to gain an understanding as to how these ionic solids react to sliding forces. It is proposed that wear decreases as the Coulombic potentials between atoms of a given species increases. A simple summation method is employed to determine the combined interaction forces that the anion or cation experiences from neighboring ions. A custom pin-on-disk tribometer is fitted to a scanning white light interferometer in order to immediately and intermittently image the forming wear track. Numerous single crystal ionic solids were tested and results were compared for samples with similar crystal structures. It was found that a trend does exist between low wearing samples and high Coulombic potentials.
11 – 11:30 am
Wide Spectrum Wear Tests and Wear Model for Plane Bearing Materials
R. Adams, Q. Zou, Oakland University, Rochester, MI
It has been thought that the wear rate of a plane bearing material is proportional to the PV limit of the application, where PV, the product of pressure and velocity, is a measure of the power input into a plane bearing system. Below the PV limit, material wear rates are calculated as a linear proportion of the wear at the PV limit. In this study, wide spectrum wear tests were performed to evaluate the wear property of plain bearing materials. The wear behavior of the materials has been mapped on and around the PV limits. It has been found that wear is not constant over a single PV, nor is it linear relative to that PV. When viewed from a wide spectrum perspective it is evident that, depending on the material, there are different wear behaviors. These wear behaviors may indicate that different wear mechanisms are present. PV cannot be used as a simple limit or predictor of bearing behavior.

11:30 am – Noon
Adhesive Wear of Rollers in Vacuum
I. Shareef, Bradley University, Peoria, IL, T. Krantz, NASA Glenn Research Center, Cleveland, OH
This work was done to support NASA’s James Webb Space Telescope that is equipped with a Near Infrared Camera and Spectrograph, coupled with cryogenic actuators, and Micro Shutter Assembly (MSA). A MSA mechanisms qualification test in cryogenic vacuum at 30°K for 96k cycles resulted in roller wear and formation of debris. Lab testing was done to determine the number of cycles it takes to produce wear debris, the effect of misalignment angle, if any, on debris formation and to understand the wear of Ti6Al4V mated with 440F steel rollers in vacuum. Misalignment angle was found to have the most significant effect on debris formation. The adhesive wear rate was found as approximately proportional to misalignment angle. Wear particles occurred in lab testing even for zero misalignment angle within the expected mechanism’s lifetime. The wear is a 2-way phenomenon. While there was a net loss of mass from the steel rollers, XRF and EDX spectrums showed peaks of Ti on steel rollers.

CONDITION MONITORING II
Session 7H • Room 221
Session Chair: TBD
Session Vice Chair: TBD

8 – 8:30 am
Introduction

8:30 – 9 am
Fluid Sensors and Application in In-situ Evaluation of Consistency and Aging of In-service Greases
E. Bupp, MRG Labs, York, PA, D. Wooton, Wooton Consulting, Beaverdam, VA, R. Wurzbach, MRG Labs, York, PA
While grease applications vary widely, grease consistency plays a critical role in overall lubricant effectiveness. Deviations from the desired consistency could result in poor machine reliability. Research into the use of rheometers and other novel test methods to quickly and reliably determine the consistency of sometimes very small samples of in-service grease are underway. In-situ sensor measurements of grease rheology can be a desirable means of condition monitoring. The fluid sensor measures the apparent viscosity and oxidation of in-service grease. In-situ sensors such as this allow corrective actions to be taken immediately upon condition changes, possibly prior to failures. This paper will discuss the technology involved in the fluid sensor used in this study and its effectiveness at measuring the condition of lubricating grease when installed in a motor operated valve gearbox test stand.

9 – 9:30 am
Application of Sensors for In-situ Measurements of In-service Grease Rheology
E. Bupp, R. Wurzbach, MRG Laboratories, York, PA, D. Wooton, Wooton Consulting, Beaverdam, VA
Deviations from the desired lubricant consistency in industrial grease applications could result in poor machine reliability, and for this reason consistency trending is a critical part of condition monitoring programs. If the application is difficult to access or if data is required in a real time basis, in-situ sensor measurements of grease rheology can be an asset to the maintenance program. Sensor technology allows corrective actions to be taken immediately upon condition changes, possibly prior to failures. This paper will evaluate the effectiveness of one available sensor, the Sengenuity Fluid Condition Sensor (FCS), at making meaningful real-time measurements of the apparent viscosity of low-grade grease in an industrial application and discuss the implications of dynamic grease flow on sampling and condition monitoring. The FCS was installed in a motor operated valve (MOV) gearbox, running under controlled lab conditions to simulate a real working environment.

9:30 – 10 am
Advanced Predictive and Prognostic Computational Models
P. Casto, Meridium, Roanoke, VA
Condition monitoring technologies that provide insight into the condition of equipment have made significant advances over the past few years. These technologies such as vibration, lubrication, thermography, etc. provide insight into specific aspects of the health of equipment. In addition, communication methods have made the capture of process and equipment information from PLC, DCS, process control and process historian systems a practical matter. However, the ability to integrate, organize and draw meaningful insight from this integrated data is not a trivial matter. This paper will investigate the current state of advanced predictive technologies, advanced predictive computational models and prognostic methods. The paper will be organized as follows: A literature search on this subject matter; Discussion about the problem faced when attempting to build meaningful integrated data models and A review of current state of predictive and prognostic computational models.

10 – 10:30 am • Break

10:30 – 11 am
Tests for the Analysis of Used Lubricating Grease
D. Turner, Shell Global Solutions (US) Inc., Houston, TX
Analysis of in-service lubricants is a useful tool in determining the state of both the fluid and the equipment being lubricated. Many laboratories perform analysis of used oils. The results of the analyses are often tracked to allow trends in the results to be observed. Analysis of used lubricating grease is a more challenging task, since the amount of grease in many applications is quite small, the grease may be partially or totally replaced each time new grease is added, and access to the lubricated contact zone may be difficult. Many commercial in-service lubricant analysis laboratories lack the specialized test equipment required for grease analysis, so that type of analysis is performed by a limited number of laboratories, primarily those of the grease manufacturers. Various techniques are employed to determine both the macro and micro condition of used lubricating grease. The strengths and weaknesses of those techniques are discussed herein.
Lubrication theory, the Young-Laplace equation, and Poisson-Boltzmann profiles simulated from a model which takes into account Reynolds mica surfaces were observed in water and 1 mM KCl solution. The changing profiles of a fixed bubble with various speed of approach has been investigated using a modified Surface Force Apparatus. The study, the deformation of bubbles under the influence of surface forces of bubble interface influenced by solid surfaces is essential. In this and solid surfaces under dynamic condition, understanding the kinetics since a lot of processes in reality involve interaction between bubble and solid surfaces whose radius of curvature differs by 5–6 orders of magnitude. Low adhesion gives a linear dependence of the friction force on load, whereas high adhesion gives the combination of electric double-layer and hydrodynamic boundary conditions.

Bio-based Lubricants for Compliant Superhard Carbon Coatings
Most of traditional tribological lubricant additives, like ZDDP and MoDTC, are responsive to ferrous materials and they pollute the environment. Nowadays, the development of new lubrication technologies, combining biodegradable additives and resistant surface treatments is crucial in order to meet the environmental concerns of the 21st century. Nanocrystalline diamond and DLC coatings are very interesting under lubrication conditions in the presence of selected biodegradable additives. Recently, we discovered the ability of nanocrystalline diamond and ta-C coatings to be lubricated by some polyhydric alcohols. Several organic molecules were tested like fatty acids, glycerol, glycerol monooleate, and inositol. Some of these compounds can be obtained from glycerol, a by-product of the synthesis of bio-fuels. Glycerol and inositol are able to lubricate superhard carbon coatings with a friction coefficient near 0.01 in severe mixed and boundary conditions [1].

Friction Control Utilizing Biomimetic Polymer Brush Technology
A. Takahara, M. Kobayashi, JST ERATO Takahara Soft Interfaces Project, Fukuoka, Japan
Biomimetic water lubrication system can be achieved by tethering hydrophilic polymers or polyelectrolytes on the solid surfaces. We carried out surface-initiated controlled radical polymerizations of various Ionic monomers on a silicon wafer and glass ball to prepare polyelectrolyte brushes with excellent water wettability. The frictional coefficient of the polymer brushes was measured at 298 K. The friction coefficients of cationic, anionic, and phosphobetaine polymer brushes in water were 0.01 – 0.03 at the higher sliding velocity. The anionic polymer brush revealed a significantly low friction coefficient around 0.01. We supposed that the abrasion of the brush was prevented owing to a good affinity of anionic polymer brush with water forming a water lubrication layer, and electrostatic repulsive interaction among the brushes bearing sulfonic acid groups. The dependence of salt concentration and sliding velocity on the macroscopic frictional properties were also investigated.

Boundary Conditions at Air-water Interface: Investigation With the Surface Force Apparatus
S. Ohnishi, L. Del Castillo, University of South Australia, Adelaide, SA, Australia, S. Carnie, The University of Melbourne, Melbourne, VIC, Australia, R. Horn, Deakin University, Melbourne, VIC, Australia
Many industrial processes are carried out under multiphase flow, in which bubbles play a key role in determining the process efficiency. Since a lot of processes in reality involve interaction between bubble and solid surfaces under dynamic condition, understanding the kinetics of bubble interface influenced by solid surfaces is essential. In this study, the deformation of bubbles under the influence of surface forces has been investigated using a modified Surface Force Apparatus. The changing profiles of a fixed bubble with various speed of approach of mica surfaces were observed in water and 1 mM KCl solution. The experimental results will be discussed in comparison with theoretical profiles simulated from a model which takes into account Reynolds lubrication theory, the Young-Laplace equation, and Poisson-Boltzmann equation, using different combinations of electric double-layer and hydrodynamic boundary conditions.
Friction and wear behaviors of two different commercially available Ti-based coatings, namely Titanium nitride (TiN) and Titanium diboride (TiB2) were evaluated under boundary lubrication regime with both, formulated and unformulated lubricants. The study was conducted with uncoated steel roller in reciprocating line contact. When lubricated with the unformulated PAO lubricant the friction in test with both coatings showed similar friction compared to the uncoated steel. In test with formulated lubricants, sometimes significant friction reduction was observed, and no change in friction was observed with some other lubricants. Both coatings produced more wear on the uncoated counterface, compared to the steel flats.

3 – 3:30 pm • Break

3:30 – 4 pm
Structure of Self-Assembled Monolayers on Surfaces with Nanoscopic Curvature Examined by Molecular Dynamics
B. Ewers, R. Jones, J. Batteas, Texas A&M, College Station, TX

Self-assembled monolayers of alkylsilanes have been considered as wear reducing layers to facilitate dynamic motion in Microelectromechanical Systems (MEMS). Though these films have reduced stiction based wear, they tend to fail in shearing contact, likely owing to the inherent nanoscale roughness of surfaces in MEMS devices. Complementing FTIR and AFM studies, and informing them in molecular detail, classical dynamics simulations have been employed to investigate the structure of alkylsilane films on surfaces with nanoscopic curvature. Torsional defect density, film thickness, and apparent surface coverage have been characterized as a function of curvature and chain length to understand the impact of surface curvature on the structure of these films. Additionally, because these films have demonstrated a tendency to uptake various molecules, explicit solvent simulations have been conducted to investigate the effects of intercalates on the properties of these films.

4 – 4:30 pm
Surface Engineering Technical Committee Meeting
PRACTICAL LUBRICATION II
Session 8C • Room 226

Session Chair: W. Needelman, Filtration Science Solutions, Huntington Bay, NY
Session Vice Chair: D. McCoy, The Elco Corporation, Cleveland, OH

1:30 – 2 pm
Extending Hydraulic System Filter Element Change-out Intervals on Large Excavators
C. Bauer, Pall Corporation, Port Washington, NY

The filter elements installed in the return lines of the hydraulic systems on large excavators are typically changed out according to a set maintenance schedule, in order to avoid unscheduled downtime due to plugged filter elements. This practice, however, could result in incomplete utilization of the available filter element service life.

In this work, the author discusses a protocol for optimizing filter change-out intervals, which includes a combination of periodic sampling and monitoring of fluid cleanliness levels and upgrading to high performance filtration, for individual operators and applications.

2 – 2:30 pm
Optimization of the Cleaning Performance of the Doctor Blade – Roll Tribosystem During Paper Production
M. Rodriguez Ripoll, B. Scheichl, B. Jakab, F. Franek, AC2T research GmbH, Wiener Neustadt, Austria

In the paper production, scraping (doctor) blades are placed in contact with rolls during wet pressing in order to keep the roll surface clean. The aim of this work is to determine the process parameters required for an optimum cleaning performance while simultaneously minimizing the wear of the doctor blade, thus increasing blade lifetime and reducing energy consumption. So far, this process has been improved on a trial-and-error basis.

Our hypothesis is that the optimum conditions occur under "weak" hydrodynamic conditions. Friction force and wear can be substantially reduced, whereas the cleaning efficiency can be maintained as long as the film thickness is kept smaller than the minimum diameter of particles to be removed. Based on the equilibrium conditions at the blade tip between hydrodynamic and contact forces, a non-dimensional group involving the key parameters is obtained. This allows for a systematic improvement of the cleaning efficiency, which is verified experimentally.

2:30 – 3 pm
A Novel Approach to Bulk Fuel Filtration
C. Bauer, Pall Corporation, Port Washington, NY

New developments in fuel injector technology, such as high pressure common rail injection systems place much higher demands on the cleanliness levels of incoming Diesel fuel, particularly in surface mine sites, where incoming bulk fuel can contain as much as 20 mg/L suspended solid contaminants, and, in some locations, also significant quantities of free water. Therefore, particulate and water contamination in diesel fuel must be controlled throughout the entire fuel supply chain, from the bulk storage and filling points to the injection systems on-board engines, through the use of particulate filtration and liquid/liquid coalescers.

In this work, the author discusses the benefits of using advanced filtration and separation technologies, by means of several case studies.

3 – 3:30 pm • Break

FLUID FILM BEARINGS IV
Session 8D • Room 230

Part 1
Session Chair: F. Dimofte, University of Toledo/NASA GRC, Cleveland, OH
Session Vice Chair: S. Glavatskih, Lulea University of Technology, Lulea, Sweden

1:30 – 2 pm
Effect of Thermal Distortion of Slider and Asperities: with a Special Reference to Load Generation in Parallel Sliders
G. Deresse, Bahir Dar University, Bahir Dar, Ethiopia, P. Sinha, Indian Institution of Technology, Kanpur, Kanpur, India

The objective of the present work is to investigate numerically the influences of thermal distortion on the thermodynamic lubrication of infinitely long tilted pad slider rough bearings. The slider is assumed to be distorted to a parabolic shape and the asperities expanded as a consequence of thermal expansion and the load applied. Christensen's stochastic approach is used to derive the Reynolds-type equations. Density and viscosity are considered to be temperature dependent. The modified Reynolds equation, momentum equation, continuity equation and energy equation are decoupled and solved using finite difference method to yield various bearing characteristics. From the numerical simulations it is observed that the performance of the bearing is significantly affected by the thermal distortion of the slider and asperities and even the parallel sliders seem to carry some load.

2 – 2:30 pm
Tilting Stiffness Variation in a Large Vertical Tilting Pad Thrust Bearing
S. Duriseti, Bhaskar Engineering College, Hyderabad, India

The tilting pad thrust bearing is also known as the variable geometry bearing. The hydrodynamic pressure and thermal gradient induce the pad top and the flexible pivot to thermo-elastically deform. The primary objective in this paper is to optimise the deformation of the pad within the structural and thermal limits of the material. An ANSYS based finite element method is used to perform the deformation analysis. There are 8 elements in radial, 8 in circumferential and 8 along thickness to a total of 512 hexahedral Solid 226 elements in the thermo-structural deformation function. The nodal values of the elements at the bottom surface match the corresponding temperature and heat flux values of the lubrication problem. The analysis is coupled and solved in an iterative manner. Subsequently, the variation of the tilting stiffness of the lubricant film with respect to the renewed film thickness resulting from pad deformation is analysed.
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2:30 – 3 pm
**Performance Characteristics of a Hydrostatic Journal Bearing**
A. Bouzidane, Ibn Khaldun’s University of Tiaret, Tiaret, Algeria, M. Thomas, École Supérieure de Technologie, Quebec University, Montreal, QC, Canada

The design of hydrostatic journal bearings is commonly determined by their basic bearing parameters such as the length, width, bearing dimension ratio, concentric pressure ratio, and the relevant control device and its dimensions. The aim of this research is to study the static and dynamic characteristics of a hydrostatic journal bearing having four hydrostatic flat pads and supporting a rotor. Capillary restrictors were considered to feed the bearing. It is assumed that the fluid flow is incompressible laminar, isothermal and steady state. Linear modeling was performed using a numerical method in order to investigate the effects of film thickness, concentric pressure ratio and eccentricity ratio on the static and dynamic characteristics of the four hydrostatic bearing flat pads. The results indicate that variation in concentric pressure ratio and eccentricity ratio affect the performance characteristics of hydrostatic journal bearing systems quite significantly.

3 – 3:30 pm • Break

**MATERIALS TRIBOLOGY III**

**Session 8F • Room 232**

Session Chair: B. Krick, University of Florida, Gainesville, FL
Session Vice Chair: A. Bennett, University of Florida, Gainesville, FL

1:30 – 2 pm
**High Speed and High Temperature Lubrication of PEK/Steel Sliding Contacts**
C. Dyson, University of Leeds, Leeds, United Kingdom, B. Hopkins, ROCOL Lubricants, Swillington, Leeds, United Kingdom, M. Fox, M. Priest, University of Leeds, Leeds, United Kingdom

Formulating lubricants for polymer-on-steel contacts requires a very different technological approach to steel-on-steel contacts. This work describes the challenges of high temperature, high speed sliding contacts with carbon-fibre reinforced PEK (Polyetherketone) and steel faces. PEK is a thermoplastic with excellent thermal and chemical stability, and has some suitability to tribological applications, especially when reinforced with carbon fibres. A range of synthetic-based lubricants are evaluated for their suitability in these contacts, primarily in terms of friction, using a pin-on-disc tribotester and other supplementary tests. A range of speeds, loads and temperatures are considered, to cover a variety of tribological environments, including those that are representative of known high speed and high temperature tribological applications of PEK.

2 – 2:30 pm
**Stamping of Bipolar Plate Micro-Channels using Ferritic Stainless Steel Sheets**
L. Ravi Narayan, University of Windsor, Windsor, ON, Canada, A. Morales, General Motors R&D Center, 30500 Mound Road, Warren, MI, A. Alpas, University of Windsor, Windsor, ON, Canada

 Austenitic stainless steels have been used as substrate for bipolar plates in Polymer Electrolyte Membrane Fuel Cells (PEMFC) but the alloys are expensive due to their high content of Ni. Ferritic stainless steels are low-cost alternatives due to their excellent corrosion properties but their formability is limited. In order to replace the austenitic stainless steels with a ferritic type, a better understanding of its formability in the micro-scale is required. Micro-scale channel stamping of high Cr stainless steel was done at ambient and warm forming conditions (25 – 400°C). Evolution of microstructure, surface morphology, strain distribution and dimensional conformity were studied as function of contact friction, stamping load, speed and temperature in order to find the best forming conditions to form micro-channels using these type of steels.

2:30 – 3 pm
**Micro-Scale Metal Contact Lubrication using Adsorbed Vapor Molecules**
A. Barthel, A. Al-Azizi, S. Kim, Pennsylvania State University, University Park, PA

Material deformation and contamination are two critical problems dealing with metal contacts at the micro scale. Vapor phase lubrication (VPL), in which lubricating molecules adsorb onto a surface from a constant supply of vapor, can reduce friction between rubbing contacts. VPL studies of water and pentanol vapors were conducted using a ball-on-flat tribometer with a stainless steel ball rubbing against a copper substrate. In water vapor, adhesive wear of the copper occurred at low humidities, but uniform wear on the stainless steel ball occurred near saturation. Conversely, pentanol vapor displayed lubricious qualities across all partial pressures investigated. The adsorbed pentanol vapor did not appear to polymerize or further contaminate the surface under a Hertzian contact pressure of roughly 320 MPa. Investigation into further vapors and carrier gases could lead to lubricated and contaminant-free metal, micro-scale devices.

3 – 3:30 pm • Break

**WEAR IV**

**Session 8G • Room 100**

Session Chair: X. Lu, Varel International, Carrolton, TX
Session Vice Chair: Y. Li, Lawrence Technological University, Southfield, MI

1:30 – 2 pm
**Impact of Tribolayer Composition on Wear Behaviour**

Bio-components like ethanol have become standard admixtures in car fuels, whereas the influence of these admixtures and their combustion products on the behaviour of the engine, especially the wearing behaviour, is hardly understood. An important step to study the influence of bio-fuel admixtures in the engine oil can be seen in the precise measurement of the lubricating performance of the altered oils and the analysis of the tribolayers on the surfaces.

Piston ring and cylinder liner systems were tested with fresh and artificially aged oils with or without different ethanol combustion products. The chemical compositions of the tribolayer on the cylinder liners were analysed with XPS sputter depth profiling. The results show that the layers differ considerably concerning the concentration of lubricant additive components. A correlation could be observed between the thickness and the composition of the formed layers on the cylinder and the wear behaviour of the piston rings.

2 – 2:30 pm
**Optimization of PTFE Lip Seals**
A. Daubner, W. Haas, University of Stuttgart, Stuttgart, Germany

Elastomeric lip seals cannot be used at high temperatures, high circumferential velocities to seal aggressive fluids. Lip seals, made of Poly-Tetra-Fluor-Ethylene (PTFE), exceed these limitations, but they fail in fact of wear at the contact area to the shaft. The acknowledgement of
the friction and wear behaviour of PTFE allows appreciating the durability of PTFE lips seals.

This paper describes an approach to model and simulate wear at PTFE lip seals. Based on experimental investigations of the tribological system, an energetic approach is used to quantify the wear rate. The global change of the lip seal geometry is calculated by a finite element program, which is extended by self-written wear algorithms. This allows an optimization of the lip seal geometry.

2:30 – 3 pm
Development of Iron-Nickel Coated Graphite Composites by Laser Assisted Process
C. Ramesh, PES Institute of Technology, Bangalore, India, S. Srinivasa, Central Manufacturing Technology Institute, Bangalore, India, P. Chetan, K. Ramaiah, PES Institute of Technology, Bangalore, India

In recent years, there is considerable interest to develop ferrous based composites for innovative industrial products using computer aided laser assisted process. In the light of the above the present work focuses on development of Iron – graphite (Cu-coated) composites using Direct Metal Laser Sintering (DMLS) technique. Powders of iron and graphite(Cu-Coated) of particle size varying between 25-50µm were used to build the specimens using the DMLS process. CO2 laser of 200W power at different scan speeds varying between 50mm/s to125mm/s were adopted to develop the composites. Microstructure, micro hardness, density, coefficient of friction and adhesive wear tests have been carried out on the developed composites. Lower the laser speed, higher is the improvement in density, micro hardness and wear resistance of the composites. Increased content of graphite in iron results in increase in coefficient of friction and decrease in wear rates of the iron-graphite composites.

3 – 3:30 pm • Break

CONDITION MONITORING III
Session 8H • Room 221

Session Chair: TBD
Session Vice Chair: TBD

1:30 – 2 pm
New Trends in Particle Counting
D. Napier, Engineered Lubricants, Maryland Heights, MO

Equipment condition can be monitored via trending data obtained through regularly scheduled lubricant testing. Particle counting is among the most basic testing done to measure fluid cleanliness. Frequently used methods of particle counting include ferrography and particle counting by light extinction. Each of these methods provides excellent information for tracking machine wear, but they are not suitable for use in all circumstances. The methods are limited in what information they can provide regarding the sizes and types of particles present in a sample and in the types of fluids the methods can test. This leaves many machines with insufficient wear data. What can be done to provide vital needed data for condition monitoring in these machines? This presentation will examine the positive and negative aspects of particle counting by conventional means, and discuss a new possibility in the field: automated particle counting and analysis by optical microscope.

2 – 2:30 pm
Introduction of Group II and Group III Ashless Oils and Their Impact on Hydraulic and Lubricating System Operation
J. Duchowski, V. Diehl, Hydac, Sulzbach, Germany

The phasing out of the Group I oils, many of which contained metal-based additives, and the introduction of Group II and Group III oils, many of which contain organic-only additives, has brought about many new phenomena previously not apparent or considered in typical hydraulic and lubricating systems. The range of these phenomena is indeed quite broad (and interesting) and may include everything from electrostatic discharge, varnish formation, novel additive interaction and degradation mechanisms. Many aspects of these new behavioral mechanisms have yet to be characterized in greater detail and often require the introduction of new analytical techniques, such as cyclic voltammetry, measurements of electrical conductivity, X-ray emission and infra-red spectroscopic techniques, etc. This paper will present several case studies from a wide variety of industrial applications where these new behavioral mechanisms have been observed and characterized.

2:30 – 3 pm
Applications of Novel Filter Structures for Single-Step In-line Phase Separation Applications
J. Duchowski, E. Koch, Hydac, Sulzbach, Germany

Traditional filtration and separation devices can often be thought of as being combined from several layers of flat sheet non-woven materials (often pleated) or a deep bed melt-blown structure assembled in a single step extrusion process. Recently, new materials appeared on the market in which the porous structure is obtained in the course of a condensation polymerization process. The versatility of latter materials offers particular promise because their properties, such as porosity, pressure drop, filtration efficiency, etc., can be relatively easily adjusted by choosing suitable reaction conditions. Moreover, their properties appear to lend themselves suitable for standard filtration applications as well as for liquid-liquid and liquid-gas phase separation applications. Several examples of application of these structures to various separation processes will be described and their advantages and disadvantages compared and contrasted.

3 – 3:30 pm • Break

3:30 – 4 pm
Oil Cleanliness and Filtration
S. Legay, Lubricants & Specialties, Fairfax, VA, T. Nadasdi, Research & Engineering, Paulsboro, NJ

It is no mystery to Maintenance professionals, that clean oil promotes enhanced equipment performance and reliability. There is, however, something that many of them do not know. Today's most commonly used particle counting tests for determining oil cleanliness too often yield inaccurate and inconsistent results. This paper will discuss how this inconsistency and lack of precision can lead companies to waste considerable amounts of money and time developing maintenance plans based on inaccurate and unreliable information. But, by incorporating innovative methods to address sources of error – including air entrainment, water content, and additive effects – particle counting precision and accuracy can be greatly improved. Maintenance professional can then make better oil suitability decisions. In the Wind Industry, this will also help ensure that the appropriate filtration practices are implemented to secure both oil cleanliness and foam and air release performance.
A Fluid Contamination Multi-sensor for Field Use
C. Snyder, L. Gschwender, University of Dayton, Dayton, OH, A. Theys, METTS Corporation, Tokyo, Japan, E. Bielo, PAMAS GmbH, Stuttgart, Germany

Measuring the water, particulate and air contamination levels in fluids in the field is very troublesome. Collecting fluid samples in bottles and sending them to a laboratory for analysis can result in sample contamination and a significant delay in obtaining the results. In order to address this issue, a sensor was developed that can simultaneously measure water, particulate and air contamination and do this in the field. The sensor can either be hooked up in-line or it can analyze samples from a bottle. The accuracy of the measurements has been confirmed in laboratory tests and validated in limited field tests.

NON-FERROUS METALS IV – BIOBASED CHARACTERIZATION
Session 8I • Room 222

Session Chair: R. Pruhs, Quaker Chem, Aurora, IL

1:30 – 2 pm
Formulation Chemistry for Ultra-Stable Ester-based Oils
T. Karis, Hitachi Global Storage Technologies, San Jose, CA

Inhibition of oil oxidation is the key to long life of synthetic lubricants operating in thermal stress and boundary lubrication environment. A kinetic model which includes the synergistic effects of primary and secondary antioxidants and metal catalyst on oil oxidation lifetime is employed to guide the formulation. Examples of accelerated oil life testing are shown with an aromatic amine primary antioxidant and an alkyl dithiocarbamate secondary antioxidant as well as the effect of dissolved metal catalyst in accelerated oil oxidation life tests. Understanding the chemical mechanism enabled rapid convergence on an optimized formulation. Knowledge of the chemistry provides a significant benefit because it reduces the development cycle time and lowers the total cost to obtain improved motor lifetime. This presentation describes the development of ester-based oil formulations that were ultimately incorporated in grease and oil for high performance magnetic recording disk drives.

2 – 2:30 pm
Corrosion Protection of Steel by Thin Coatings of Starch-Oil Dry Lubricants
V. Finkenstadt, J. Kenar, G. Fanta, USDA, Peoria, IL

Corrosion of materials is one of the most serious and challenging problems faced worldwide by industry. Dry lubricants reduce friction between two metal surfaces. This research investigated the inhibition of corrosive behavior a dry lubricant formulation consisting of jet-cooked corn starch and soybean oil on SAE 1010 steel. Electrochemical Impedance Spectroscopy (EIS) was used to evaluate the corrosion inhibition of starch-soybean oil coatings containing varying amounts of soybean oil loading. EIS of control starch samples (0% soybean oil) indicated minor protection up to approximately twice that of bare steel and the incorporation of soybean oil in a composite achieved protection up to 10 times that of the control sample.

2:30 – 3 pm
The Pressure Viscosity Coefficient of Polar and Non-polar Oils
B. Girma, G. Bantchev, USDA-ARS-NCAUR, Peoria, IL

The pressure viscosity coefficient (PVC) of several vegetable, polyalphaolefin (PAO) and hexadecane oils were investigated. Vegetable oils are polar because they have multiple ester functional groups in their structure. On the other hand, the petroleum based PAO and hexadecane have no functional groups and are, thus, non-polar. PVC was estimated using three different methods. The effect of oil chemical structure on PVC values are discussed.

3 – 3:30 pm • Break

Future STLE Meeting Dates

2012 International Joint Tribology Conference
October 8-10, 2012
Denver, Colorado

68th STLE Annual Meeting & Exhibition
May 5-9, 2013
Detroit, Michigan

69th STLE Annual Meeting & Exhibition
May 18-22, 2014
Orlando, Florida

70th STLE Annual Meeting & Exhibition
May 16-21, 2015
Dallas, Texas

71st STLE Annual Meeting & Exhibition
May 14-19, 2016
Las Vegas, Nevada
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Robert W. Bruce, General Electric, Cincinnati, Ohio, USA

Since publication of the first edition of this bestselling handbook, energy’s rising costs and its impact on the environment have increased the significance of tribology. This updated and expanded edition provides a condensed treatment of the most essential information surrounding this topic. With contributions by some of the foremost experts in the areas covered, the book summarizes established knowledge and practices and includes references for more detailed study.

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- Reviews the basic principles of tribology
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- Examines components and equipment commonly found in tribological systems
- Summarizes wear- and friction-reducing materials and treatments
- Explores specific industrial areas in tribology and their processes

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The Commercial Marketing Forum allows companies to make presentations promoting their latest products, services and technical innovations, something not allowed during technical sessions. Each CMF session is approximately 30 minutes, with 20 minutes allotted for presentation and 10 minutes for Q&A. The CMF sessions are held concurrently with the annual meeting’s technical sessions.

Monday, May 7, 2012

COMMERCIAL MARKETING FORUM I
Session 1G • Room 100

8 – 8:30 am
Open

8:30 – 9 am
ExxonMobil Chemical Co.
Emerging Polyalphaolefin (PAO) Base Stock Technology

Don Mattran, ExxonMobil Chemical

ExxonMobil Chemical has been a leading manufacturer of synthetic fluids and lubricant base stocks for more than 50 years. As the lubricant industry continues to evolve and additional challenges arise, new synthetic base stocks are being developed to meet the future needs. ExxonMobil Chemical’s Synesstic™, Esterex™, and SpectraSyn™ products continue to address these challenges, including the newest line of metallocene polyalphaolefin products, SpectraSyn Elite™. This next evolution of synthetic base stocks provides additional advantages over conventional base stocks, including improved low-temperature fluidity and increased viscosity index. Through our proprietary metallocene catalyst technology, we are able to tailor the properties of our SpectraSyn Elite™ PAOs to help meet the needs of formulators across the globe. This is critical in today’s environment, with the ever growing demand for high performance synthetic lubricants.

9 - 9:30 am
The Lubrizol Corporation
Grease Technology Innovations

Gareth Fish, PhD

Technology has brought great change to modern equipment, enabling higher power output and greater efficiency. In addition, modern industrial plants are taking greater advantage of new technology to add automation to a higher degree than ever before. As a direct result, modern greases are expected to perform well in a growing number of applications operating under increasingly severe conditions including higher temperatures, faster speeds, with greater efficiency, and higher loading than previously considered possible. Fortunately, grease thickeners and additive chemistries have also benefited from many technological innovations, and these new technologies will play an important role in enabling a new generation of lubricating grease to satisfy current and emerging equipment demands.

This presentation will showcase a few such grease technology innovations and describe how they can be used to satisfy the unique demands of modern equipment.

9:30 – 10 am
ALS Laboratory Group, Tribology Division
What Makes a Successful Fluid Analysis Program?

Patrick Kilbane, CLS, Business Development Manager

All successful fluid analysis programs contain a minimum of components that ensure success. We will discuss these components and the ALS Tribology method of implementation to maximize benefits and return on investment.

10 – 10:30 am • Break

COMMERCIAL MARKETING FORUM II
Session 2G • Room 100

1:30 – 2 pm
Bruker Nano
Bruker Stylus, Optical Metrology, and Tribology Instrumentation Solutions

Matt Novak, Ph.D. Market Applications Development Manager, Bruker Stylus and Optical Metrology

Bruker, a world leader in metrology instrumentation for applications-focused solutions for our customers, is currently adding capability for combined 3D optical metrology, mechanical and tribological testing. Bruker has two highly synergistic business units which are working together to bring a powerful combined technology to market for our customers in the tribology, functional surface and materials research spaces.

In this Commercial Marketing Forum, we will provide a brief overview of the instrumentation solutions from our Tribology and Mechanical Testing and Styis and Optical Metrology divisions, as well as give some details on the combined power of materials testing and surface metrology on an integrated platform to meet or customers materials research and characterization needs.

2 – 2:30 pm
The Lubrizol Corporation
Replacing Solvent-based Rust Preventives to Meet VOC Challenges

Jennifer Ineman

With the latest volatile organic compound (VOC) regulations in place, formulators are faced with a myriad of technology choices. They must balance different benefits, features and formulating challenges to meet their products’ performance for each specific application. Each application requires an in-depth review of pre- and post-process expectations before selecting the optimal rust preventive. No single technology will be the best or only replacement of solvent-based rust preventives.

This presentation will discuss key Lubrizol water-based rust preventive additives. These additives deliver a wide range of performance characteristics and application needs while meeting new volatile organic compound regulatory requirements. Lubrizol products presented will cover in-process corrosion inhibitors and water-dispersible chemistry that provides short-term indoor and long-term outdoor protection.

The importance of having a range of technology choices in meeting both the newest VOC regulations and the industry performance demands will be discussed.
2:30 – 3 pm
Croda, Inc.
**Croda Lubricants – Leading the Way Naturally**
Suresh Swaminathan, Sales Development Specialist-Lubricants
Croda Lubricants is a global business offering a unique range of ingredients designed to deliver superior performance and tailored solutions to our customers in the automotive and industrial lubricant sectors. With natural feedstocks as its foundation, Croda’s PrioLube™ ester technology and Perfad™ additive chemistry include organic and polymeric friction modifiers for oil-based systems, specialty esters for engine and transmission fluids, bio-based seal swell additives for replacement of phthalates, and high-temperature stable esters for chain oils. These technologies are designed to improve fuel economy in challenging engine oil tests; reduce emissions and increase equipment efficiency. This Lubrizol biocide chemistry, has been designed to meet the special needs of metalworking fluid concentrates. This Lubrizol biocide chemistry, has been designed to meet the special needs of metalworking fluid concentrates. This Lubrizol biocide chemistry, has been designed to meet the special needs of metalworking fluid concentrates. This Lubrizol biocide chemistry, has been designed to meet the special needs of metalworking fluid concentrates.

3 – 3:30 pm • Break

3:30 – 4 pm
Evonik Oil Additives USA, Inc.
**VISCOPLEX® Pour Point Depressants for Food Grade Applications**
Ms. Joan Souchik, Evonik Oil Additives, Regional Technical Manager
Evonik Oil Additives has commercialized a NSF HX-1 approved Pour Point Depressant for Food Grade applications with Kosher/Halal certification. VISCOPLEX® 1-135 is specially designed for use in food-processing lubricants with incidental food contact and is manufactured according to GMP (Good Manufacturing Practice) standard. VISCOPLEX® 1-135 delivers optimum low temperature performance, particularly in Group III/White Oil-based lubricants. The use of VISCOPLEX® 1-135 is a cost effective alternative in formulating high-performance food grade lubricants.

4 – 4:30 pm
The Lubrizol Corporation
**Globally Proven Biocide Now Available in the U.S.**
Dr. Uwe Falk
Recently, discussions in the metalworking industry around formaldehyde and the potential limitations of the triazine molecule have intensified. In response to the growing need for an alternative to these traditional chemistries, Lubrizol has been granted EPA registration for a new active ingredient for use in the United States. CONTRAM ST-1, a biocide utilizing methylene-bis-morpholine (MBM) chemistry, has been designed to meet the special needs of metalworking fluid concentrates. This Lubrizol biocide has been in use around the world for many years, and its performance has been substantiated by metalworking fluid suppliers and operators who utilize metalworking fluids in their manufacturing processes.

This paper will review the performance of this new-to-the-U.S. biocide designed specifically for metalworking fluids. Dr. Falk will also discuss how the EPA supports the use of this chemistry in metalworking concentrates as “a reduced risk alternative to formaldehyde releasers currently on the market.”

4:30 – 5 pm
Dow Chemical Company
**Solving Today’s Energy Efficiency and Maintenance Challenges with UCON™ OSPs from Dow**
Brian Goldstein, Product Marketing Manager, Dow Chemical
After more than a year on the market, Dow’s family of oil soluble polyalkylene glycol (OSG) products have demonstrated benefits in a number of new markets and applications. Dow follows up its 2011 STLE technical and commercial presentations with new data supporting the Dow UCON™ OSP innovation technology which has enabled formulators to use polyglycols as additives or base oils to enhance the performance of mineral oil based lubricants and greases. Dow UCON OSps can bring the benefits of polyglycols into your formulation thus redrawing the boundaries of hydrocarbon lubricant performance.

The key attributes of Dow UCON OSps include low friction coefficient, high thermo oxidative stability and unique polarity. These three properties generate a number of value propositions in all lubricant segments including:

- **Engine oils:** Adding Dow UCON OSps to your lubricant formulation can lower fuel consumption and improve engine cleanliness
- **Gear and bearing lubricants:** Dow UCON OSps can provide energy efficiency and high temperature stability
- **Hydraulic and compressor fluids:** Dow UCON OSps can reduce varnish and thus help increase oil life and reduce maintenance costs
- **Greases:** The polarity of Dow UCON OSps offer formulators new options to dissolve additives

Technical and commercial information will be presented on the benefits of using Dow UCON™ Oil Soluble Polyalkylene Glycols. Case studies will also be presented for end-user applications, showing how lubricants with Dow UCON™ OSPs enhanced performance deliver against unmet customer needs. For more information, please contact us at OSP@dow.com.

Tuesday, May 8, 2012

COMMERCIAL MARKETING FORUM III
Session 3H • Room 100

8 – 8:30 am
SurfaTec Laser Solutions
**Nano-Slick™ – Game Changing Green Lubrication Coating**
Serge Tesker, Ph.D., President of SurfaTec Laser Solutions
Among surface engineering techniques designed for wear and corrosion mitigation only a few can be applied to large components and lengthy surfaces of dynamic equipment (turbines, compressors, pumps, centrifuges, valves etc.) with no risk of delamination and hardly any are easy and cost-effective to apply.

Nano-Slick™ low friction coating technology is the best choice to provide lubrication and 3 fold increase in service life of moving components. It has been implemented with great success in many applications for oil & gas industry equipment to mitigate wear and corrosion issues. Nano-Slick™ is proven to provide 3 to 8 fold reduction in friction, thus significantly decreasing lube and energy usage, maintenance and operating costs.

Applications where Nano-Slick™ showed its endurance and capability include: valve components, metering pumps, screw compressors, waste water pumps, diaphragm pump components, natural gas compressors and steam turbines. Nano-Slick™ is affordable, fast, innovative and environmentally friendly solution chosen by leading equipment manufacturers and users around the world.
8:30 – 9 am
Open

9 – 9:30 am
Sea-Land Chemical
Navigating a World of Opportunities with Sea-Land Chemical
Joseph Clayton
This presentation will provide an update of the actives of the Sea-Land Chemical Company as a supplier of specialty chemicals into the lubricant market place. Domestic and Global operations will be discussed.

9:30 – 10 am
Additives International
“Growing Up Fast in Additives for Metalworking and Lubricants”
Gregory Jorjorian, President, Additives International; E Jon Schnellbacher, Technical Director, Additives International
In 2008, FTC through its consent decree provided Additives International all of the original Lockhart Chemical technology and process instructions related to the manufacture of oxidate based rust preventative additives. Today, Additives International has expanded the technology beyond what was provided by FTC.

Since transition to the Lockhart Chemical facility in Flint, MI, in 2009, Additives International has become a global player in Sulfonates and Rust Preventive Additives. This presentation will describe “What’s new with Additives International.”

10 – 10:30 am • Break

10:30 – 11:00 am
Dover Chemical Co.
Chlorinated Paraffin Free Additives
John Nussbaumer
This presentation covers the chlorinated-paraffin-free extreme-pressure (EP) lubricating additives. The topics being discussed will include the additive chemistries, the types of fluids used, as well as the testing equipment and parameters used in the evaluation.

11 – 11:30 am
The Lubrizol Corporation
Low Foam Metalworking Fluid Emulsifier Systems: An Expanded Product Range and Future Directions
Jennifer Ineman
Foaming tendency of metalworking fluid emulsions continues to challenge the industry as more machine tools employ small volume sumps and high pressure fluid delivery systems. In response to this issue, The Lubrizol Corporation has focused research for 5+ years on the development of new emulsifier molecules and formulations that minimize foaming tendency and reduce reliance on traditional defoamer chemistry. This effort has led to the introduction of several additives that allow for the design of low foaming emulsion products built from a wide range of base stocks, including: naphthenic oils, vegetable oils, fatty acid esters, and Group II & III paraffinic oils. Formulation approaches and relative foam performance data will be presented. Additionally, new advances for low foam performance in low oil semi-synthetic formulations will be introduced.

11:30 – Noon
Open

COMMERCIAL MARKETING FORUM IV
Session 4H • Room 100

2 – 2:30 pm
Afton Chemical Corporation
Afton Chemical’s Key Driver Seminar: Energy Efficiency Initiatives in the Fluid Power Industry
Eric Lanke, Chief Executive Officer, National Fluid Power Association; Phil Rohrer, Industrial Marketing Manager, Afton Chemical Corporation
As fluid power customers focus more and more on energy efficiency, the fluid power industry is responding with a number of initiatives designed to help differentiate itself from competing technologies as a contributor to machine efficiency. Like other essential components of a fluid power system, the fluid itself presents numerous opportunities for efficiency gains. This talk will explore some of the initiatives being led by the National Fluid Power Association and provide suggestions for where fluid manufacturers and engineers can best engage with those efforts.

2:30 – 3 pm
The Lubrizol Corporation
Meeting Micropitting Challenges
Dave Oesterle
Current trends in gearbox manufacturing have produced smaller gearboxes with higher power densities. These smaller systems generate increased gear and bearing loads, which in turn, present increased lubricant formulating challenges. Alongside the reduced size requirement, OEMs also need to balance steel quality and surface finishing methods in an effort to increase manufacturing throughput and profitability. These manufacturing trends are leading to more frequent occurrence of micropitting failures on gear teeth. The inclusion of micropitting resistance, bearing and seal/paint compatibility tests in key specifications from leading OEMs are the most significant factors impacting industrial gear oil formulating today.

This paper will discuss recent developments and discoveries that will shed some light on how to address these performance requirements. Recent specification changes pertaining to seal and paint compatibility has presented challenges to meet performance requirements across a wide range of base oil types. Extensive formulating and laboratory testing has led to different options to meet industry requirements, including those listed in the latest Siemens MD (formerly Flender) Revision 13 specification.

3 - 3:30 pm • Break

3:30 – 4:30 pm
Afton Chemical Corp.
Afton Chemical’s Metalworking Trends and Insights: How New Materials, Processes and Technology are Changing Metalworking Fluids
Steve Griffiths, Marketing Technical Service MW, Afton Chemical Corporation
Metalworking fluids performance requirements are constantly changing as materials and machining processes continue to develop. This session will explore the current and future trends in the metalworking arena and suggest where metalworking fluid marketer’s and manufacturers can focus their energies in developing and managing the next generation of fluids.

4:30 – 5 pm
Open