

Society of Tribologists & Lubrication Engineers Annual Meeting & Exhibition 2013

**Detroit, Michigan, USA
5-9 May 2013**

ISBN: 978-1-62993-289-7

Printed from e-media with permission by:

Curran Associates, Inc.
57 Morehouse Lane
Red Hook, NY 12571



Some format issues inherent in the e-media version may also appear in this print version.

Copyright© (2013) by the Society of Tribologists and Lubrication Engineers
All rights reserved.

Printed by Curran Associates, Inc. (2013)

For permission requests, please contact the Society of Tribologists and Lubrication Engineers
at the address below.

Society of Tribologists and Lubrication Engineers
840 Busse Highway
Park Ridge, Illinois 60068-2302

Phone: (847) 825-5536
Fax: (847) 825-1456

information@stle.org

TABLE OF CONTENTS

BIOTRIBOLOGY

Wear Behavior of Highly Entangled Ultra-High Molecular Weight Polyethylene	1
<i>Douglas W. Van Citters, Evan M. Carlson, Steven D. Reinitz</i>	
Effect of Kinematic Conditions and Materials of Contact Surfaces on Protein Film Formation in the Artificial Hip Joint.....	4
<i>Martin Vrbka, Tomas Navrat, Ivan Krupka, Martin Hartl, Jiri Gallo</i>	
Development of a Multidirectional Rolling-Sliding Tribo-system for UHMWPE	7
<i>D. Van Citters, E. Patten, M. Ries, L. Pruitt</i>	

CERAMICS/COMPOSITES

Micro-Abrasive Wear of Two Dental Restorative Materials	10
<i>E. A. Gallardo, A. Peña, M. Vite, M. Moreno</i>	

TESTING

Solid Particle Erosion Testing With a Gas-Jet Apparatus	13
<i>K. G. Budinski</i>	

ENGINE & DRIVETRAIN

Frictional Heat Analysis of the Planetary Roller Screw Considering Load Distribution	16
<i>Shangjun Ma, Geng Liu, Ruiting Tong</i>	
Friction Coefficients of a Wet Clutch Using Blends of Automatic Transmission Fluid (ATF) and Bio-Lubricant (Jatropha Curcas Oil) Using a Pin on Disk Tester.....	19
<i>L. Farfan, E. Gallardo, M. Cruz, M. Vite</i>	
Frictional Moment Analysis of Ball Screws Considering Load Distribution.....	22
<i>Geng Liu, Xiaocai Zhang, Ruiting Tong, Shangjun Ma</i>	
Friction Reduction on Powertrains by Polyglycols, Alternative Steels and/or Thin Films.....	25
<i>Christian Scholz, Dirk Spaltmann, Mathias Woydt</i>	

ENVIRONMENTALLY FRIENDLY FLUIDS

Test Methods for Testing Biodegradability of Lubricants	38
<i>Ben Martin Mueller-Zermini, Gerhard Gaule</i>	
The Effect of Surface Roughness on the Tribological Performance of Environmentally Friendly Bio-based Lubricants with Varying Particle Size	41
<i>Carlton J. Reeves, Pradeep L. Menezes, Tien-Chien Jen, Michael R. Lovell</i>	
Friction and Wear of Jatropha Curcas Oil Using a Four Balls Tester.....	44
<i>F. Nieto Camacho, E. A. Gallardo Hernández, M. Figueroa Guadarrama, E. D. García</i>	
An Investigation Into the Tribological Performance of Diesel and Diesel-GTBE Blends.....	47
<i>G. D. Thakre, Savita Kaul, M. S. Negi, Dinesh Bangwal, P. K. Arya, B. M. Shukla</i>	
Designing Green Lubricants for Manufacturing Industry Using Renewable Base Materials.....	50
<i>P. V. Joseph, P. Bhatnagar, D. Saxena, B. Basu, R. K. Malhotra</i>	
Evaluation of Karanja Oil (Pongamia Pinnatta) as Bio-Degradable Base Oil for Lubricants	54
<i>N. H. Jayadas, D. Mahipal</i>	
Methods of Experimental Design and Analysis in the Research and Development of Sustainable Metalworking Fluids.	57
<i>David Enright</i>	
Synthesis, Characterization and Evaluation of 2-Ehtyl Hexyl Ester of Karanja Oil Fatty Acid Estolide.....	60
<i>G. Ajithkumar, N. H. Jayadas, D. Mahipal</i>	

Synthesis of a Potential Biodegradable Lubricant from Castor Biodiesel Esters via Enzymatic Catalysis	63
<i>José André Cavalcanti Da Silva, Alberto Cláudio Habert, Valéria Ferreira Soares, Denise M. G. Freire</i>	
A New Environmentally Friendly Algal Oil with Enhanced Performance in Lubricants	66
<i>Scott Franklin, Jad Finck, Chris Dicocco</i>	

FLUID FILM BEARINGS

The Account of an Angular Flexibility of Supports of a Cranked Shaft in Designing of the Bearings of Modern Internal Combustion Engines	69
<i>J. V. Rozhdestvenskiy, N. A. Khozeniuk, A. A. Mylnikov, I. G. Levanov</i>	
Functional Testing of PVD Coatings on Wave Bearings for Heavy Loading Applications	72
<i>Florin Dimofte, Nicoleta M. Ene</i>	
Influence of Geometric Irregularities of Journal on the Performance of Capillary Compensated Multirecess Hydrostatic Journal Bearing	75
<i>Satish C. Sharma, Arvind K. Rajput</i>	
Application of Parallel Particle Swarm Optimization Method to the Air Foil Bearing Design.....	79
<i>Nenzi Wang, Chi-Rou Hsu, Hua-Chih Huang</i>	
Measured Displacement Coefficients of an Adjustable Hydrodynamic Rotor Journal Bearing.....	82
<i>James Keith Martin, David Walter Parkins</i>	
Experimental Force Coefficients for an Open Ends Squeeze Film Damper Performing Large Amplitude Circular Orbital Motions, Centered and Off-Centered.....	88
<i>Luis San Andrés, Sung-Hwa Jeung, Gary Bradley</i>	
A Three Dimensional Investigation of the Thermo-Elastic Effects on the Characteristics of a Hydrodynamic Bearing Using Two-Way Fluid-Solid Interactions	92
<i>Craig A. Laukiavich, Minel J. Braun, Abhilash J. Chandy</i>	
The Research of Non-Newtonian Properties and Rheology of Thin Lubricant Layers in Hydrodynamic Journal Bearings	95
<i>E. Zadorozhnaya</i>	
Experimental Investigation of Hydrodynamic and Thermal Effects on a Flat-Land Thrust Bearing	98
<i>Y. Henry, J. Bouyer, M. Fillon</i>	
THL Analysis of Rolling Piston and Journal Bearings in Rotary Compressors.....	101
<i>Jintai Mi, Yonggang Meng</i>	
Influence of Wear on the Performance of Four-Pocket/Six-Pocket Conical Journal Bearing System Compensated with Constant Flow Valve Restrictor	104
<i>Vikas M. Phalle, Satish C. Sharma</i>	
Mathematical Model for Variation of Viscosity with Temperature and Concentration of Nanoparticles in the Lubricant and It's Application to a Fluid Film Bearing.....	108
<i>K. Prabhakaran Nair, Rajendra Kumar, K. Sreedhar Babu</i>	
Static and Dynamic Analysis of Hydrodynamic Journal Bearing Operating Under Nano Lubricants.....	112
<i>K. K. Saju, Prabhakaran Nair, Mohammed Shabbir Ahmedtani</i>	
Promoted Wedge Action by Textured Surface.....	115
<i>Kazuyuki Yagi, Joichi Sugimura</i>	
Effect of Cooling Air Flow Rate on Rotordynamic Performance of an Oil-Free Power Turbine Rotor Supported on Gas Foil Bearings for 7.5 kW Micro Gas Turbines.....	118
<i>Kyuho Sim, Bonjin Koo, Gunhee Jang, Yong-Bok Lee, Tae Ho Kim</i>	

GEARS

Modeling and Analysis of the Meshing Losses of Involute Spur Gears in High-Speed and High-Load Conditions	121
<i>L. Chang, Yeau-Ren Jeng, Pay-Yau Huang</i>	
Grease Lubrication – Wear Behavior of Gears Lubricated With NLGI 00 Greases at Low Speeds.....	124
<i>Hansjoerg Schultheiss, Thomas Tobie, Klaus Michaelis, Karsten Stahl</i>	
Transient Elastohydrodynamic Analysis of Helical Gear Tooth Contacts	128
<i>R. W. Snidle, H. U. Jamali, K. J. Sharif, H. P. Evans</i>	
Rolling Contact Fatigue: Experimental Study of the Influence of Sliding, Load and Material Properties on the Resistance to Micro-pitting of Steel Discs.....	131
<i>P. Rabaso, T. Gauthier, M. Diaby, F. Ville</i>	

GREASE

A Study of the Tribological Benefits Offered by Various Surface Features and Roughness Conditions within Grease-Lubricated Interfaces	134
<i>Yutaka Imai, Richard S. Sayles, Amir Kadiric</i>	

LUBRICATION FUNDAMENTALS

Effect of Temperature on Tribological Performances of WDLC Coatings in Model Oils.....	141
<i>Liuquan Yang, Anne Neville, Alisdair Brown, Paul Ransom, Ardian Morina</i>	
Response of Naphthenic Oils to Viscosity Index Improvers.....	144
<i>Luis Bastardo-Zambrano, Linda Malm</i>	
Multimolecular Adsorption Lubricants And Its Integration In The Theory Fluid Friction	147
<i>I. V. Mukhortov, E. A. Zadorozhnaya, I. G. Levanov</i>	
Ionic Liquids: High Performance Additives for Lubricants	150
<i>F. M. Stiemke, T. J. Schubert, M. Ahrens, H. Sahin</i>	
Thermoelectric Measurements of Fe-Constantan Sliding Asperity Contact Flash Temperatures	154
<i>R. A. Erck, O. O. Ajayi, G. R. Fenske</i>	
3D FEM Simulation of Line Contact EHL Problems	157
<i>Lichun Hao, Yonggang Meng, Cheng Chen</i>	
Investigation of Negative Effects of Polymer Films on Cooling	160
<i>Akira Sasaki, Kenji Matsumoto</i>	
Non-Newtonian Thermal Elastohydrodynamic Lubrication Analysis of Perfluoropolyether Fluids with High Density	169
<i>Toshifumi Mawatari, Nobuyoshi Ohno, Motohiro Kaneta, Petr Šperka, Ivan Krupka, Martin Hartl</i>	
Lubrication Regime Transition Analysis Based on non-Newtonian Thermal Elastohydrodynamic Lubrication under Elliptical Contact: Traction and Film Thickness Behavior	172
<i>Toshifumi Mawatari, Bo Zhang, Akira Nakajima, Nobuyoshi Ohno, Motohiro Kaneta</i>	
Nanodiamond-based Nanolubricants: Investigation of Friction Surfaces	175
<i>O. Shenderova, M. G. Ivanov, Z. Mahbooba, S. Turner, D. M. Ivanov, G. McGuire</i>	
Clarification of Friction and Wear Reduction Mechanism by Various Additives for DLC Coatings	177
<i>Tomomi Honda, Yusuke Shima, Takahiro Miyao, Yoshiro Iwai, Moritsugu Kasai</i>	
Rapid Prediction of Roughness Effects in Sliding EHL Contacts.....	180
<i>Sperka Petr, Krupka Ivan, Hartl Martin</i>	
An Elastic Potential based Soft-EHL Model for Slurry Fluid Pressure Prediction during CMP	183
<i>J. A. Sierra Suarez, G. Srivastava, C. F. Higgs III</i>	
A Wafer-Scale Particle Augmented Mixed Lubrication Modeling Approach for Chemical Mechanical Polishing	186
<i>Gagan Srivastava, C. Fred Higgs III</i>	
A Contrasting Lubrication Property of Imidazolium-Based Ionic Liquids Under High Vacuum Affected by the Nature of the Surface	190
<i>Masabumi Masuko, Takahiro Terawaki, Kenji Kobayashi, Akihito Suzuki, Yukitoshi Fujinami, Takashi Nogi, Shingo Obara</i>	
Polymer Process Engineering for the Lubricant Additives Industry	193
<i>Michael Covitch, G. Chris Meldrum, Barton J. Schober, David Price</i>	

MATERIALS TRIBOLOGY

Nano-Mechanical and Chemical Characterization of Tribofilms Formed under Conformal Contact Conditions	197
<i>Kartik S. Pondicherry, Thomas Schöberl, Florian Grün, István Gódor, Emmanuel Lainé, Martin Offenbecher</i>	
Fluorinated Carbon Blacks as New Nano-Additives for Lubricating Oils and Greases.....	200
<i>P. Thomas, J. L. Mansot, A. Molza, F. Begarin, M. Dubois, K. Guerin, A. Hamwi</i>	
Tribological Profile of Binderless Niobium Carbide.....	203
<i>Mathias Woydt</i>	

METALWORKING

The Application of Water Soluble Polymers in Rust Preventives.....	207
<i>Kook-Wha Koh, Kwang K. Koh</i>	
Amine/Biocide Impact on MWF Performance Longevity: An Accelerated Laboratory Evaluation.....	210
<i>Patrick E. Brutto, Bonnie A. Pyzowski, Arthur T. Jones</i>	
Long Life Emulsion Metalworking Fluids Formulated with an “HLB” Optimized N-alkylalkanolamine.....	213
<i>Michael D. Gernon, Guy Verdino, Kurt Buyse, Robin Matton</i>	
Evaluation of ZnO Metalworking Nanofluids (MWnFTM).....	216
<i>Faraz Niyaghi, Karl R. Haapala, Stacey L. Harper, Michael C. Weismiller</i>	

NANOTRIBOLOGY

The Effects of Nanomagnetorheological Fluids On the Rotor Bearing System Dynamic Behavior.....	220
<i>Dimitrios A. Bompos, Pantelis G. Nikolakopoulos, Chris A. Papadopoulos</i>	
Studies on Two Dimensional Nanoscale Reciprocating Sliding Contacts of Textured Surfaces	223
<i>Ruiting Tong, Geng Liu, Tianxiang Liu</i>	
Ionic Liquid-mediated Dispersions of Nanomaterials for High Performance Lubricants.....	226
<i>Frank Stiemke, Thomas J. S. Schubert, Hülya Sahin</i>	
Achieving Ultra-low Friction in Commercial Oils by Serpentine Modification of Sliding Surfaces.....	229
<i>Qiuying Chang, Pavlo Rudenko, Youbo Si, Ali Erdemir</i>	
Nano Tribological Properties of Tribofilms Obtained from Microparticles of Graphite	233
<i>G. Minatchy, L. Romana, P. Bilas, N. Nomède Marthy, P. Thomas, Y. Bercion, J. L. Mansot</i>	
Experimental Characterization of Friction and Wear Graphene Monolayers.....	236
<i>Emil Sandoz-Rosado, Ottman Tertuliano, Elon J. Terrell</i>	

NONFERROUS METALS

Electric Charge and Evaporation Control in Ester Oils.....	239
<i>T. E. Karis</i>	
Tribological Properties of Polymer Brushes from Bio-based Monomers	242
<i>Yuji Higaki, Ryosuke Okazaki, Motoyasu Kobayashi, Atsushi Takahara</i>	
Non-Ferrous Hot Rolling Lubrication: The Next Generation.....	244
<i>Robert L. Blithe</i>	
Lubrication Properties of New Crop Oils.....	249
<i>Steven C. Cermak, Girma Biresaw, Terry A. Isbell, Rogue L. Evangelista, Steven F. Vaughn, Rex Murray</i>	

POWER GENERATION

Evaluations of Non-Aqueous Fire Resistant Hydraulic fluids Using the Hot Manifold Ignition Test	253
<i>N/A</i>	
In Situ Monitoring of Wear Particles and Water in Power Generation Lubricants.....	254
<i>N/A</i>	

PRACTICAL LUBRICATION PRACTICES

Deposition on Bearing Pads by Insoluble Particulates in Turbine Oils	256
<i>Fumihiko Yokoyama, Yuka Iwama, Masahiro Maruyama, Mitsuo Sano</i>	

ROLLING ELEMENT BEARINGS

Dynamic Simulation of Touchdown Bearings for Magnetic Spindles	259
<i>Lars-Erik Stacke, Jens Anders, Peter Leslie</i>	
Accuracy in Tapered Roller Bearing Equilibrium.....	262
<i>Bruno Mevel</i>	

Experimental Investigations on the Coefficient of Restitution of Prestressed and Non-Prestressed NITINOL 60.....	265
<i>Martin C. Marinack Jr., Benjamin Cosio, Christopher Dellacorte, C. Fred Higgs III</i>	
Rolling Contact Fatigue in Rolling Element Bearings for Wind Turbine: A Focus on White Etching Cracks.....	268
<i>A. Ruellan, F. Ville, X. Kleber, A. Arnaudon, B. Liatard</i>	
Numerical Investigations on Drag Coefficient of Balls in Rolling Element Bearings	271
<i>Yann Marchesse, Christophe Changenet, Fabrice Ville, Philippe Velex</i>	
Comparison of Models for Rolling Bearing Dynamic Capacity and Life	275
<i>Pradeep K. Gupta, Fred Oswald, Erwin V. Zaretsky</i>	
Sensor Integration for the Condition Monitoring of Wind Turbines.....	284
<i>Eneko Gorritxategia, Patxi Etxaniz, Jesús Terradillos</i>	
Investigations on Power Losses and Thermal Behaviour of Rolling Element Bearings: Transient Aspects	287
<i>François Pouly, Christophe Changenet, Fabrice Ville, Philippe Velex, Bruno Damiens</i>	
Analysis of Rolling Contact Fatigue Using Modeling with Granular Representation with Cohesive Elements	290
<i>J. P. Noyel, A. Quillery, P. Rabaso, F. Ville, P. Jacquet</i>	
A Computational Efficient Finite-Element Bearing Model.....	293
<i>Adrijan P. Ribaric</i>	
Influence of Rolling Elements Distance on Starvation.....	296
<i>David Kostal, Petr Sperka, Petr Svoboda, Ivan Krupka, Martin Hartl</i>	

SEALS

Fast Lead Analysis Method for Shaft Counter Surfaces of Radial Lip Seals	299
<i>M. Baumann, E. Novak, F. Bauer, W. Haas</i>	
The Influence of Seals on High Pressure Centrifugal Compressors.....	302
<i>Gordon Kirk</i>	
The Problem is Solved - Bidirectional PTFE Lip Seals	305
<i>J. Götz, F. Bauer, W. Haas</i>	
Prediction of Radial and Axial Acting Seals Followability Under Extreme Operating Conditions.....	308
<i>Michel Organisciak, Rossana Iervolino, Mickael Sansalone, Stellario Barbera, Piet Lugt, Alex X. Paykin</i>	
Test Apparatus to Identify Rotordynamic Coefficients and Leakage Flow of a Flexible Floating Ring Seal with a Metal Mesh Damper.....	311
<i>Maryna Ienina, Bonjin Koo, Slidenko Viktor, Changho Kim</i>	
Leakage for an All-Metal Compliant Gas Seal Operating at High Temperature	315
<i>Luis San Andrés, Alain Anderson</i>	

SURFACE ENGINEERING

Effect of Air Plasma Spraying Distance on WC-12%Co Cermet Coating Using SS-321 Substrate	318
<i>M. Afzal, M. Ajmal, A. Nusair Khan</i>	
Influence of Surface Roughness of Steel Belt on Friction Behavior on a Polymer/Steel Contact	321
<i>Yan-Ming Chen, David Caze</i>	
Improvement in the Tribological Characteristics of Si-DLC Coating by Laser Surface Texturing at Elevated Temperatures	324
<i>A. Amanov, R. Tsuboi, S. Sasaki</i>	
Tribological Behavior of Silica or/and Alumina Coatings on Stainless Steel.....	327
<i>A. Marsal, F. Ansart, V. Turq, J. P. Bonino, J. M. Sobrino, Y. M. Chen, J. Garcia</i>	
Tribological Behavior of Ni-P Deposits on Dry Condition	330
<i>Yanhui Cheng, Hengyang Chen</i>	
Extending the Classical Hertz Solution by an Equivalent Young's Modulus for a Coated Spherical Contact	335
<i>R. Gotsberg, I. Etsiona</i>	
Wear Prediction of Mild Steel Coated with INCONEL718 using Adaptive Neuro-Fuzzy Inference System.....	337
<i>C. S. Ramesh, R. Suresh Kumar, Madhav Murthy, T. H. Manjunatha</i>	
Surface Modification of Carbon Fibre Rods	341
<i>C. S. Ramesh, H. Adarsha, Ashutosh Gupta, Lokesh Swami</i>	

Wire Spraying of Aluminium on Ni-P Coated GFRP Panels.....	344
<i>C. S. Ramesh, Prajval G. Dsilva, L. Rahul Trinadh, Zulfiqar Khan</i>	
Experimental Study on the Effect of Thermal Barrier Coating on the Combustion Chamber Surfaces of Diesel/Biodiesel Fuelled C I Engine Performance.....	347
<i>T. B. Prasad, C. S. Ramesh, Zulfiqar Khan</i>	

SYNTHETIC AND HYDRAULIC LUBRICANTS

Extended Pump Shearing of Hydraulic Fluids.....	351
<i>Bart Schober, Hongmei Zhao, Steve Bealko</i>	
Comparing Field Testing Shear to Laboratory Shear Testing for Hydraulic Fluids.....	354
<i>Bart Schober, Elizabeth Schiferl, Christina Oliveto</i>	

TRIBOTESTING

Fast Lead Analysis Method for Shaft Counter Surfaces of Radial Lip Seals	299
<i>M. Baumann, E. Novak, F. Bauer, W. Haas</i>	
Stick-Slip Leads to Considerable Error in Measuring Friction Coefficient	356
<i>Nakano Ken, Tadokoro Chiharu, Kado Naohiro</i>	
The Traction Behavior of Desert Gold Grease under Heavy Loads, Low Speeds and Various Temperatures.....	359
<i>Boyan Yang, Diann Hua, Bing Su, Xiafan Yan</i>	
Rheology for Tribology: Additional Informations and Synergies	364
<i>Frederik Wolf</i>	

WEAR

New Adhesive Wear Law of Micromechanical Surface Contact	367
<i>Biswajit Bera</i>	
Modelling the Variation of Friction in a Self-Lubricating Composite Bearing Due to Wear.....	370
<i>R. Gay, H. P. Evans, R. W. Snidle, A. T. Bell</i>	
Journal Bearings Wear Correction using Magnetorheological Fluids.....	373
<i>Pantelis G. Nikolopoulos, Dimitrios A. Bompas</i>	
Experimental Analysis and Wear Modeling for Mechanical Components of a Typical Rail Launcher.....	376
<i>Emre Aćmaz, Bülent Acar, Metin Akkök</i>	
An Experimental Approach to the Study of Rail Wheel/Flange Lubrication.....	379
<i>Omasta Milan, Josef Fryza, Ivan Krupka, Martin Hartl</i>	
"Kicking Up Some Dust" - An Experimental Investigation Relating Lunar Dust Erosive Wear to Solar Power Loss	382
<i>Jeremiah N. Mpagazehe, Kenneth W. Street Jr., Irebert R. Delgado, C. Fred Higgs III</i>	

WIND TURBINE TRIBOLOGY

Investigations of Bearing Failures Associated with White Etching Areas (WEAs) in Wind Turbine Gearboxes.....	385
<i>Robert Errichello, Robert Budny, Rainer Eckert</i>	
Investigation and Characterization of Micropitting Damage in Bearing Steels.....	388
<i>P. J. Blau, Y. Yamamoto, K. M. Cooley, K. S. Reeves</i>	
Serial Sectioning, FIB and TEM Investigations of Butterfly and White Etching Crack (WEC) Formation.....	391
<i>M.-H. Evans, L. Wang, R. J. K. Wood</i>	
Sensor Integration for the Condition Monitoring of Wind Turbines	284
<i>Eneko Gorritxategi, Patxi Etxaniz, Jesús Terradillos</i>	

ADDITIONAL PAPER

Reducing Friction of Heavy Duty Hydrodynamic Pod-Drive Bearing by Means of Lubrication Control and AE Condition Monitoring.....	394
<i>H. T. Nguyen, S. Gold, J. Weber, A. Albers</i>	
Author Index	