Higher Performing Greases, Higher Performing Machines

High-performance specialty components and grease additive packages address a variety of performance needs. From reducing bearing temperature to increasing machine efficiency, specialty components provide the long-lasting lubrication needed for improved bearing life.

For more information, visit http://go.lubrizol.com/grease.

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Thank you for joining NLGI’s Virtual Technical Week 2020. Although it’s unfortunate we couldn’t all be together in Miami this year, NLGI leadership is confident you’ll receive a great deal of value in this week’s virtual event. This event will provide the chance to learn more about grease and the grease industry and get up to date on the latest technological developments in our industry.

The week begins with our renowned education courses - Basic Education Course and Advanced Education Course. Both courses include various industry information ranging from base oils, additives, applications and troubleshooting to thickeners base fluids, raw materials and testing. These courses will occur simultaneously from approx. 10:00 a.m. - 4:00 a.m. Monday and Tuesday.

On Wednesday, we invite all registered attendees to join us for the institute’s kickoff, followed by industry speaker Dr. Christopher DellaCorte, Senior Technologist: Tribology & Rotating Machinery at NASA, Glenn Research Center. Following Dr. Dellacorte’s presentation will include the first half of our twelve technical presentations. The remaining technical presentations will occur on Thursday. Topics include:

• 2019 Grease Production Survey
• A Fresh Look at Lithium Complex Greases Part 1: How Did We Get Here?
• A Fresh Look at Lithium Complex Greases Part 2: One Possible Path Forward
• A Fundamental Examination of Grease Thickener Self-Assembly
• Getting a Jump on it! The Correlation Between ASTM 7718 & 7918 Grease Analysis and Bearing Failure
• Challenges and Different Methodology in Tribological Testing of Greases
• Less Could Be More – Leveraging Technology to Produce Cost-Effective High-Performance Greases
• Oscillating Wear – A Little Back and Forth
• Back to the Basics Part II: Fundamental Building Blocks of Grease Formulation – The Next Story
• The Mechanical Stability of Polymer-Modified Grease
• Past, President and Future Outlook
• An In-Depth Study of the Structural Stability & Tribological Performance of Polyurea Grease

On Friday, join us for an awards ceremony highlighting our 2020 award recipients, followed by a live panel discussion on NLGI’s new High-Performance Multiuse (HPM) grease specification. The panel discussion will focus on:
1. Intro/History of the Specification
2. Specification Details/Philosophy
3. Trademark/Licensing/Timeline for Launch
4. Q&A

For more details this event, please download the Whova app or visit NLGI’s website: https://www.nlgi.org/news-events/nlgi-technical-week/

Finally, I would like to thank all of our generous sponsors this year. Your continued support is very much appreciated. We couldn’t do this without you.

Jim Hunt
NLGI President
THE VISION OF NLGI

As the global leader in the lubricating grease industry, NLGI promotes usage and ensures confidence in grease solutions to consumers, researchers, manufacturers, suppliers, marketers, academia and other key stakeholders.

OUR MISSION STATEMENT

It is the mission of NLGI to provide value-added resources relevant to the needs of the global grease community.

ANTI-TRUST STATEMENT

As participants in this meeting, we must refrain from activities prohibited by existing antitrust laws. Discussions of agreements that may restrain competition, the exchange of information concerning prices, rates, coverages, market practices, claim settlement practices, or any other competitive aspect of a company’s operation are strictly prohibited.

NLGI
118 N Conistor Lane | Suite B-281 | Liberty, MO 64068
Phone: 816-524-2500
Email: nlgi@nlgi.org • Web page: www.nlgi.org
Space: A Surprisingly Greasy Environment
Space is often defined by what is lacking. No air, no water, no heat, no noise. The vacuum of space is the epitome of nothing. Yet, from this tribologist’s point of view, space is full of grease. In fact, grease has become an essential element that enables numerous space missions that open new frontiers in our understanding of the universe. Grease also plays a critical role in ensuring that vital systems ranging from telecommunications satellites to navigation systems operate flawlessly and efficiently. History, however, has shown that space can be unforgiving and that each space bearing or mechanism has unique lubrication needs. In this keynote presentation, the requirements for space lubricants and the proper selection of a wide range of space greases will be reviewed. A common theme is that space is a rather greasy place.

Biography
Dr. Christopher DellaCorte is NASA’s Senior Technologist for Tribology (friction, wear and lubrication) and Rotating Machinery. He began his NASA career in 1985 as a graduate student of Case Western Reserve University and joined NASA as a permanent staff member in 1987. He has degrees in Fluid and Thermal Sciences, Mechanical and Aerospace Engineering with a deep emphasis in Materials Engineering.

Dr. DellaCorte has played key roles in many failure investigations including several on the International Space Station (ISS), Mars Curiosity Rover and NASA’s new Orion spacecraft. His earlier work on solid lubricant technology was recently recognized as NASA’s Government and Commercial Invention of the Year. He began exploring NiTi alloys for bearings, gears and mechanical components in 2004.

Dr. DellaCorte is the Editor-In-Chief of the journal Tribology Transactions and is a fellow of both the American Society of Mechanical Engineers (ASME) and the Society of Tribologists and Lubrication Engineers (STLE). In addition to nine awarded patents on tribology technologies, Dr. DellaCorte has published well over 100 peer-reviewed papers and journal articles and has been recognized with prestigious national and international level awards.
MONDAY, August 24, 2020
10:00 a.m. - 4:15 p.m. EDT Basic Education Course
9:45 a.m. - 3:30 p.m. EDT Advanced Education Course

TUESDAY, August 25, 2020
10:00 a.m. - 4:00 p.m. EDT Basic Education Course
9:45 a.m. - 4:30 p.m. EDT Advanced Education Course

WEDNESDAY, August 26, 2020
10:00 a.m. - 10:30 a.m. EDT Kickoff
10:30 a.m. - 11:30 a.m. EDT Industry Speaker Presentation
11:30 a.m. - 12:15 p.m. EDT 2019 Grease Production Survey Presentation
12:15 p.m. - 1:00 p.m. EDT Lunch Break
1:00 p.m. - 4:00 p.m. EDT Technical Presentations – Day 1

THURSDAY, August 27, 2020
10:15 a.m. - 12:30 p.m. EDT Technical Presentations – Day 2
12:30 p.m. - 1:00 p.m. EDT Lunch Break
1:00 p.m. - 4:00 p.m. EDT Technical Presentations – Day 2

FRIDAY, August 28, 2020
9:30 a.m. - 10:00 a.m. EDT Awards Ceremony Highlighting 2020 Award Recipients
10:00 a.m. - 11:30 a.m. EDT Live Panel Discussion on NLGI’s High-Performance Multiuse (HPM) Grease Specification
NLGI has promoted technical training for the grease industry for many years through its Grease Education Program. Course contents cover a broad spectrum of subjects and are designed to familiarize the student with all aspects of the grease industry, including manufacturing, chemistry, application, product characteristics and marketing. Course instructors are experienced specialists in their respective topics of discussion and course participants are supplied with an extensive study manual for later reference.

Courses offered at this year’s NLGI Annual Meeting are subject to an extra fee and pre-registration. Maximum capacity for the Basic Course is 42 participants and 51 participants for the Advanced Course. Basic and Advanced Courses are conducted concurrently for one and one-half days, from 10:00 am – 5:00 pm Monday, June 10, and 8:00 am - 12:30 pm Tuesday, June 11. It is not possible to attend both. Lunch for students and instructors is provided on Monday and Tuesday.

Basic Grease Education Course
With more than 1200 alumni, NLGI’s Basic Grease Education Course is the world’s foremost foundational training class for the global grease industry. This course provides an excellent overview of the types of greases, thickeners, base oils and additives. The methods of manufacturing, testing methodology and their use in bearings and in industrial and automotive applications are also covered. Topics include the following:

- Introduction to Greases
- Base Oils
- Additives
- Grease Testing
- Grease Manufacturing
- Grease Packages and Dispensing
- Grease Selection and Recommendations
- Automotive Applications
- Industrial Applications
- Trouble Shooting

Advanced Grease Education Course
This course provides advanced instruction regarding specific types of greases, grease chemistry and specialized applications. There is an increased focus on high-value specialty greases and their manufacture and use. Topics include the following:

- Advanced Thickeners
  - Polyurea
  - Calcium Sulfonate
  - Aluminum Complex
  - Lithium Complex
  - Summary
- Synthetic Base Fluids
- Specialized Raw Materials
  - Polymers
  - Solid Additives
- Applications
  - Advanced Grease Lubrication
  - Tribology
- Testing
- Incidental Food Contact Greases
## TECHNICAL PRESENTATION SCHEDULE

### Technical Session - Day 1  WEDNESDAY, August 26, 2020

<table>
<thead>
<tr>
<th>Timeslot</th>
<th>Paper Number</th>
<th>Presentation Title</th>
<th>Author</th>
</tr>
</thead>
<tbody>
<tr>
<td>11:30 a.m. - 12:10 p.m. EDT</td>
<td></td>
<td>2019 Grease Production Survey</td>
<td>Chuck Coe</td>
</tr>
<tr>
<td>1:00 p.m. - 1:40 p.m. EDT</td>
<td>2020-01</td>
<td>A Fresh Look at Lithium Complex Greases Part 1: How Did We Get Here?</td>
<td>Andy Waynick</td>
</tr>
<tr>
<td>1:45 p.m. - 2:25 p.m. EDT</td>
<td>2020-02</td>
<td>A Fresh Look at Lithium Complex Greases Part 2: One Possible Path Forward</td>
<td>Andy Waynick</td>
</tr>
<tr>
<td>2:30 p.m. - 3:10 p.m. EDT</td>
<td>2020-03</td>
<td>A Fundamental Examination of Grease Thickener Self-Assembly</td>
<td>Paul Shiller</td>
</tr>
<tr>
<td>3:15 p.m. - 3:55 p.m. EDT</td>
<td>2020-04</td>
<td>Getting a Jump on it! The Correlation Between ASTM 7718 &amp; 7918 Grease Analysis and Bearing Failure</td>
<td>Richard Wurzbach</td>
</tr>
</tbody>
</table>

### Technical Session - Day 2  THURSDAY, August 27, 2020

<table>
<thead>
<tr>
<th>Timeslot</th>
<th>Paper Number</th>
<th>Presentation Title</th>
<th>Author</th>
</tr>
</thead>
<tbody>
<tr>
<td>10:15 a.m. - 10:55 a.m. EDT</td>
<td>2020-05</td>
<td>Challenges and Different Methodology in Tribological Testing of Greases</td>
<td>Ameneh Schneider</td>
</tr>
<tr>
<td>11:00 a.m. - 11:40 a.m. EDT</td>
<td>2020-12</td>
<td>Less Could Be More – Leveraging Technology to Produce Cost-Effective High-Performance Greases</td>
<td>George Diloyan</td>
</tr>
<tr>
<td>11:45 a.m. - 12:25 p.m. EDT</td>
<td>2020-07</td>
<td>Oscillating Wear – A Little Back and Forth</td>
<td>Rajeev Kumar</td>
</tr>
<tr>
<td>1:00 p.m. - 1:40 p.m. EDT</td>
<td>2020-08</td>
<td>Back to the Basics Part II: Fundamental Building Blocks of Grease Formulation – The Next Story</td>
<td>Joseph Kaperick</td>
</tr>
<tr>
<td>1:40 p.m. - 2:25 p.m. EDT</td>
<td>2020-09</td>
<td>The Mechanical Stability of Polymer-Modified Grease</td>
<td>Erik Willett</td>
</tr>
<tr>
<td>2:30 p.m. - 3:10 p.m. EDT</td>
<td>2020-10</td>
<td>Past, Present and Future Outlook</td>
<td>Alan Gurt</td>
</tr>
<tr>
<td>3:15 p.m. - 3:55 p.m. EDT</td>
<td>2020-11</td>
<td>An In-Depth Study of the Structural Stability &amp; Tribological Performance of Polyurea Grease</td>
<td>Liwen Wei</td>
</tr>
</tbody>
</table>
2019 NLGI Grease Production Survey

The NLGI Grease Production Survey continues to be the single most comprehensive global report on lubricating grease production. It tabulates the global production of grease providing a snapshot of growth by thickener type and base oil type, organized by geographic region of the world. This paper will provide a summary overview of the key results and trends from the completed 2019 production survey, which will be published in July 2020.

Chuck Coe,
President Grease Technology Solutions, LLC and past President of NLGI

Chuck holds a BS Chemical Engineering from the Pennsylvania State University, along with NLGI CLGS and STLE CLS professional certifications. He worked for Mobil and ExxonMobil for over 32 years, including 6 years as ExxonMobil’s Global Grease Technology Manager and many years as an industrial oil and grease formulator and technical advisor. He retired from ExxonMobil and launched Grease Technology Solutions LLC, a grease training and consulting business in 2009. He is a past president of NLGI, currently on the Board of Directors, and is the Grease Education Course Chair of STLE. He has authored a number of technical papers and articles on grease, and received Best Marketing Paper and Best Paper awards from both NLGI (2008) and ELGI (2009), and both the John A. Bellanti Memorial Meritorious Service Award (2012) and the NLGI Fellows Award (2015) from NLGI, along with the NLGI Award for Educational Excellence (2019).
A Fresh Look at Lithium Complex Greases Part 1: How Did We Get Here?

In 1942, five U.S. Patents were issued with Clarence E. Earle as named inventor. These five patents defined simple lithium soap greases for subsequent decades. However, these greases were limited in their high temperature utility owing, at least in part, to their dropping points – typically about 200 C. In August, 1959, only months after the Earle patents expired, the first lithium complex grease patent issued. Stearic acid was used as the long chain fatty acid. An alkyl diester of sebacic acid was also used. Reaction with lithium hydroxide monohydrate with a small amount of added water accomplished the thickener formation. Reported dropping points were between 248 C and 276 C or higher when mineral oil was used as the base oil.

Since that 1959 patent, many modifications and advances in lithium complex grease formulation and manufacturing have been documented. All such work can be placed into one or more of only three categories: formulation change, process change, or manufacturing equipment change. Interestingly, no organized and critical review of the decades of development of lithium complex greases can be found in the published literature. This paper provides such a review. By doing so, explanations of certain physical and chemical behavior never fully documented are brought into full focus. This, in turn, allows those involved in the formulation and manufacture of lithium complex greases to gain an improved perspective on potential future paths to improve the cost-effectiveness of these greases. Given the recent sharp rise in lithium prices, such an improved perspective is more relevant now than ever before.

Andy Waynick received his B.A. in Chemistry in 1974 from Central Methodist College, and his M.S. in Physical Chemistry in 1977 from Purdue University. For the 43 years since that time, Andy has been a professional research chemist. For more than 39 of those years he has been involved in fluid lubricants, greases, fuels, and fuel additives. Andy’s work includes 17 years at Amoco Oil Company and more than 7 years as a senior research scientist at Southwest Research Institute. His primary areas of responsibility have been and continue to be technology and product development and technical problem solving. Andy has developed commercially successful lubricating greases for automotive CV joints, automotive U-joints, sealed-for-life automotive wheel bearings, and rail track/wheel flange grease. Andy developed the first documented commercially successful polyurea thickened grease for steel mill continuous caster bearings. Under contract with the U.S. military, Andy developed a lithium-based grease for the engine thrust bearings used in strategic cruise missiles that resulted in a new MIL specification written specifically for it. Sponsored by and in cooperation with South Dakota School of Mines and Technology, Andy co-developed the first lubricating greases thickened in part or entirely by carbon nanotubes. At the invitation of the editor of ACS peer-reviewed journal “Energy and Fuels”, Andy submitted and had published the only review article ever written on the development and use of metal deactivating additives in the petroleum industry. Andy has 40 U.S. Patents and more than 34 published research papers. Andy has received the Clarence E. Earle Memorial Award, the NLGI Fellows Award, and the NLGI Author Award for Application.
A Fresh Look at Lithium Complex Greases Part 2: One Possible Path Forward

The recent sharp rise in lithium prices has put pressure on the lubricating grease industry to find more cost-effective alternatives to the currently manufactured lithium-based greases. Three such alternatives appear possible: (1) use greases with other thickener chemistries that provide similar or improved performance at lower cost; (2) develop new finished lithium-based grease formulations with much higher performance properties, thereby reducing customer grease usage rates and associated cost; (3) develop new lithium-based grease thickener chemistry that will significantly decrease the required amount of lithium (and resulting cost) without reducing the performance. This paper provides new technology that falls into the third of these three alternatives.

The new technology involves the addition of a very small amount of overbased calcium sulfonate, overbased magnesium sulfonate, or both to the initial base oil before adding the thickener acids. Water and lithium hydroxide monohydrate are also added before the thickener acids. When properly used, this approach allows both thickener acids (long chain monocarboxylic acid and shorter chain dicarboxylic acid) to be added at essentially the same time with only one heating and cooling cycle. Additionally, the ratio of long chain monocarboxylic acid to shorter chain dicarboxylic acid can be increased to as much as 5.8. This is in contrast to prior art technologies where that ratio was between 1.0 and 3.2. The much higher value of this ratio results in a significantly lower required amount of lithium hydroxide monohydrate to achieve the same consistency final grease. Also, since the cost of the shorter chain dicarboxylic acid is typically 4 to 5 times the cost of the long chain monocarboxylic acid, further cost reductions result.

When using this new technology, the chemical reaction between the lithium hydroxide and the two thickener acids occurs almost instantaneously, in contrast to typical prior art technologies where the reaction requires much more time. Greases made using this approach will have dropping points typically between 299°C and 328°C. Closed and pressurized reaction kettles or contactors are not required; open reaction kettles can be used to achieve these results. When properly formulated, high performance lithium complex greases with significant cost reductions are possible. This paper documents the development of this new technology and provides some insight into why it works the way it does.

Andy Waynick received his B.A. in Chemistry in 1974 from Central Methodist College, and his M.S. in Physical Chemistry in 1977 from Purdue University. For the 43 years since that time, Andy has been a professional research chemist. For more than 39 of those years he has been involved in fluid lubricants, greases, fuels, and fuel additives. Andy’s work includes 17 years at Amoco Oil Company and more than 7 years as a senior research scientist at Southwest Research Institute. His primary areas of responsibility have been and continue to be technology and product development and technical problem solving. Andy has developed commercially successful lubricating greases for automotive CV joints, automotive U-joints, sealed-for-life automotive wheel bearings, and rail track/wheel flange grease. Andy developed the first documented commercially successful polyurea thickened grease for steel mill continuous caster bearings. Under contract with the U.S. military, Andy developed a lithium-based grease for the engine thrust bearings used in strategic cruise missiles that resulted in a new MIL specification written specifically for it. Sponsored by and in cooperation with South Dakota School of Mines and Technology, Andy co-developed the first lubricating greases thickened in part or entirely by carbon nanotubes. At the invitation of the editor of ACS peer-reviewed journal “Energy and Fuels”, Andy submitted and had published the only review article ever written on the development and use of metal deactivating additives in the petroleum industry. Andy has 40 U.S. Patents and more than 34 published research papers. Andy has received the Clarence E. Earle Memorial Award, the NLGI Fellows Award, and the NLGI Author Award for Application.
A fundamental examination of grease thickener self-assembly.

The University of Akron research grant from the NLGI has been completed. The research results from this grant are presented. The results confirm that the critical micelle concentration is 4% lithium hydroxystearate soap thickener in ISO VG 10 base oil. Testing confirms the mixture properties change around this concentration point changing from a simple mixture at 3% to a grease at 5%. Dynamic light scattering puts the particle size at about 1600 nm. Cone on plate rheology shows a yield stress and solid-like properties at 4% concentration indicative of grease formation. Molecular dynamic modeling hints at the fibrous growth of the thickener as opposed to the spherical growth usually associated with micelle formation. This force acts along the length of the soap molecule rather than through the head or tail groups.

Paul Shiller, PhD, AARDCO, LLC; Youngstown, OH

Paul received a Ph.D. degree in Physical Chemistry from Case Western Reserve University in Cleveland, OH developing mechanisms for surface reactions at fuel cell electrodes using molecular orbital theory under the guidance of Dr. A. B. Anderson. He received an M.S. degree in Chemical Engineering also from Case Western Reserve University where he deposited and characterized “Diamond-like films” with his advisor Dr. John C. Angus. From Youngstown State University he received an M.S. degree in Chemistry for a project that used attenuated total reflectance infrared spectroscopy to study surface electrochemical reactions under the direction of Dr. Daryl Mincey. He also received a BE degree in Chemical Engineering from Youngstown State University.

Paul owns AARDCO, LLC a consulting engineer company with clients mainly in the tribology and lubrication areas. Paul, through AARDCO, LLC, works as a freelance digital copywriter in the STEM disciplines writing technical articles, white papers, and case studies. Paul also develops training classes and is working on taking these training classes to an online audience. Paul retired from a research professor appointment at the University of Akron. He moved to the University of Akron as a Research Scientist in an “Open Innovation” collaborative effort between The University of Akron and The Timken Co. in 2011. At The University of Akron he is working in the Timken Engineered Surfaces lab and the Center for Surface Engineering and Lubrication Research. This position is also affiliated with the National Center for education and Research on Corrosion and Material Performance. He is also currently a part time Senior Lecturer in the department of Engineering and Science Technology. In his research position he carries out fundamental studies of lubrication additives and lubrication mechanisms with an emphasis on chemical modeling, rheology, and high-pressure viscosity. Prior to moving to the University of Akron he worked at The Timken Company as a Tribological Specialist within the Tribology and Next Generation Materials group at the Timken Technology Center in North Canton. At Timken he analyzed how the chemistry of lubricants affects bearings especially how additives can be used to extend bearing life. Before coming to Timken he managed a polymer analytical chemistry lab at the Packard Electric division of DELPHI. He started at Packard Electric as a quality control engineer in the ignition cable department when Packard Electric was a division of General Motors. He was a Process Engineer on the thin film deposition processes for liquid crystal display products at PanelVision in Pittsburgh. Paul worked as a Research Engineer at The General Tire Company in Akron developing process controls for polymer extrusion and molding and analyzing the key process variables that affect the performance of tennis balls. Paul has received a Professional Promise Award from AIChE and the Shell Lubricants award for Instructor Excellence from NLGI. Paul is a member of STLE, ACS, SOR, and MENSA.
Getting A Jump on It! The Correlation Between ASTM 7718 & 7918 Grease Analysis and Bearing Failure

ASTM D7718 and ASTM D7918 test methods address grease analysis and is arguably a valuable tool for determining the condition of the lubricant and discovering abnormal conditions in equipment that may otherwise lead to unexpected failures. But just how good is the correlation between the data of early on-set and an eventual failure? This presentation explores the various screening tests (ferrous debris, FTIR, and Colorimetry), the basic tests (metals, die extrusion), and advanced analysis (analytical Ferrography, rheology, RULER, particle count) for grease providing insight into the correlation between these data points and failure opportunities. The information obtained will provide an understanding of bearing reliability entitlement according to various applications and conditions.

Mr. Wurzbach has nearly 30 years of experience in the development of Condition Based Maintenance programs and the applications of diagnostic technologies for industrial equipment. His past experience includes work at the Three Mile Island and Peach Bottom Nuclear Plants and the US National Institutes of Health. He has served on two research teams in Denmark studying lubrication and sampling practices for off-shore wind turbine components. Mr. Wurzbach holds four patents on his designs for lubricant sampling and analysis devices. He authored the Electric Power Research Institute’s (EPRI) report “Effective Grease Practices” and was a co-author of the EPRI Report, “Lube Oil PdM, Handling, and Quality Assurance Guideline”. He has participated on the American Wind Energy Association CBM Committee that has developed Recommended Practice guidelines for Wind Turbine Operations and Maintenance. He has presented and published over 50 scientific papers. He holds a Bachelor’s Degree in Chemistry from Millersville University in Pennsylvania, and is a Machinery Lubrication Engineer (MLE), Machinery Lubricant Analyst (MLA-III), Machine Lubrication Technician (MLT-II), and Laboratory Lubricant Analyst (LLA-II) by ICML.

Challenges and Different Methodology in Tribological Testing of Greases

Lubricating greases can be used in a wide range of applications and conditions as well as gain more importance by e-mobility. Lubricating greases and lubricating oils behave differently in a tribological contact. Complex tribological characteristics of greases have been discussed through the last decades in which the effect of thickeners on tribological performances has been the core of many publications. The aim of this study was to investigate the influence of test parameters and modes on the tribological performances of differently formulated greases. The aim of this study is to investigate the influence of tests parameters on the tribological response of differently formulated greases. Challenges such as transferring the real load collective to the test environment will be discussed. In the presented tribological tests, special emphasis is placed on motion pattern, velocity and temperature. In addition to the coefficient of friction results the wear volume is also taken into consideration. In special cases, tribo-film were subjected to X-ray photoelectron spectroscopy (XPS) analyses. The results provide more insights about formation of the tribo-film and its stability.

Dr. Amenh Schneider
PRESENT AFFILIATION: Area sales manager for Europe & Asia - Lubricant expert at Optimol Instruments Prueftechnil GmbH – Munich/Germany
EDUCATIONAL: PhD. in Technical Chemistry from Technical University of Vienna in organic Chemistry
QUALIFICATIONS/MAJOR: 25 years of experience in Engineering Research and Development - Mainly in the field of Tribology and lubricants
ACHIEVEMENTS / AWARDS: More than 25 publications and one patent in the field of ionic liquid as additive
Less Could Be More – Leveraging Technology to Produce Cost-Effective High-Performance Greases

Today’s highly competitive market demands automotive and heavy-duty industries to increase efficiency, reduce downtime and emission. Core parts of various mechanisms are exposed to extreme conditions: temperature, load and vibration. To meet industry requirements the use of the high-performance additive for lubricant and grease production to protect equipment under extreme conditions, has significant importance. It is well known that in order to fulfill these requirements, beside a suitable thickener type and base fluid, several types of additives are used e.g. extreme pressure, anti-wear, corrosion inhibitor, tackifier, friction modifier, copper passivator etc... However, one of the drawbacks of combining numerous of components is balance. Combination of multiple components in many cases may give antagonistic effect and result in significantly increased cost.

The authors believe that one of the hardest challenges to formulate a high-performance lubricating grease is laying in the simplicity of the formulation which in turns can be linked to both performance and cost efficiency.

The aim of this work was to ease this challenge by minimizing the number of the components needed. Hence only four components were used: Thickener, Base oil, Antioxidant and submicron spherical (IF-WS2) and platelet/lamellar structure. One of the areas of this research was to understand if there is any relationship between the internal resistance of the grease and the availability of the solid particles on the tribological contacts in a rotational movement e.g. ball on disc.

The outcome of the performance study suggests a simpler and subsequently more cost-efficient lubricating grease, this without any compromise in the performance, for use in various industrial applications.

Dr. George Diloyan received his PhD in Mechanical Engineering from Temple University, USA with a focus on nano technology, electrochemistry and material science. He has extensive experience with applications of nano materials to solve hardcore industrial problems. Dr. Diloyan also holds two MS degrees in Computer Science and Thermodynamics.

Mr. Diloyan also has extensive experience in technology commercialization, development and implementation of IP strategy, technology analysis, prior art forensic analysis, drafting and filing of patent applications.
Oscillating Wear – A Little Back and Forth

Rajeev Kumar is a Research Associate in Lubricants Technology at ExxonMobil Research and Engineering. He joined EMRE in 2014. He contributed to various lubricants (oil and grease) product research & development. In 2007 he earned his PhD in organic chemistry at the Indian Institute of Technology, Kanpur, India. He joined University of California Santa Barbara, CA as Post-Doctoral Fellow. Starting in 2010 he worked for Nano Terra Inc., Boston as Senior Scientist. In past he has participated in working groups in ASTM D02 N Subcommittee.

Fretting wear is the oscillating motion of two mating pieces against each other and can result in significant damage to grease lubricated bearings and other components. Examples of such wear are seen in wheel bearings, heavy machinery and wind turbines. The measurement and prevention of this type of wear is critical for grease formulators. This paper presents an examination of oscillating wear and its measurement with specific focus on the Fafnir fretting wear test including historical context, critical aspects of measurement and a discussion of its value to the grease industry today. Data will be presented from studies to highlight additive effects as well as the variability of the test.

Back to the Basics – Part II: Fundamental Building Blocks of Grease Formulation – The Next Story

Joe Kaperick is a Senior R&D Advisor for Greases at Afton Chemical Corporation. Joe began working for Afton in their St. Louis manufacturing facility as an Analytical Chemist in 1991 and moved to their Richmond, Virginia headquarters in 1994. Joe received a Master’s Degree in Analytical Chemistry from St. Louis University as well as undergraduate degrees in Chemistry, Fine Arts and Classical Humanities. He has been in the Industrial R&D area with a primary focus on Grease since 1999.

Previous work focused on evaluation of common additives and additive systems in a simple lithium base grease. Some routine and less common performance tests were used to evaluate differences between different types of additives and packages as well as looking at the impact of additive combinations. The focus was on antiwear (AW), extreme pressure (EP), antioxidant (AO) and borate components along with performance packages containing different component combinations.

This current work explores the differences observed with these same components and tests when the base grease used is a lithium complex thickener.

Joe is currently serving as President of NLGI. Joe has also been recognized as a Certified Lubricating Grease Specialist by NLGI. He is a member of STLE, the chair of the joint NLGI/ELGI Working Group on Grease Particle Evaluation, and the Chair of Section G.01 Chemical and Laboratory Tests for ASTM.
The Mechanical Stability of Polymer-Modified Greases

Polymer additives are routinely used to improve the water resistance, oil bleed, and tackiness of grease. The role of those grease polymers in the ‘mechanical stability’ of grease is less known.

Mechanical stability is a broad concept but generally refers to the ability of a grease to resist changes in consistency from continued mechanical shearing in the field or by lab methods like worked cone (ASTM D217) and roll stability (ASTM D1831). Data points collected over the years does indicate that certain polymers reduce consistency losses in ASTM D217 and ASTM D1831.

This study seeks to establish a more fundamental understanding of why grease polymer structure influences the mechanical properties of grease and how to select the right grease polymer for a given grease. The study includes various polymer chemistries in combination with NLGI #2 base greases of simple lithium, lithium complex, calcium sulfonate, aluminum complex, silica, and bentonite.

Erik Willett, PhD is the technical director at Functional Products Inc. His key interests are studying and applying the unique behavior of polymers to solve customer-driven problems in lubrication. Erik graduated with a Bachelors in Chemistry from the University of Connecticut in 2011; and a Doctorate in Polymer Science from the University of Akron in 2018 while working at Functional as polymer engineer. He has previous won the NLGI Development Author Award and NLGI India’s P.P.C. Gonsalves Memorial Award.


Many grease-lubricated bearings operate in wet environments where appropriate grease selection can make a significant difference to the life of the machine. Although there are current industry standards attempting to evaluate a grease’s resistance to water contamination, basic tests indicate that these may actually have minimal utility. This paper overviews existing water resistance standards, discusses previous experiments seeking to describe the effects of water on grease, demonstrates the need for more meaningful standards, and proposes a new parameter to describe a grease’s water resistance.

Alan Gurt is a graduate student at Louisiana State University who received a B.S. in Mechanical Engineering in May 2019, and is currently working towards an M.S. in Mechanical Engineering. His field of research is Tribology, with a focus on grease lubrication. He was a speaker at the 2019 NLGI annual meeting where he discussed the use of entropy as a measure of degradation and its application to grease. He is currently working on developing a model to quantify the effects of various mechanisms of degradation on grease.
An In-Depth Study of the Structural Stability & Tribological Performance of Polyurea Grease

This paper described our recent study on the structural stability and tribological performance of polyurea grease made via preform thickener. The use of preform thickener gives the flexibility and ease in the control of grease structural stability that is defined through the use of particle size analyzer and rheometer. In the subsequent addition of additives through a combination of Timken, 4-ball, and Falex P&V testers testing a noel and ashless (S/N/P) EP additive was uncovered that outperform traditional alternatives.

Liwen Wei is president and CTO of Novitas Chem Solutions with over 20 years of technical and commercial experience in the lube and grease industries. Since 2006 Liwen begun his consulting career in the grease industry and in 2015 assumed the president position and in 2019 the CTO position of IFIR, institute of innovative research, a division of Novitas Chem Solutions.

HPM LIVE PANEL
The panel discussion will take place on Friday, August 28


Join us for a live panel discussion featuring the new HPM grease certification. Are you up to speed on the latest developments? Do you have questions about what you and your company can start doing now to get ready? Discussion topics include:

- Introduction/History
- Philosophy
- Trademark/Licensing/Launch Timeline
- Q&A
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The Membership Committee focuses on membership growth by recruiting new member companies including international expansion. Additional focuses of the Membership Committee include member benefits, membership value and retaining current member companies.

**Annual Meeting**
The Annual Meeting Committee serves as the advisory group for the Annual Meeting including selecting speakers, award recipients, solidifying technical sessions and direction on the site selection process. The Annual Meeting Committee is comprised of four sub-groups:
- Site Selection
- Speakers
- Awards
- Technical Sessions

**Academic**
The Academic Committee seeks to strengthen the grease industry by fostering relationships with universities containing tribology programs as well as evolving the organization’s research grant program. The Academic Committee is comprised of two sub-groups:
- Outreach
- Research Grants

**Education**
The Education Committee focuses on all components of NLGI education including education strategy, courses, certifications (CLGS and certification marks) as well as working groups. The Education Committee is comprised of three sub-groups (including two sub-sub-groups):
- Education Courses (will include Education Strategy discussion)
- Certifications
  - CLGS
  - Certification Marks
- Working Groups
  - Food Grade
  - Grease Particle
  - Bio-Based
  - Grease Specifications

**Editorial**
The Editorial Committee collaborates on content circulated to NLGI members and non-members including the NLGI Spokesman, Annual Production Survey and Ask the Expert Q&A. The Editorial Committee is comprised of three sub-groups:
- Spokesman
- Production Survey
- Ask the Expert

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June 13-16, 2021
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June 12-15, 2022
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