WEAR NEWS

Volume 9, Number 17 **Fall 2019**

WOM- Wear of Materials Conference

The 22nd Wear of Materials conference was held at the Hyatt Regency Hotel in downtown Miami Florida from April 14-18, 2019. It was attended by about 350 delegates. There were 153 oral presentations, 115 posters and 3 exhibitors. There was a keynote or special session each day. The following are summaries of the keynotes.

The first keynote speaker got everybody's attention with the statistics on the use of gold for electrical contacts: 150 metric tons per year (worth about $7 billion). The speaker was Michael Chandross from Sandia National Lab. The USA government is concerned about the cost and risks associated with relying on the use of gold for electrical contacts. The USA has limited gold reserves. Scandia is doing research on ways to eliminate gold for electrical contacts and research on ways to make gold versus gold contacts wear less and have low friction. For example, their tests suggest that alloying and refining grain size will reduce wear and friction. They also learned that platinum may be a lower–cost replacement for gold.

The second day's key note was Nutria Espallargas from Norengren University in Norway. She talked about tribocorrosion. Her definition was a bit different from the ASTM G2 one, but it sounded good to me: Tribocorrosion – n, material degradation or transformation due to the interaction of wear and corrosion.
What was new to me was the learning that the presence of an oxide on a passive film on a metal will increase wear in a corrodent. I always thought that the oxide would protect, but she said that the oxide gets rubbed away and its reformation requires chemical conversion of more metal to oxide. It also was apparent that the tribocorrosion researchers do not like to rub an electrical conductor (like a metal) on another metal because this conduction complicates corrosion potential measurements on the potentiostat. Overall tribocorrosion is growing as an area of research that seems to be commencer ate with the growth of interest in biotribology.

The third day's keynote was presented by Seigfried Fouvry from Ecole Centrale de Lyon, France. His talk was about the nuances of fretting wear and corrosion. They are proponents of the stick, partial slip, and gross slip regimes. The mechanisms of damage are thought to change depending on the regime that you are in with you operating conditions. For example, gross slip just produces sliding wear; partial slip tends to produce pitting. He went on to show how they perform fretting tests and how they use friction logs (3D shapes produced by stacking the force recordings for each cycle). These friction logs show what is happening from the friction standpoint, but they have yet to correlate fretting friction to material damage. He did not offer any tips on preventing damage, but he did concede that 25μm may be a preferred testing amplitude.

The last day of the conference began with a panel discussion on the question: to coat or not to coat? The panel consisted of Somuri Prasad from Sandia National Lab, Peter Blau, Tribology Consulting, and Andras Korenyi-Both from Tibologix Inc.

Each gave a 10-minute presentation and the group then addressed questions from delegates.

All of the speakers cited examples where coatings allow tribosystems to work that would not work without the coatings. The panel's answer to the question to coat or not to coat was: depends.

Overall, the conference was great. The venue (Miami) could be tolerated with reasonable effort. The organizers are to be congratulated for a job well done. The next WOM will be in Banff Alberta Canada. It will definitely include caribou sightings in the city center.

STLE Annual Meeting

The annual meeting of the Society of Lubrication Engineers and Tribologists was held from May 19 to May 23, 2019 in Nashville Tennessee. The conference was attended by 1600 delegates from 43 countries. The format was the same as previous annual meetings: lots of concurrent technical talks in "tracks" or subjects. The exhibit that accompanies the conference was sold out. There were over 100 exhibits and at least 50 posters that were next to the exhibit area. The session tracks seemed to be repeats of previous conferences with some exceptions: Testing of Soft Matter, Tribochemistry, and Frontiers on Tribology Research. I was on a mission this year so I only attended sessions on lubrication fundamentals, biotribology and tribotesting.

The most significant thing that and I learned from the conference was that I must go back to changing my oil in my truck every 3000 miles. The manufacturer recommends 6000 miles. Just about a year ago Evan Zebawski, the editor of TLT magazine did a study on recommended oil change intervals going back 40 years or so. He reported that manufactures recommended intervals from 1000 miles to 20,000 miles. Many current manufactures suggest intervals of 5 to 10,000 miles. The correct answer of 3000 miles comes from Dr, Nicole Dorr from AC2T Research GmbH in Austria. She did a comprehensive study on the life of oil additives using chemical analysis of aged and used oil. She aged new oil in the lab at 150C for 3500 hours and checked periodically for the concentration change in additives like ZDDP. She also repeated this chemical analysis test at mileage intervals in automobiles. The antiwear additive was almost gone at 200 hours in the lab ageing test and at 5000 km in the automobile tests. She also did lab wear tests (SRV) on metal-to-metal couples with oils aged for different times. All three tests showed that ZDDP disappears with use in a vehicle or in aging in the lab. She convinced me that oil wears by additive loss and I am going back to the 3000 mile interval that I used for decades. One of the degraded compounds that she identified from ZDDP breakdown was phosphoric acid; another was sulfuric acid.

Another important learning for me was that at titanium (Ti6Al4V) corrodes significantly in-vivo from mechanically assisted crevice corrosion (MACC) and other corrosion processes. Dr. Jeremy Gilbert from Clemson University presented an invited paper that was rife with bloody photos of in-vivo medical devices that were severely corroded. Biotibology professionals have generally agreed that the modular designs of hip and shoulder implants produce fretting wear and corrosion, but he detected severe corrosion on titanium and Co/Cr/Mo alloys in areas where there is no metal-to-metal or metal-to-other material rubbing. He believes that there is a biological form of corrosion that is conjoint with tribocorrosion. He believes that it is biological in nature since cells are growing on the corroded metal. I also asked him why they anodize titanium for use in the body. Does this enhance corrosion resistance? He replied: Do you want to know the real answer? I responded: certainly. He said: It is because surgeons like to have the different colors on parts afforded by anodizing. Screws are gold, plates are purple etc.

The following are some additional nuggets from the four days of talks.

- "Dichotomus reconstruction method" – no idea what it means, but I like the term.
- DLC protects valve train parts from soot abrasion
- Kodak is now the international model for how to not run a company
- Tesla's cars are designed for a life of 1,000,000 miles.
- Electron flow is common in ball bearings in electric vehicles and it can cause "fluting" which looks like worm-tracks on the surface on the balls.
- Oil molecular chains are torn apart by high shear events in oils
- Squalene is non-polar
- VI improvers are mostly polymers
- Biocides in metal cutting fluids can make aluminum turn black
- If you reduce your oil temperature by 5 degrees C, you reduce oxidation of the oil by 50 percent.
- Spur gears are 95% efficient, but they are noisy
- You can obtain a sheet of graphene by pulling Scotch take off of a block of graphite
- India imports' 80% of its petroleum products
- Lubricants should be lab tested at 1m/s speed to get hydrodynamic test conditions
- Minus 190 slip/roll ratio produces scuffing in a mini traction machine
- All modular implants are prone to fretting damage in-vivo
- In-vivo corrosion cannot be duplicated in the lab (yet)
- Implant taper connections use a locking taper angle of 5 degrees 40 minutes
- Only 1% of implants need revision (that is only 70,000 in the USA)
- Type 316 stainless steel is the most prone metal to MACC
- Contact lenses abrade the sclera (white part of the eye) during blinking
- Adding stearic acid to an oil increases its oiliness
- Adding sulfur compounds to an oil will stop scuffing
- MAX phase additives are expensive.

Overall this STLE annual meeting was a very successful event. There were lots of presentations, networking, good music, nice weather and hot chicken. STLE we thank you.

ASTM G2 FRICTION, WEAR AND EROSION ACTIVITIES

The ASTM G2 Committee on Wear and Erosion spring 2019 meeting was held at the Sheraton Hotel in Denver Co on June 25 and 26. The following are brief summaries of the subcommittee meetings.

G02.50 Friction Activities

Chair Ken Budinski. (Bud Labs) led a discussion on determining the friction component of an oil. There are many D2-Committee standards for measuring oil friction; they all involve wear tests and all are different. Which one should be used? A workshop on the subject was proposed to possibly arrive at a guide to determining the friction component of an oil or grease. Attendees were of the consensus that such an event would be useful and planning should proceed. The workshop will take place on December 12 at the New Orleans Marriott and the workshop will coincide with the ASTM G2 and D2 meetings.

G02.20 Erosion Activities

Chair John Hadjioannou (EPI) reported that the hot solid particle impingement erosion test, ASTM G 211, is in need of a review for reapproval. Troy LeValley (Falex Corp.) offered to review the

standard since Falex does the test and makes the test rig.

John will contact Mark Gee about updating the ASTM G73 droplet erosion test and for comments on the G211 test.

G02.30 Abrasion Activities

The subcommittee meeting was chaired by Brian Merkle (Lincoln Electric). Brian reported that ASTM G75 test on slurry abrasion is in need of review for reapproval. Brian will contact Jim Miller for the review. ASTM G171 , the abrasion scratch test, needs attention. An interlab test program has been in the works for some time to have different labs measure the widths of the same scratches. Nick Randall (Anton Paar) volunteered to write a research report on what has been accomplished in this study. Nick will revise the ASTM G171 standard and reballot it and the revision will address the use of different ways (microscopy, profilometry) to measure the scratch widths.

Eli Barlow reported that they have successfully used the ASTM G174 loop tester to evaluate the abrasion resistance of different grades of carbide hardfacing. The procedure that they used was: 60 µm alumina abrasive, 1N normal force, one hour of testing (at G174 speed) with a belt change every five minutes.

There was also discussion of removing Falex as the sole supplier of wheels in the G65 dry-sand rubber wheel test, but no action was taken.

G02. 40 Non-abrasive Wear Activities

Chair Nick Randall (Anton Paar) will take care of reballoting of ASTM G99 and G133. Nick also reported that there is a workgroup on developing a low-force G99 test procedure for the pin-on-disk test. Ted McClure is also working on a standard for the twist compression test. He sent a standard draft to five collaborators and he has six labs lined up to do the required interlaboratory tests. Changes to the standard (draft) were also suggested and Ted will revise the draft to accommodate the suggested changes.

Chair Nick Randall requested a review for the ASTM G214 fretting test to determine if changes are needed before reballoting. Ken budinski agreed to review the document.

G2.02 Tribotest Development Activities

G2 Chair John Hadjioannou reported that this subcommittee will be dissolved and it's only standard, ASTM G190 on Wear Test Selection, will be moved to the G2.91 executive subcommittee. Scott Hummel suggested balloting this proposal.

G2. 90 Terminology Activities

Chair Scott Hummel (Lafayette College) reported that the he will assume the existing work item to review and revise the ASTM G190 standard on wear test selection and that Peter Blau (Consultant) with perform the review and revision. Terms submitted for definition at this meeting were: lubricity, oiliness, and tribomaterials

Future meetings

December 10 and 11, 2019, New Orleans LA with D2

June 30 to July 1, 2020 (with D2) Washington DC, Marriott Wardmar Park

Dec 8-9, 2020 (with D2) Austin Texas, Austin Marriott

Miscellaneous

- Possible future workshop topics:

Tribotesting needs
ASTM G65
Friction outputs

- Workshop on the measurement of the friction component of oil in a tribosystem:

Venue: New Orleans Marriott, December 12

Program:

THURSDAY, DECEMBER 12, 2019

9:00 AM
Opening Remarks
Ken Budinski, Bud Labs USA, Workshop Chairman

9:10 AM
Oiliness: Outmoded Jargon or a Distinct Concept in Tribo-Science?
Peter Blau, Blau Tribology Consulting, Enka, NC, USA

9:30 AM
Hydrodynamic Fluid Film and Tribofilm Formation – Combining the Friction Signals with Contact Resistance
Mathias Woydt, MATRILUB, Berlin-Dahlem, Germany and Raj Shah, Koehler Instruments Company, Inc., Holtsville, NY, USA

9:50 Break

10:00AM
Rolling Friction, Wear and Slip rolling Resistance with the 2Disk Test Rig
Mathias Woydt, MATRILUB, Berlin-Dahlem, Germany and Raj Shah, Koehler Instruments Company, Inc., Holtsville, NY, USA

10:20 AM
Using the PCS HFRR to Investigate Lubricant Boundary Friction
Andrew Hutchinson, PCS Instruments, London, United Kingdom

10:40 AM
Twist Compression Test (TCT) Description and Applications
Ted McClure, SLC Testing Services, Westlake, OH, USA

11:00 AM
Investigation of the Sensitivity of the Wire-on-Capstan
Peter Lee, Southwest Research Institute, San Antonio, TX, USA

11:20 AM
Friction Modifiers and Lubricated Friction – Requirements to Identify Friction Reduction
Dirk Drees, Falex Tribology, Antwerp Area, Belgium

11:40 AM
Lubricated Friction Measurement – Sliding Tribosystems
George Plint, Phoenix-Tribology, Hampshire, United Kingdom

12:00 PM LUNCH (on your own)

1:30 PM
Improving Fuel Lubricity Sensitivity Using High Frequency Reciprocating Line Contact
Greg Hansen and Peter Lee, Southwest Research Institute, San Antonio, TX, USA

1:50 PM
Determining the Effect of Oil Formulation on Friction Results – Improving Fuel Economy

Rich Baker, TriboTonic, Ltd, London, United Kingdom

2:10 PM
Use of the Pin-On-Disk Test to Discern Friction Differences in Oils
Steve Shaffer, Bruker Nano Surfaces, Campbell, CA, USA

2:30 PM
Interlaboratory Test Results on the Use of the 4-Ball Test to Measure System (Oil) Friction
Mike Anderson, Falex Corporation, Greater Chicago Area, IL, USA

2:50 PM BREAK

3:10 PM
Lubricated Friction Measurement – Sliding/Rolling Tribosystems
George Plint, Phoenix-Tribology, Hampshire, United Kingdom

3:30 PM
Workshop Summary and Group Discussion
Moderated by Ken Budinski, Bud Labs USA

4:00 PM WORKSHOP ADJOURNS

Note: Wear News is the informal account of selected tribology events and the activities of the ASTM G2 Committee on Wear and Erosion

Contributed tribology articles are welcome. Send them and inquiries to
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