WEAR NEWS

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The 6th World Tribology Congress

The World Tribology Congress is usually the largest gathering of tribologists and it occurs only once every four years. The last one was in Turin Italy. Like the Turin congress, the venue for the affair was the remains of their last Olympics. The Beijing convention center was where the talks were held and it was across from the famous birds-nest structure that housed the Olympics opening ceremony in 2007. Of course the area surrounding the Olympic village was very pretty and the hotels that ringed the Olympic village bordered a beautiful park. The Congress was opened by the vice Premier of China, and there were many dignitaries at the opening ceremonies to show their support of tribology research. The congress had over 800 oral presentations over a five day span, a large exhibit for the full five days and there were over 300 posters presented over a two day span.

Each day commenced with two plenary lectures from well-known tribologists. There were lots of student talks and lots of talks where all testing was performed on a pin-on-disk test. Surprisingly there were almost no talks on abrasion. Lubrication and additives like ZDDP were common subjects as was DLC coating.

For me, the highlight of the entire conference was a paper by Jacob Israelochveli from the University of California at Santa Barbara. Jacob was not in attendance, but Chinese electronic technology allowed him to be present through the internet on every PowerPoint slide and he made the statement at one point in his talk: "The Stribeck curve is rubbish." He particularly took issue with the abscissa label: viscosity times speed divided by force. I have to agree that the units become hard to reconcile. Jacob conceded however, that the velocity component was significant.

Another highlight of the congress (to me) was a tour of Tsinghua University's tribology center. The school bussed about 200 attendees to the Beijing –based school and let us see all of their lab facilities. The university itself was very impressive, they have some 47,000 students, 1300 of whom are PhD candidates.

Overall, this WTC had less practical substance than other WTC's that I attended (I think that I attended all six). Most of the 800 or so papers presented were authored by academicians and as is their tendency, they stressed modeling. It was amazing to me how all of the models correlated with their experimental data. There were very few papers from industry and this has always been a great concern to me.

The venue for the conference was wonderful; the Beijing International Conference Center is a real fancy place. There were probably one hundred students from Tsinghua University who were everywhere to help delegates with any type of problem. The Chinese people demonstrated the greatest hospitality. Even the weather was great. I was really impressed to see the changes that have taken place in Beijing since my last visit to the city in 1983. The Chinese People and the Congress organizers are to be congratulated for a job well done. Thank you. The next congress will be held in Lyon France.
Ken Budinski

Ken Budinski

ASTM Symposium on Tribometry and Tribochemistry

This symposium was held in conjunction with the spring 2017 meetings of the ASTM G 2 and D2 Committees in Boston MA. The symposium was one day in length (June 28) and consisted of 10 papers. The symposium was chaired by Mathias Woydt from the Federal Institute for Materials Research and Testing (BAM) in Berlin.

I thought that the symposium would be mostly on tribocorrosion. It was not. It was mostly (9 out of 12 papers) on the nature of tribofilms that are generated mostly in lubricated sliding. There was one excellent paper on cavitation erosion (by Professor Soyama from Muroran Institute of Technology, Hokkaido Japan), and one paper on Tribocorrosion (from authors at Texas A and M), but the others dealt with tribofilms that are formed in rubbing, how to test to produce tribofilms and how to determine the nature and composition of the tribofilms. Some papers addressed new chemistries for tribofilms, ones not containing ZDDP.

The AFM papers used the probe stylus to generate a tribofilm for study. They rationalized his by saying that the AFM tip simulates a single asperity on a real rubbing surface.

Overall the conference was a welcome addition to an ASTM Committee week that is normally just meetings to discuss the specifics to standards. One-day conferences like this make attending these meetings more worthwhile. Everyone had some takeaways that can help in their work. Mine was that BAM likes to use rotating disks with line contact to study lubricating films and they run the rollers (30 to 5000N, 350 to 3000 rpm, 120C, 10 million revolutions) with about 10 percent slip and this simulates what happens in bearings and gears.

Wear of Materials 2017 Conference

The biannual Wear of Materials conference was held from March 26 to 30 in Long Beach California USA at the Hilton Hotel. The event was well organized and Elsevier, the organizer of the conference saw to all details. It was run like the previous WOM conferences with keynote speakers each day and concurrent technical sessions. A unique part of this WOM was a symposium dedicated to Ken Ludema, the founder of the Conference. Ken died at the start of the last WOM. A close colleague of Ken, Dr. Quan Rhee, (formerly from Bendix) gave a talk about Ken at the conference dinner. Ken's family was also in attendance.

Some learnings (for me) from the conference are below:

- Nital-etched balls are used in Calowear tests for best results
- 32% of papers in WEAR use the pin-on-disk test to do their investigations
- Mass loss calculated from geometry changes is more accurate than gravimetric methods.
- Submerged waterjet is the preferred cavitation test
- Euler identified the existence of cavitation
- White etching structure on wind turbines reduces life from 20 years to less than 2
- USA doctors do 300K hips and 600K knees per year
- Cu and Ni do not fret
- Boric acid an reduce piston/cylinder wear
- All greases absorbed water
- ZDDP's reaction to form a tribofilm requires only about 2 minutes to take place
- An Al/Si coating is used on hot formed auto parts to keep them from galling on tooling

- Hardox can wear like cemented carbide
- Hardox 400 can be used as a G65 rubber wheel replacement
- Static friction is proportional to the concentration of interfacial bonds between surfaces
- An asperity is from 2nm to 2 um in size
- Grooved surfaces will stop brake squeal
- Bearings made from M50NIL are more resistant to white layer failure
- Tribofilms can be amorphous, crystalline or a mixture of both
- SM C 1624 is a scratch test
- Only need to coat one surface with moly disulfide
- DLC's are used to protect the glass screens in grocery scanners
- Vorticity in unlubricated sliding causes mechanical mixing
- B scratches A if it is 20% harder
- Coke has a pH of 2
  Amonton's Law is invalid. Amonton's original paper clearly said that the coefficient of friction is equivalent to F/N for some systems. Not all systems.

In summary, this year's WOM was as good as all that I have been to. The venue was not. The hotel was in the middle of nowhere and there were lots of floor changes to get to talks. The exhibit was the worst in decades – only ten booths. It needs revitalization. The exhibit may be best replaced with a commercial poster session at lower cost. The conference is largely attended by academicians and efforts should be made to bring in people from industry.

However, WOM is still the best tribology conference out there and the next one is in good hands with Tom Scharf as Chair.

Ken Budinski

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ASTM STLE Annual Meeting

The annual meeting of the Society of Lubrication Engineers and Tribologists was held from May 20 to 25 in Atlanta Georgia USA at the Atlanta Hyatt Regency Hotel. This meeting is the largest convocation of tribology people in the USA: about 1600 delegates, 1000 posters and oral presentations, and 100 or so exhibitors. Attendees came from 41 countries. The STLE does a commendable job of organizing this event and the only tedious part of the conference is sitting through endless award presentations whenever there is a sole event on the schedule. However, they are a necessary part of a volunteer organization.

The technical sessions varied from lubrication fundamentals to tribocorrosion. I presented a paper in a session on tribotesting and attended 3 days of papers in various sessions. I left with these takeaway nuggets.

- ZDDP tribofilms have a phosphate matrix with Zn and P concentrations on top and bottom; they are usually 50 to 100nm thick.
- Engine tribologists are trying to reduce friction between the upper ring and the cylinder wall by putting friction modifies in the gas
- Polypropylene grease provide greater service life than lithium greases
- Alumina nanoparticles are not abrasive when in concentrations less than 1%
- Adding 0.5% ionic liquid to a motor oil will significantly improve the life of the oil
- Many ionic liquids are corrosive to steel
- More ZDDP may not reduce wear; there is a sweet spot for concentration
- Ferrography is the best way to analyze for particles in oil.
- Typical oil anti-wear additives for grease are ZDDP and MoTDC
- 30 % of the cost of maintaining France's 63,000km of railroad is for ballast work

- High speed railroad trains need continual ballast tamping
- Optical interferometry measurements of tribofilms are wrong if the films transmit light. Gold coating is needed.
- Crumpled graphene does not settle out in water dispersions
- Thin hard coatings like PVD TiN on one member of a gear couple will increase fatigue life of the pair.
- Many oil ranking tests use seizure as the test metric. However, users disagree on the point of seizure.
- Plastic coatings on down-hole drilling tools provide reduced friction and lower energy to turn the tools
- Tide heights are spotty over our planet; however wave activity is very high at both poles (for energy harnessing)
- Oil wear tests can be affected by humidity; ambient humidity should be less than 10%
- Do not use non-additive oils for wear tests

As usual, this was a very worthwhile event. Delegates get to see who is doing what in tribology and the atmosphere is conducive to obtaining info that can be helpful in your work. The only negative takeaway for this meeting was the message of the keynote speaker on use of tide and waves for energy production: They are working at glacial speed on this in the USA. The government's annual contribution of 30 million Dollars is not enough to even test a single concept. Hopefully other countries will take the initiative.

Overall.it was a great meeting and STLE is to be congratulated for making it happen.

ASTM G2 FRICTION, WEAR AND EROSION ACTIVITIES

The ASTM G2 Committee on Wear and Erosion met after the tribometry symposium in Boston on June 29, 2017. The following are brief summaries of the subcommittee meetings..

G02.50 Friction Activities

Chair Ken Budinski. (Bud Labs) reported that a new standard for an inclined plane test will be balloted again before the next meeting. The first ballot was withdrawn to respond to negatives and comments.

G02.20 Erosion Activities

Chair John Hadjioannou (EPI) reported that negatives on a review of G76 solid particle erosion test were addressed. There is a need to do low-angle interlaboratory erosion tests in order to add the low-angle procedure to ASTM G 76. Ken Budinski reported that he has test material for low-angle (glass-coated steel) tests but it needs cutting to standard specimen size. Scott Hummel offered to have test samples cut at Lafayette University.

Scott Hummel (Lafayette College) recommended that definitions be established for: erosion rate, erodent, erosion resistance and solid impingement

Professor Soyama (Muroran Technical Institute – Japan) will reballot changes to ASTM G 135 cavitation test.

Mathias Woydt (BAM- Germany) reported that BAM has developed an Excel spreadsheet to predict solid particle erosion rates of materials and that details are available from him.

G02.30 Abrasion Activities

The subcommittee meeting was chaired by Brian Merkle (Lincoln Electric). An action item from the balloting for reapproval of ASTM 174 loop abrasion test was to add definitions for: abrasivity, abrasive, and abradant. The ASTM G2 Staff Manager will talk to the editorial staff of ASTM to

determine if definitions can be added without reballoting.

The abrasion by ribbons and paper test, ASTM G 56 was discussed and it was the consensus that he test is still relevant. Ray Bayer (Consultant) will be contacted regarding a name change to "fabric/paper abrasivity"

Nick Randall (Anton Paar) reported that he has scratched test specimens of brass and PMMA to be used to try and use profilometry for the ASTM G 171 scratch test metric. He will conduct interlaboraory test using the profilometry technique for scratch depth measurement. Steve Shaffer and John Hadjioannou will do the scratch measurements and the G2 Staff Manager will have the ASTM statistics staff do the statistical analysis of the data. The G 171 standard will be reballoted with the updated metric before the end of 2017.

John Hadjioannou reported that as a follow up of the abrasion workshop in Houston, he conducted ASTM G 65 test using aluminum oxide as the abrasive. The abrasive worked well and produced scratching abrasion on test specimens with carbide-type hard phases. He also reported that the alumina abrasive that he obtained from SMW abrasives was lower in cost than the standard ASTM G 65 Ottawa AFS test sand.

Mathias Woydt reported that he has test specimens of niobium carbide to test to compare with cemented carbides made from tungsten carbide with a cobalt binder. He recommends including this material in any abrasion studies that compare cemented carbides/hard metals.

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G02. 40 Non- abrasive Wear Activities

Chair Nick Randall (Anton Paar) reported that the reballot on ASTM G 98 got a negative because of errors in a data compilation. The table will be editorially corrected.

ASTM 137 and 176 will be reballoted for approval without change.

The work item on a new galling test (43252) will be discontinued.

The changes to ASTM G 98 pin-on-disk test will include:
Elevated temperature sliding, low test loads (1 to 5N), other methods for measuring wear other than mass change, and an update to the reporting to include other test parameters

Mathias Woydt reported that can supply test specimens from the original round robin test from alumina, silicon nitride, and zirconia if somebody wants them for testing.

Nick Randall will take care of reballoting of ASTM G99 and G 133.

G02 Tribotest Development Activities

G2 Chair John Hadjioannou reported that the subcommittee has a work item to address issues with ASTM G 190, the guide to wear test selection. Scott Hummel is the technical contact and the G2 Staff Manager will ballot its removal. Under old business, John reported that the Italian ball-on-cylinder test proposal is still viable and the authors will try to make it conform to ASTM standards for balloting.

G2. 90 Terminology Activities

Chair Scott Hummel (Lafayette College) reported on balloting on four terms:

Friction
Burnish
Polish
Scuffing

The ballot received three negatives and three comments. A discussion was conducted to address the issues with the various terms. A negative on

scuffing was voted non-persuasive. A definition of "inclined" plane was withdrawn . It was felt to be unnecessary.

Under new business, Scott proposed adopting definitions from the D2 Committee for EP additive. PV limit, and EP additive lubricant.

Future meetings

Dec. 4 and 5, 2017 San Jose California at Bruker Facility.

June 24-29, 2018 San Diego California (with D2)

December 8, 2018 Atlanta Georgia

Miscellaneous

John Hadjioannou has been appointed Vice chairman of the G2 Committee replacing Greg Dalton (Tribsys).

Troy LeValley has resigned as G2 Secretary and Scott Hummel will be the new Committee Secretary.

Possible future workshop topics:

Tribotesting needs
ASTM G 65
Friction outputs

Note: Wear news is the informal account of selected tribology events and the activities of the ASTM G 2 Committee on Wear and Erosion

Contributed tribology articles are welcome. Send them and inquiries to
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