SAIT Newsletter

SAIT Tribology 2010 Project

The final report was submitted to the Department of Science and Technology in December. This report was very well received as a technical report on the status quo of tribology in South Africa, and will be followed up with a hard hitting executive summary for further consideration by Government. The full report will be released when fully approved by Government.

Major findings of the report were:

- There is little understanding of tribology across industry, where tribology is mostly interpreted as lubrication, which makes up 0.24% of a typical balance sheet.
- Management is generally short term profit driven, and maintenance is more often sacrificed to production.
- Lubricant consumption averages 20% of installed capacity, against an international benchmark of 10%
- That average drain periods are approximately equal to those overseas, shows that equipment failure rates are significantly higher in South Africa.
- Average bearing life has dropped by two thirds and gearbox life by 80 to 90% over the past 20 years, this trend is ascribed to a lack of skills, resulting in poor alignment during assembly, and excessive dirt entry throughout the supply chain.
- A case study showed that concentrating on filter element quality and lubricant cleanliness improved hydraulic component life from 4 months to 7 years
- Overall, if industry was able to get back to basics and focus on tribology, energy costs could be reduced by between 8 and 20%, and maintenance costs by 30 to 50%
- Specific examples of a lack of focus on tribology are:
- Conveyor idler replacement rates are 4 times the international benchmark.
- Excessive friction in a typical chain drive increased energy consumption by 19.3%%, and at the same time the energy transferred was reduced by 20%, thus overall efficiency was reduced by 33%.

SAIT Training Courses, February 2011

During February, the SAIT will run three courses in Johannesburg:

Introduction to Lubrication Engineering:
Wednesday 9 February – one day course

Introduction to Wear and Materials:
Thursday 10 February – one day course

Lubrication Engineering 71:
Monday 21 – Friday 25 February – 5 day course.

For further information or to register, contact Gill Fuller or Isabel Bradley at 011-802-5145/6/7/8 or email secretary@sait.org.za or admin@sait.org.za.

SAIT Tribology 2011 10th International Tribology Conference

Plans for the SAIT's triennial International Conference, being held at the University of Pretoria's Conference Centre from 5 – 7 April 2011, are moving forward. .We have had a good response to our Call for Papers, though we can accommodate a few more presenters.

Wits Student Honoured by the SAIT

The School of Chemical and Metallurgical Engineering of the University of the Witwatersrand held a Poster Presentations Day on 4 November 2010. SAIT Member and Wits Student, Enoch Nfise Ogunmuyiwa's poster was declared the Best Tribology Poster at this event.

Enoch Ogunmuyiwa is currently a PhD student within the Carbides and Cermets research group of the DST/NRF Centre of Excellence in Strong Materials based at Wits University. His research supervisor is Dr Natasha Sacks from the School of Chemical and Metallurgical Engineering. Enoch's PhD project is focused on the development and tribological characterization of WC-VC-Co alloys and coatings. He has a MSc(Eng) degree in Ceramic Science (Wits) and received his first degree, a BEng in Metallurgical and Materials Engineering, from the Federal University of Technology, Akure in Nigeria. He is a team player who always aspires to achieve excellence and has a great enthusiasm for knowledge and research. His aspiration is to become a notable and reputable professional in the field of Metallurgical and Materials Engineering and he seems to have a bias for failure analysis as well as material design and development. He has already received several awards for his studies both in South Africa and Nigeria. All this while being a husband and father.

A copy of the Enoch's winning poster is on the last page of this newsletter.

The **SAIMechE** offers training courses in many fields of Mechanical Engineering. Their website is www.saimeche.org.za.

International Tribology-Related Events From 2010 and 2011

STLE 66th Annual Meeting and Exhibition: May 15 – 19, 2011, Atlanta, Georgia. Go to www.stle.org for further information.

Ecotrib 2011, Vienna, Austria: 7 – 9 June 2011. Go to www.oetg.at/ecotrib2011 for more information.

International Tribology Conference, Hiroshima 2011: 31 October – 3 November 2011. E-mail nagamura@mec.hiroshima-u.ac.jp for further information.

VII International Conference, Lubricants Russia 2011: November 9 – 10 2011, Renaissance Moscow Hotel. To register contact Elena Konstantinova at Konstantinova.Elena@rpi-inc.com or go to http://www.rpi-conferences.com.

Tribology in Action

**A woman beautifies her lips –
And lubricates them at the same time!**

Friction and sliding wear of WC-12wt%Co and WC-10wt%VC-12wt%Co thermal spray coatings

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Introduction

- WC-Co thermal spray coatings are widely used due to their good wear properties and increased component lifetimes by protecting the substrate materials.
- Vanadium carbide (VC) is included as a minor constituent in sintered WC-Co alloys to inhibit carbide grain growth thereby increasing alloy hardness and enhancing wear performance.
- Currently, commercial WC-Co coatings do not contain VC.
- Therefore it would be of scientific and commercial interest to explore the addition of VC to coatings to assess if the benefits of VC additions to sintered alloys may be realized in coatings.

Objective

- To characterize the friction and wear response of WC-12wt%Co and WC-10wt%VC-12wt%Co thermal spray coatings.

Experimental

- Coating samples were polished to a surface finish of 1μm.
- Microstructural characterization of the coatings was performed to identify the phases present and the coating thickness.
- The Vickers hardness was determined using a 0.3kg load.
- Dry sliding wear tests were conducted using a CSM standard ball-on-disk tribometer (Figs. 1 and 2), with a 6.00mm diameter ball geometry. Two different static partners namely, 100Cr Steel balls and WC-Co balls were used.

Dry Sliding Wear Test Parameters

- Applied Load = 7N
- Linear speed = 0.30 m/s
- Temperature = Room temperature
- Stop condition = 200 m
- Acquisition rate = 30.0 Hz

Fig. 1. Tribometer

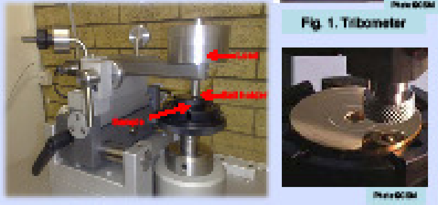

Fig 2. Test set-up

Results

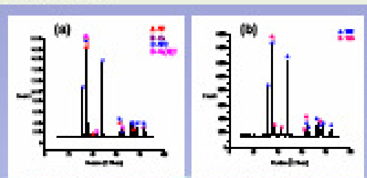

Fig. 3. XRD of (a) WC-Co and (b) WC-VC-Co coatings

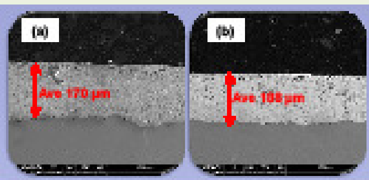

Fig. 4. Thickness of (a) WC-Co and (b) WC-VC-Co coatings

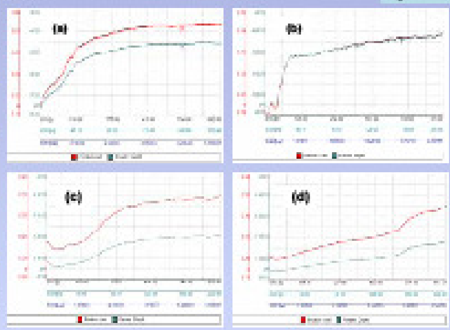

Fig. 5. Coefficient of friction versus distance curve for WC-Co and WC-VC-Co coatings against (a) & (b) 100Cr Steel and (c) & (d) WC-Co balls.

Dynamic friction coefficients

	100Cr Steel	WC-Co
WC-Co	0.77	0.30
WC-VC-Co	0.69	0.25

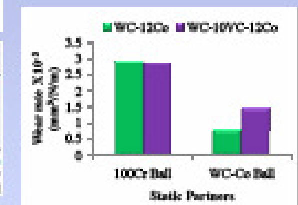

Fig. 6. Wear rate of the coatings.

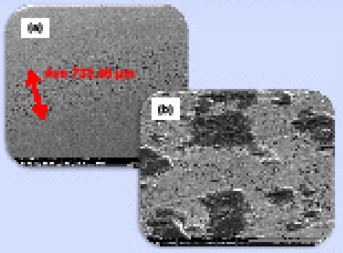

Fig. 7. Wear track on WC-Co coating from 100Cr Steel ball at (a) low and (b) high magnification. Smearing and fine cracking of matrix visible.

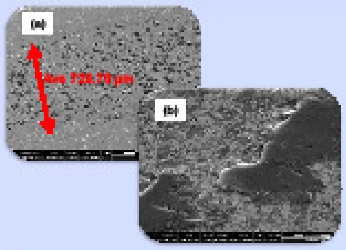

Fig. 8. Wear track on WC-VC-Co coating from 100Cr Steel ball at (a) low and (b) high magnification. Smearing of matrix and small pits visible.

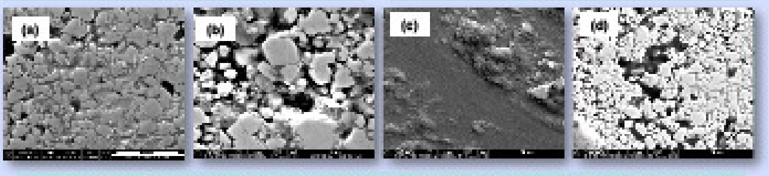

Fig. 9. Wear scars of (a) WC-Co and (b) WC-VC-Co coatings using the WC-Co ball and (c) WC-Co and (d) WC-VC-Co coatings using the 100Cr Steel ball. Carbide grain cracking, selective binder removal and matrix smearing visible.

Discussion

- The friction coefficients of both coatings against the 100Cr Steel balls show an initial sharp increase during the first 40m of sliding. As the sliding distance increases the coefficient for the WC-Co coating remains constant, while that of the WC-VC-Co coating increases steadily. The wear rates for both coatings are similar.
- The friction coefficient of the WC-Co coating against the WC-Co ball shows a linear increase during the first 80m of sliding after which the coefficient levels off. The friction coefficient for the WC-VC-Co coatings against the WC-Co balls show a linear trend, with a small spike at 150m. The wear rate of the VC coating is higher than that of the non-VC coating.
- Some of the wear mechanisms observed for both coatings include tungsten carbide grain cracking, matrix smearing, selective binder removal and grain pullout.

Coating hardness

WC-Co coating:	8.99 ± 0.6 GPa
WC-VC-Co coating:	8.05 ± 1.1 GPa

Conclusions

- The coefficients of friction are influenced by the type of ball used.
- The addition of VC to the WC-Co did not improve the wear resistance.
- The wear mechanisms for both coatings are dominated by adhesion and abrasion processes.