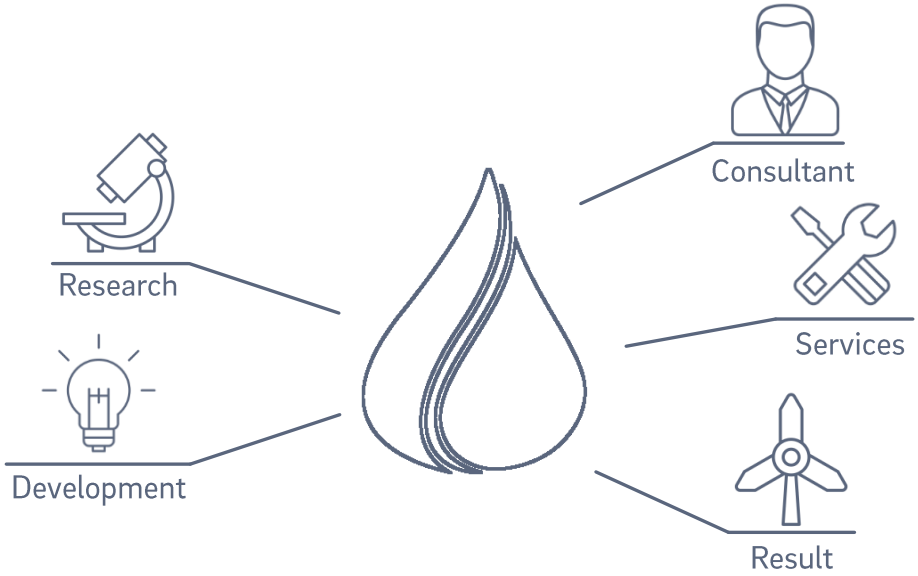
Higher Performance for Gearboxes and Bearings in Wind Turbines

REWITEC GmbH, D-35633 Lahnau

We are more than just a product.



- Repair and protection of gears, engines and tribological systems
- Refinement of surfaces based on nano and micro particles

- World wide sales network
- Patents in Europe, China and US
- Established in 2003
- Founder and Managing Partner: Stefan Bill

Products

Coating concentrates for repair and protection of wind turbine gearboxes

Significant better life improvement of gears with application of DuraGear® W100

Products

Repair and protection grease for all kind of bearings.

Significant better life improvement of bearings with application of GR400

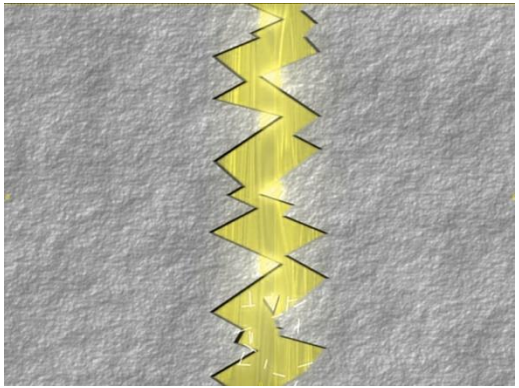
Examples of application

Coating process

Step 1

Chemical-physical process

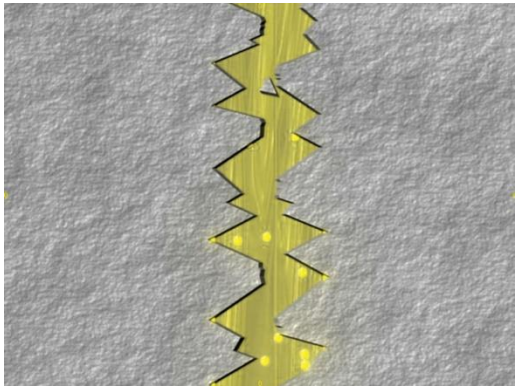
The product uses the lubricant as carrier to the mixed friction zone



Step 2

Chemical reaction

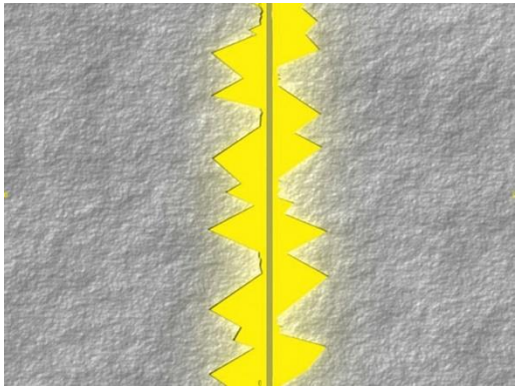
The coating particles ceramize the metal surfaces mixed friction zone



Step 3

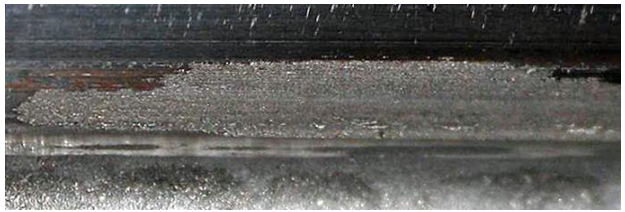
New metal-ceramic surface

Original material properties will be improved in terms of friction, temperature and wear significantly

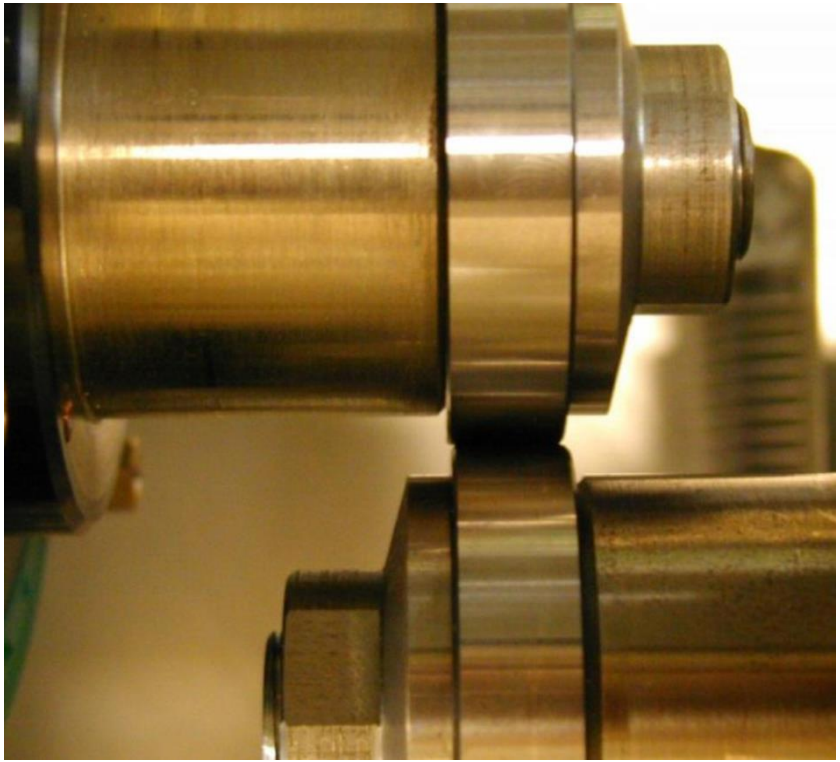


Illustrations of damages: REWITEC treatment is recommended

All these damages can be repaired, frozen or prevented by the use of REWITEC products



For more details please review the REWITEC application catalog



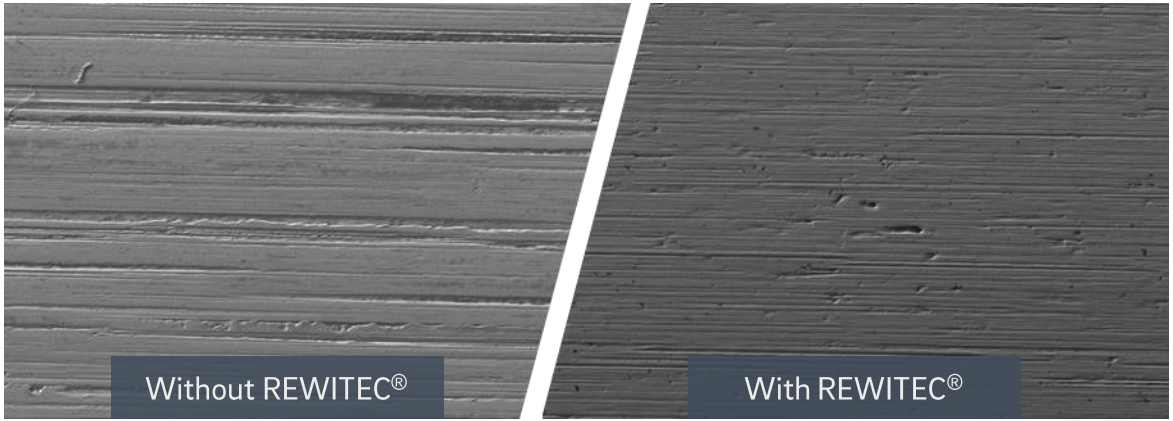
2-Disc Assembly Rolling Wear Tests with wind turbine oils

Stress value:	1 GPa (normal force 2150 N)
Rotating speed:	424 rpm / 339 rpm, slip 20 %
Test-duration:	39,3 h
Temperature:	oil inlet temp. 60°C

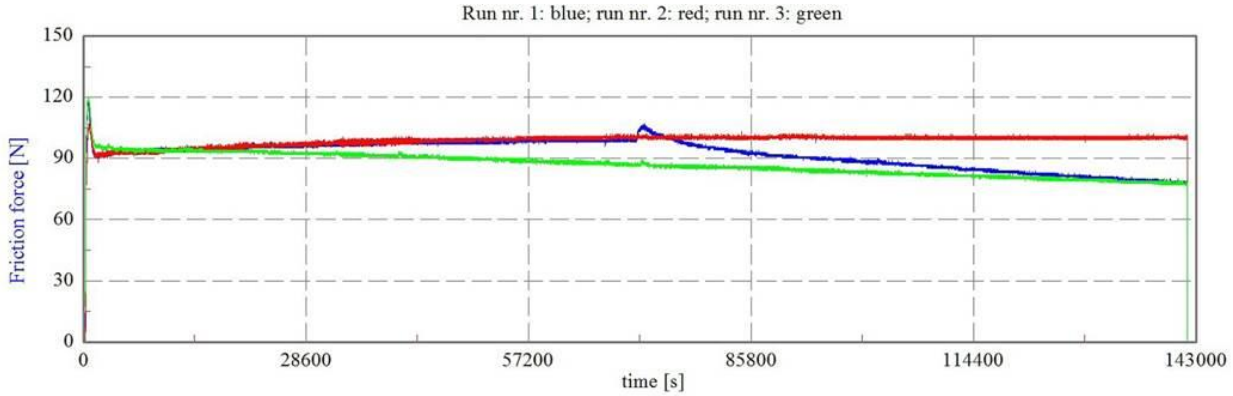
Scientific tests
2-Disc Assembly Rolling Wear Test with wind turbine oils

KOMPETENZZENTRUM tribologie MANNHEIM

SEM images after the 60 hours testing in 1:1 comparison:



Scientific tests
2-Disc Assembly Rolling Wear Test
Overview – wind turbine oils

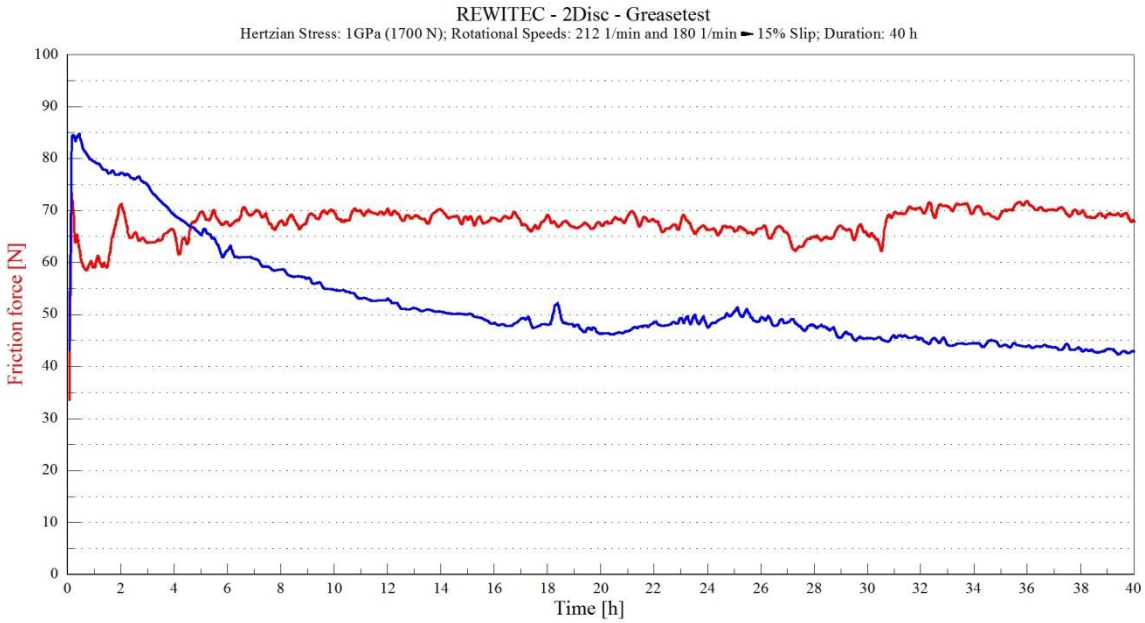


- Red graph without REWITEC®
- Blue graph with REWITEC® added after 20 hours
- Green graph with REWITEC® added at the beginning

✓ Reduction of the surface roughness (Ra) due to wear up to 58 %

✓ Reduction of the friction force up to 22 %

Scientific tests
2-Disc Assembly Rolling Wear Test
Overview – wind turbine grease



FAG Arcanol Multitop grease

- without REWITEC®
- with REWITEC®

Hertzian Stress:	1700 N
Rotational Speed:	212 min^{-1}
	& 180 min^{-1}
Slip:	15 %
Duration:	40 h
Friction reduction:	36 %
Friction coefficient:	0,0253 µm

Scientific tests
2-Disc Assembly Rolling Wear Test
Overview – wind turbine oils

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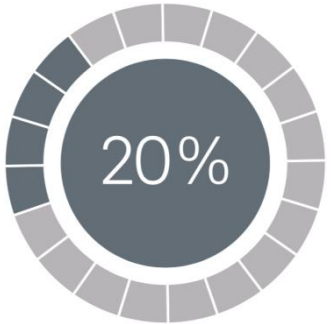
	Oil grade	Castrol Optigear Synthetic X320	Mobilgear SHC XMP 320	Klübersynth GEM 4-320N	Klüberbio EG 2-150	Fuchs Unisyn CLP 320	Amsoil PTN 320	Shell Omala S4 GX 320
Measured data	R_a, before [µm]	0,22	0,22	0,22	0,22	0,22	0,22	0,22
	R_a, after [µm]	0,129	0,123	0,1	0,133	0,109	0,18	0,165
	R_a, Reduction [%]	**41**	**44**	**54**	**40**	**50**	**18**	**25**
	R_z, before [µm]	2,00	2,00	2,00	2,00	2,00	2,00	2,00
	R_z, after [µm]	1,52	1,18	0,91	1,04	1,02	1,51	1,42
	R_z, Reduction [%]	**24**	**41**	**55**	**48**	**49**	**25**	**29**
	Friction Force, before [N]	62,9	63,3	73,5	120,0	69,0	81,8	81,0
	Friction Force, after [N]	42,6	41,0	44,0	54,0	44,0	44,0	47,0
	Reduction Friction Force [%]	**33**	**35**	**40**	**55**	**36**	**46**	**42**

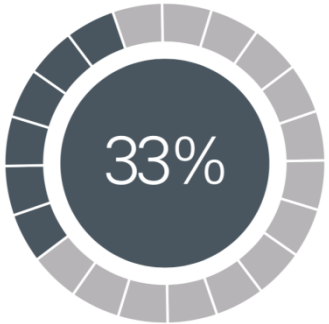
Results of a rolling wear test

61-h Test with Agip Blasia SX320 on the 2-disc assembly

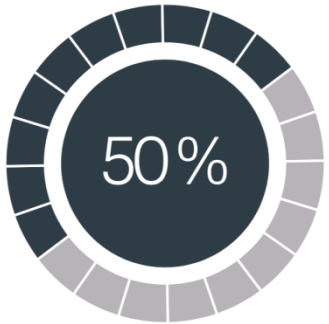
20 % less temperature in gearboxes and bearings



33 % less friction in gearboxes and bearings



50 % less roughness on metal surfaces



Scientific tests
Combined Standstill Tests (pre-damaging) and SNR-Tests | Grease without REWITEC

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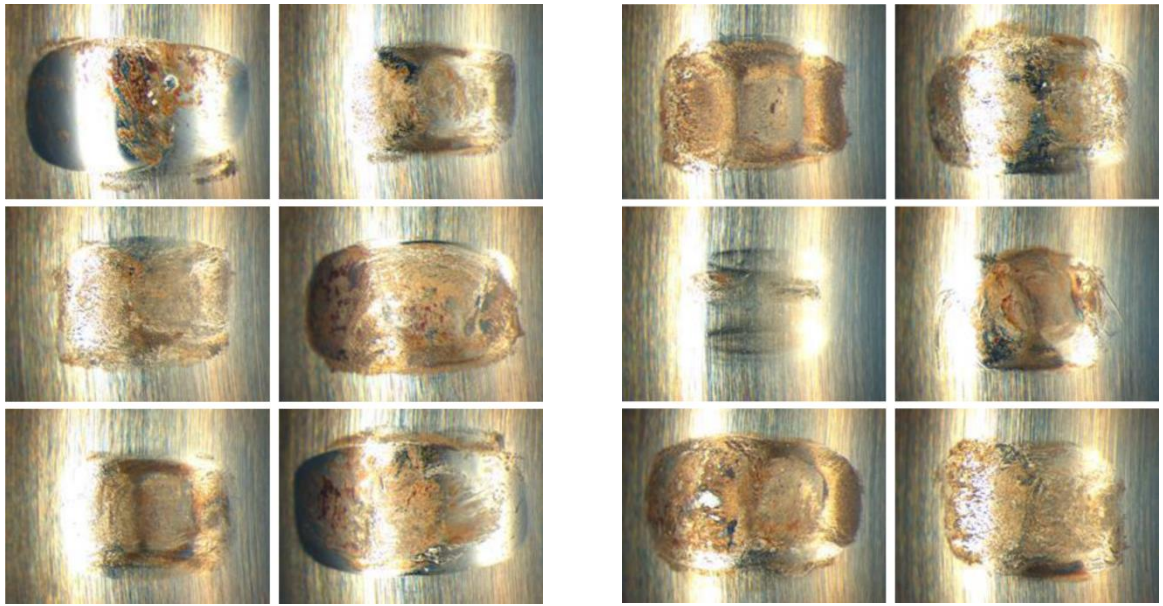

The bearings are 1.3 hours pre-damaged with very small swivel angles of +/- 0.5 ° and a force of 3 kN

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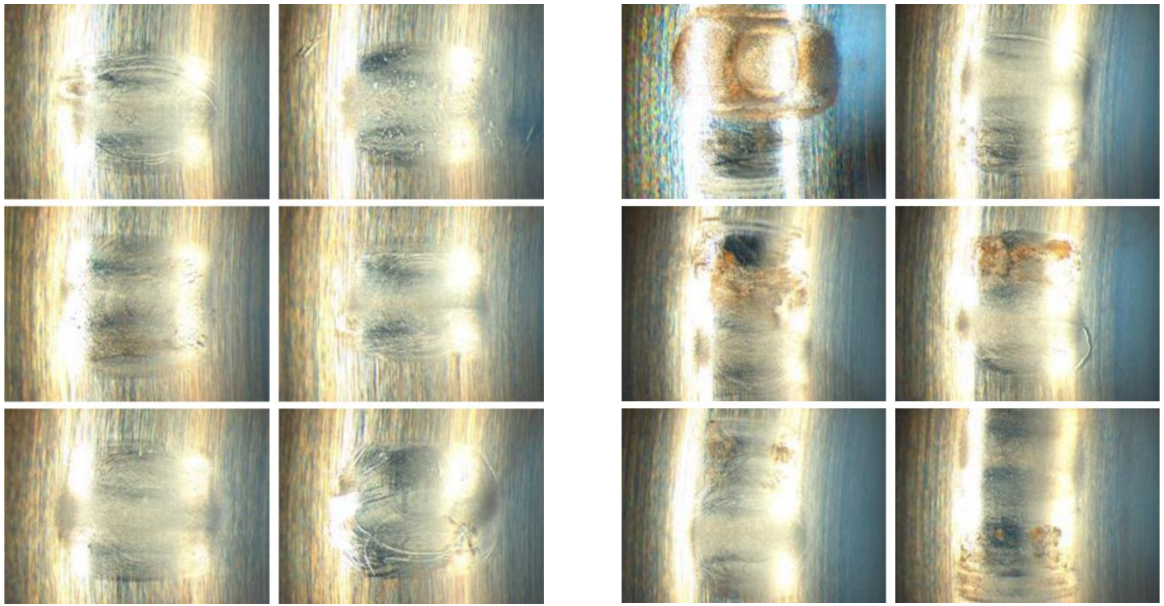

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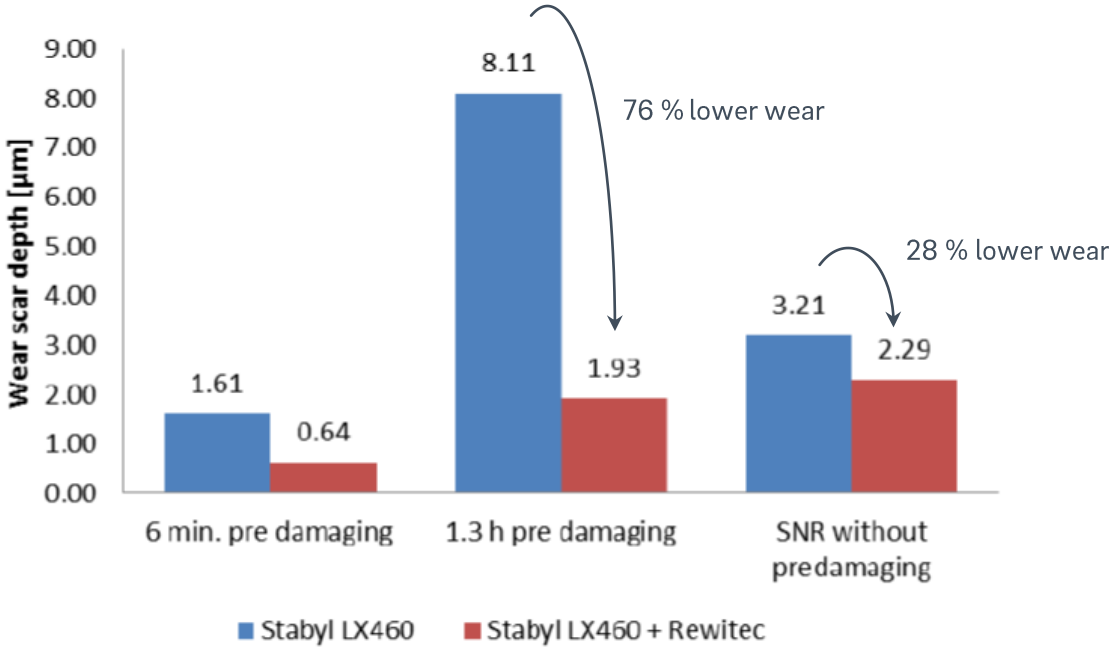
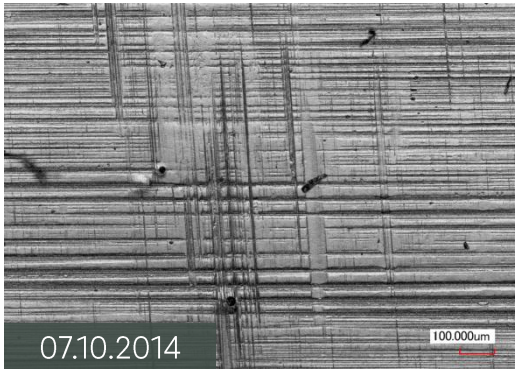
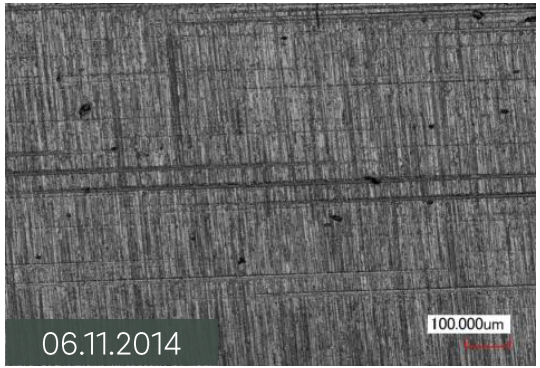
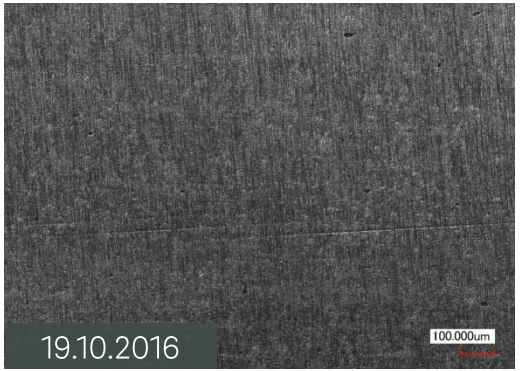


Examples of application: GE 1.5 SL

Wear development on a Bosch Rexroth gear tooth over a period of two years







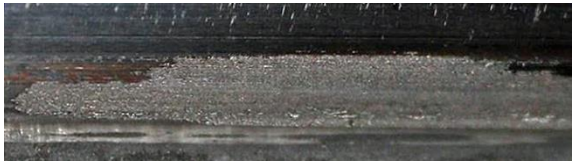
Surface roughness

R_z = 271,331 µm ➡ R_z = 143,110 µm

Improved load carrying capacity

Examples of application: CSIC 2 MW VSCF

Significant operational wear already one year after commissioning



Visible wear marks at the tooth flank:

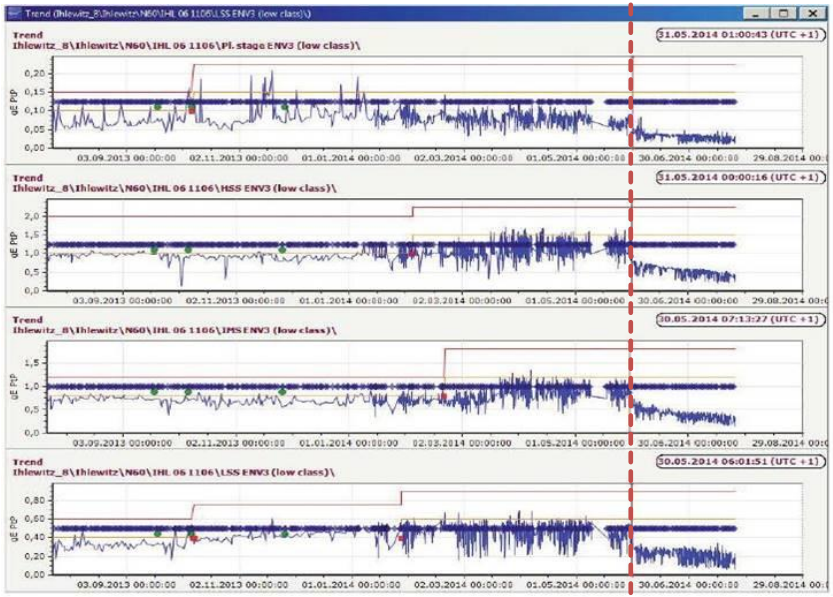
- ✓ Marked up with an oil resistant paint to find the same patch again later
- ✓ Coated with DuraGear® W100

» Review after a duration of 3 months

- Operational wear noticeably reduced
- Reduction of micro pitting
- The contact pattern is optimized

Examples of application: Nordex N60

Stop of the high vibration level and decrease of the damage frequency

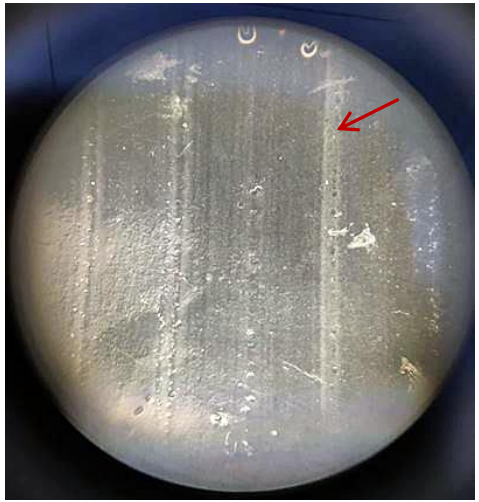


Result of condition monitoring, analysed by SKF Maintenance Services GmbH

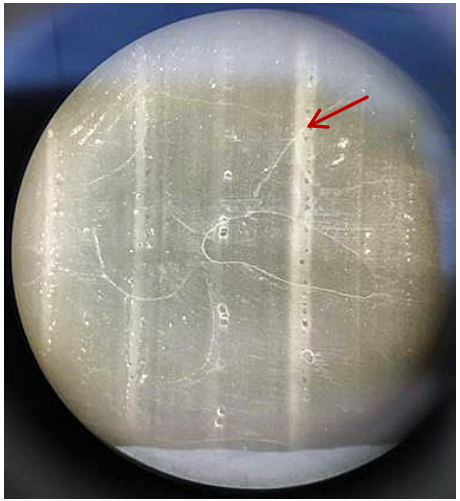
---- Dotted line in analysis marks the point at which DuraGear® W100 was applied to Nordex N60 gearbox

Examples of application: GE 1.5 MW

Analysis of a main bearing – Significant wear after current passage



Before GR400 treatment*



5 weeks after GR400 treatment*

Before Treatment:

R_a: 3,439 µm
Right Track (10x)

After Treatment:

R_a: 1,649 µm
Right Track (10x)

Reduction 52,05 %

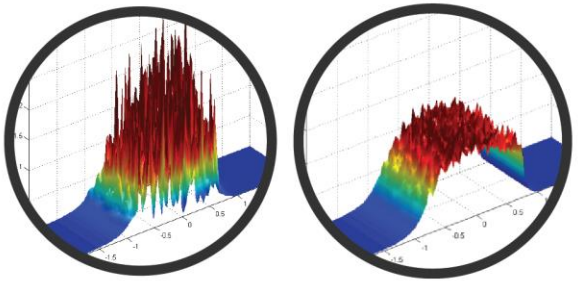
*pictures was taken through the microscope ocular

AT A GLANCE
CONCLUSION

Less surface roughness, friction and temperatures means:

» Less stress in gears and bearings and for lubricants

» Higher lubricating film thickness



– Protected metal surfaces

– Cost saving and higher earnings

– Higher efficiency, reliability and availability

✓ Life time improvement up to 2.6 – 3.3

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