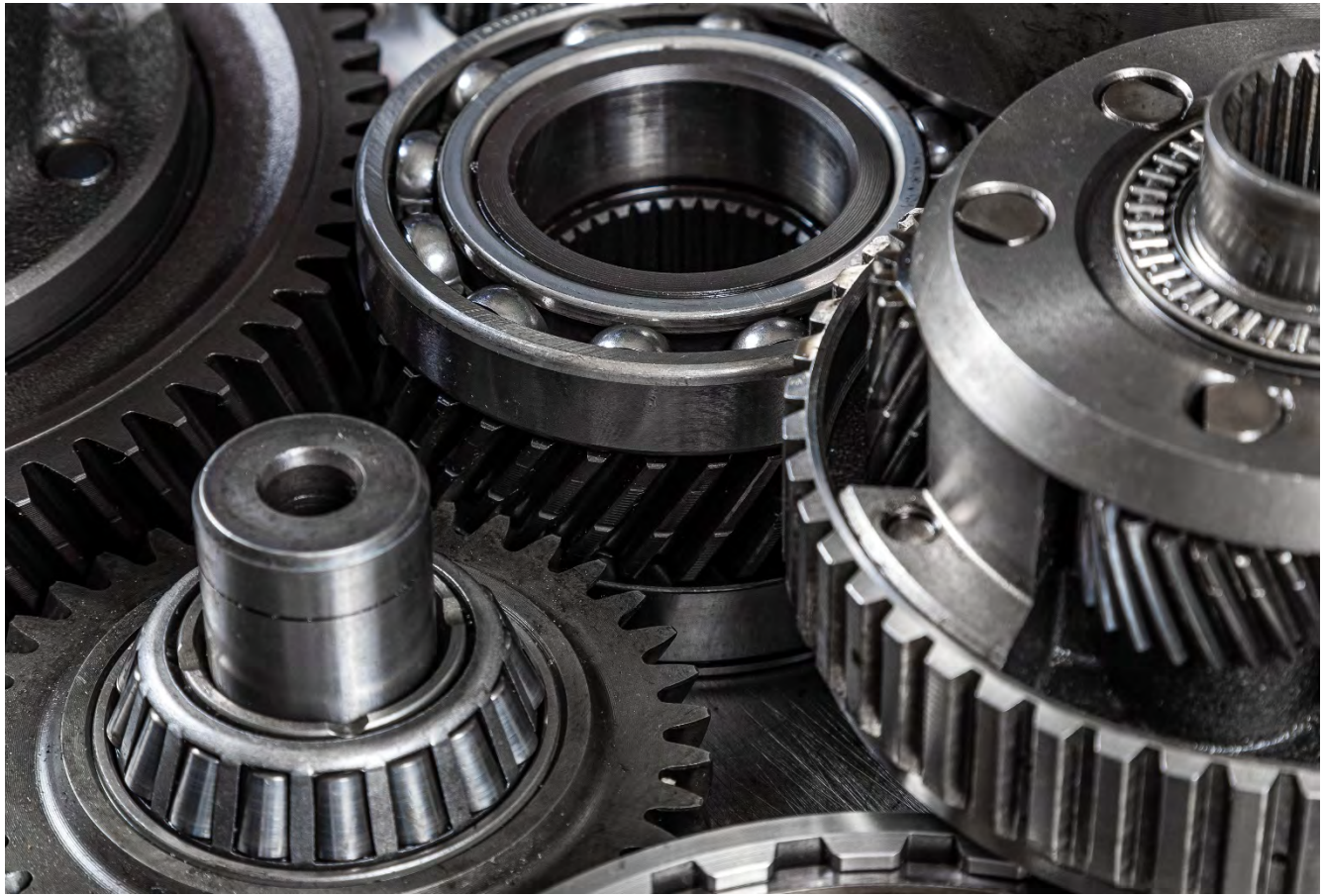


Higher Efficiency and Longer Service Life for Gears and Bearings - Industry

REWITEC GmbH
Dr.-Hans-Wilhelmi-Weg 1
35633 Lahnau
Germany

Target Markets

- **Industry**
  - **Steel**
  - **Cement**
  - **Mining**
  - **Oil, Gas**
  - **Railway**

- Wind energy
  - Onshore
  - Offshore

- Automotive
  - Consumer
  - OEM
  - Motorcycles
  - Racing
  - Classic cars

- Marine
  - Shipping
  - Barges
  - Yachts
  - Submarine

REWITEC Products

DuraGear™

Gears

GR400

Bearings

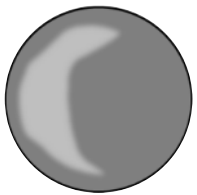
PowerShot™

Engine Oils

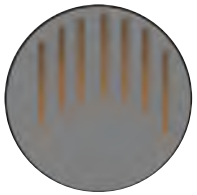
Sprays

Multi-purpose

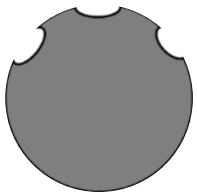
Typical Damage to Gears & Bearings



Micropitting/ grey staining

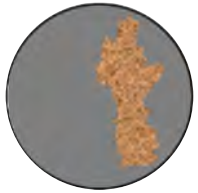


Fretting corrosion

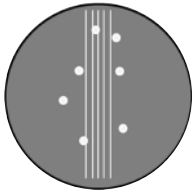


False brinelling

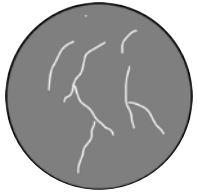
Smearing and scuffing



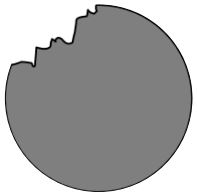
Chemical corrosion



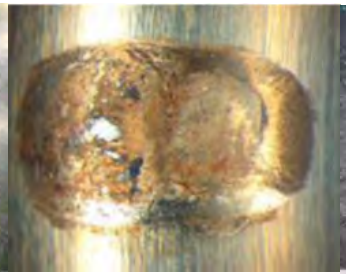
Electric damage



White etching areas/ cracks



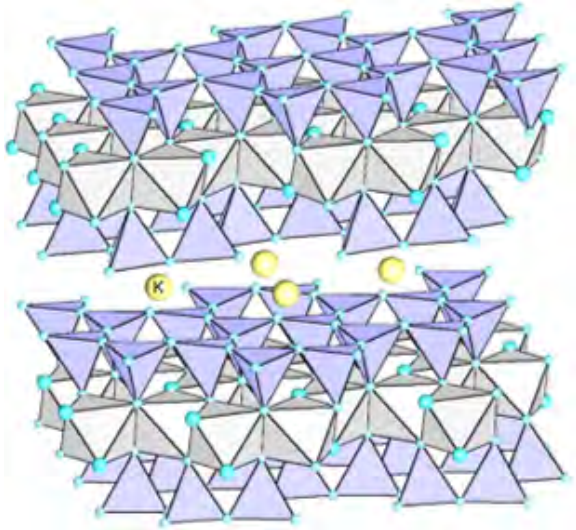
Macropitting



REWITEC Technology

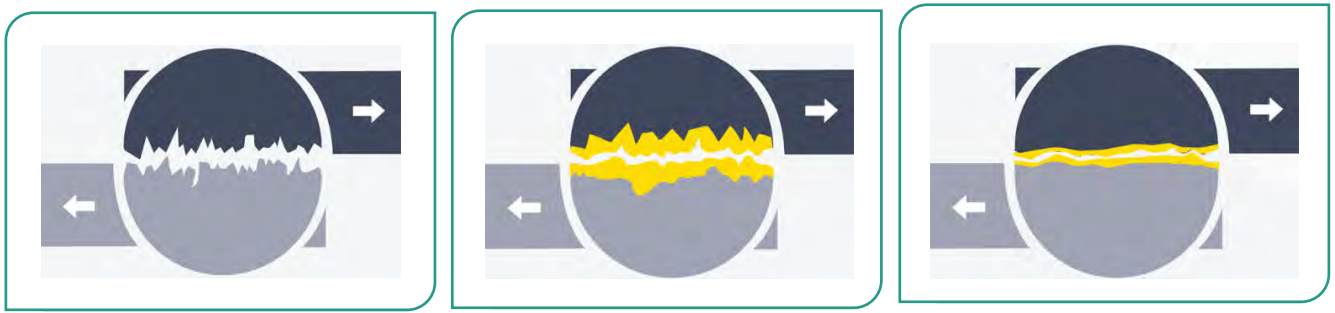
Phyllosilicate Based Particle Additives

- Platelet-shaped particles with layered crystal structure
  - Si-O and Al-O based layers
  - Strong *covalent* bonds within the layer
  - Weak *van der Waals* interaction between the layers
- Easy shearing between the layers
  - **Friction reduction**
- Big specific area with high adsorption ability
  - covering the surface, filling the holes
    - **Protective, repairing and smoothing effect**
- Particle size d90 = 4 µm
- Soft material: Mohs Hardness Scale 2.5 (like fingernail!)



Scientific publication:
”Tribological properties of a phyllosilicate based microparticle oil additive”, Chizhik et al., Wear 426–427 (2019) 835–844

Mechanism of Action



Step 1 Step 2 Step 3

Significant reduction of friction, wear, roughness and temperature

Advantages:

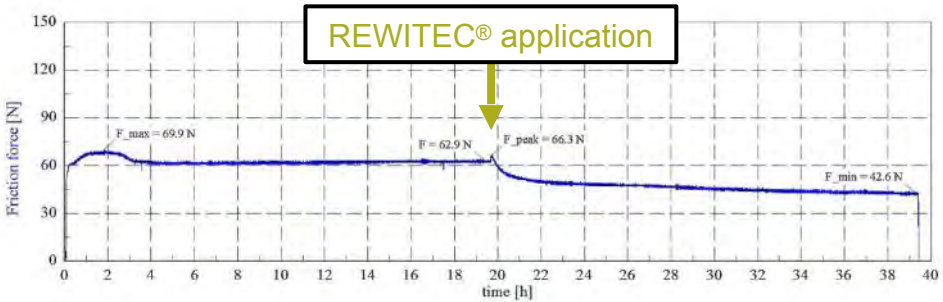
- Compatibility with all common lubricants
- Temperature independent
- No chemical interactions with other lubricant components
- Low dosage

Scientific Tests

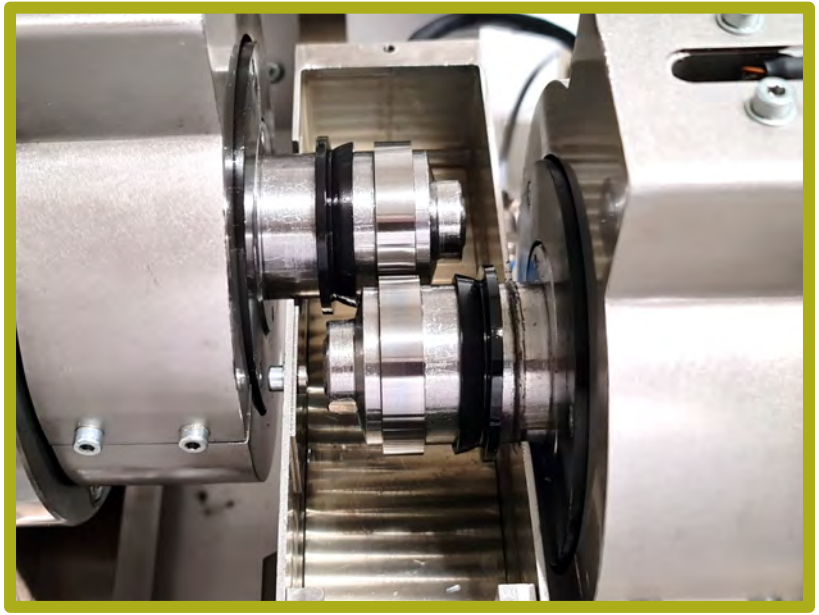
2-Disc Assembly Rolling Wear Test – Gear Oils

Reduction in friction

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



Castrol Optigear Synthetic X320

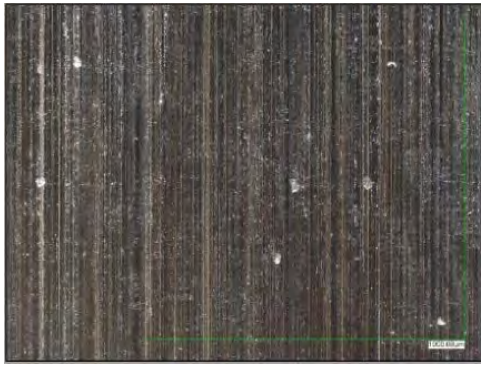


2-Disc Assembly Rolling Wear Test – Gear Oils

Oil	Friction reduction	Roughness reduction
Castrol Optigear Synthetic X320	33 %	41 %
Mobilgear SHC XMP 320	35 %	44 %
Klübersynth GEM 4-320N	40 %	54 %
Fuchs Unisyn CLP 320	36 %	50 %
Amsoil PTN 320	46 %	18 %
Shell Omala S4 GX 320	42 %	25 %
Klüberbio EG 2-150	55 %	40 %
Fuchs Pentosin EG FFL-7A	41 %	35 %
Automotive racing gear oil	55 %	40 %

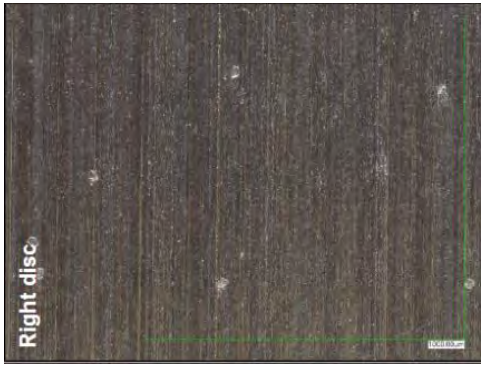
2-Disk surface roughness:
Ra reduced by 34 % / Rz reduced by 40 %

Blank disk



Ra = 0.30 µm
Rz = 2.70 µm

Gear oil + Phyllosilicate



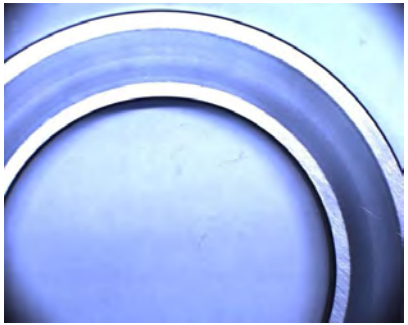
Ra = 0.20 µm
Rz = 1.62 µm

FE-8 Roller Bearing Test

Supported by:
Federal Ministry for Economic Affairs and Energy
on the basis of a decision by the German Bundestag

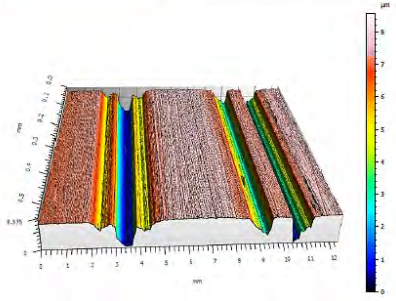
KOMPETENZZENTRUM tribologie MANNHEIM

- Speed: 7.5 rpm
- Test duration: 80 h
- Temperature: 80°C
- Load: 80 kN

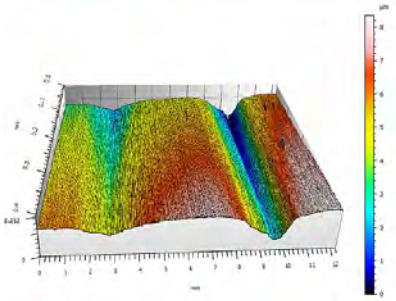


Advantages with REWITEC:

- 17 % less wear
- Smoother surface
- Better load distribution
- Protection for rolling elements and rings



without REWITEC™

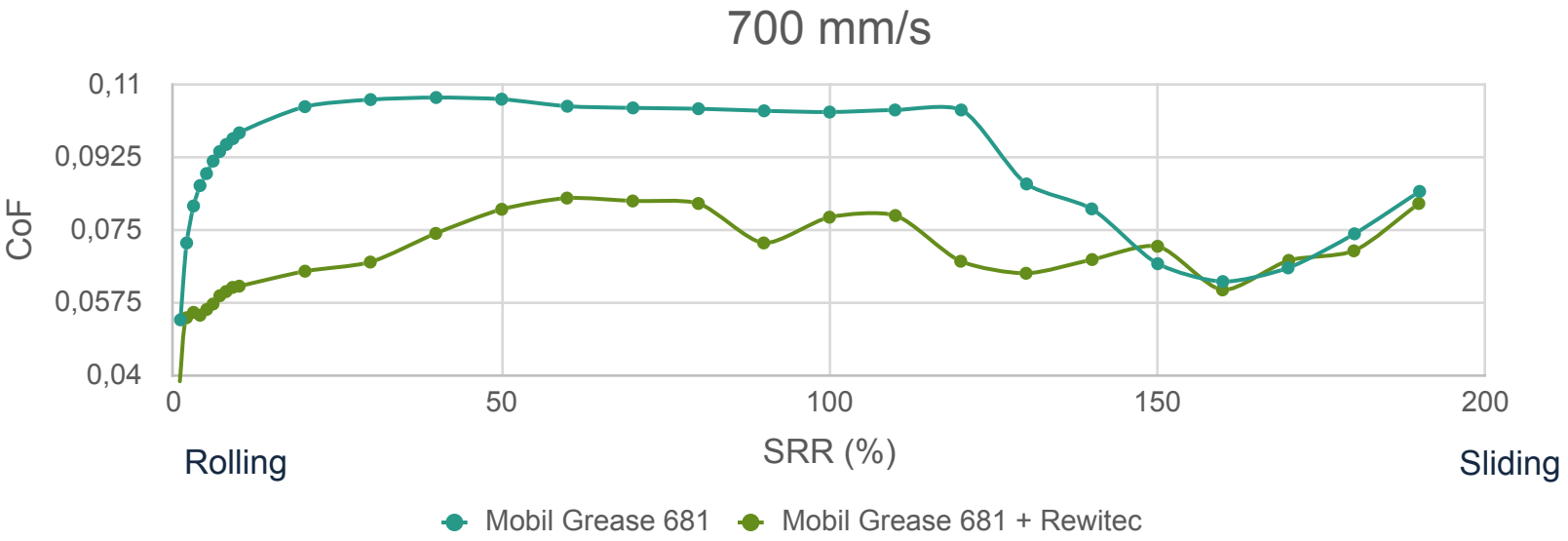


with REWITEC™

REWITEC

MTM Test Bench - Grease Test

- Load: 70 N
- Temperature: 23°C
- Time: 172 s



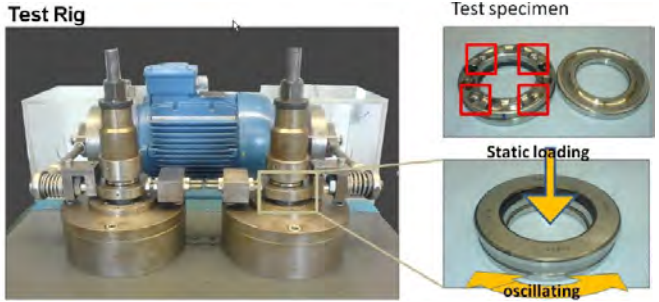
- Up to **38 %** reduction in friction with REWITEC™

False-Brinelling Test – For Pitch Bearing Evaluation

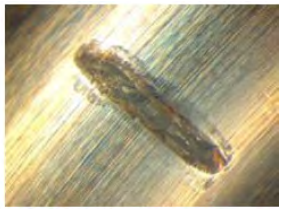
Supported by: Federal Ministry for Economic Affairs and Energy on the basis of a decision by the German Bundestag

KOMPETENZZENTRUM tribologie MANNHEIM

Frequency: 25 Hz
Oszillation angle: +/- 0.5° -> +/- 3.0°
Axial load: 3 kN to 4 balls (750 N per ball)
Temperature: room temperature
Test bearing: ARKL Type 51206 with 4 rolling elements

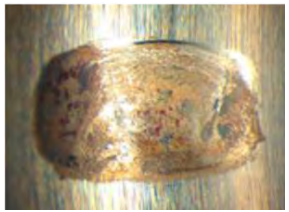


Fuchs LX460

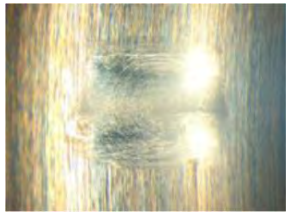


pre-damaging
(1.3 h; +/- 0.5°)

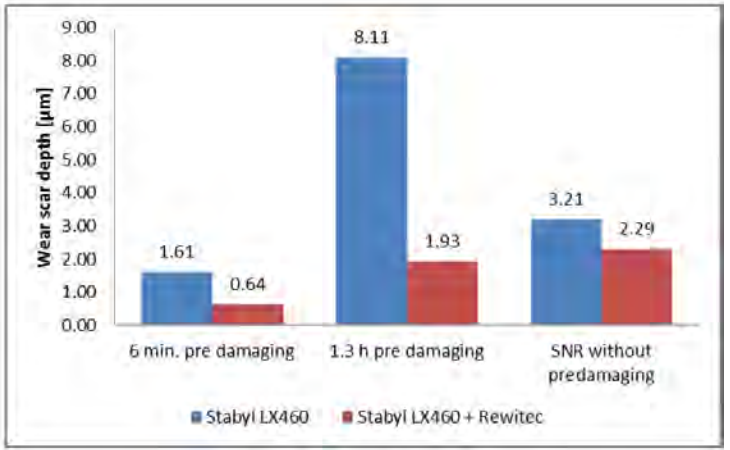
Fuchs LX460



Fuchs LX460 + **REWITEC™**



Run after the damaging
(3 h; +/- 3°)

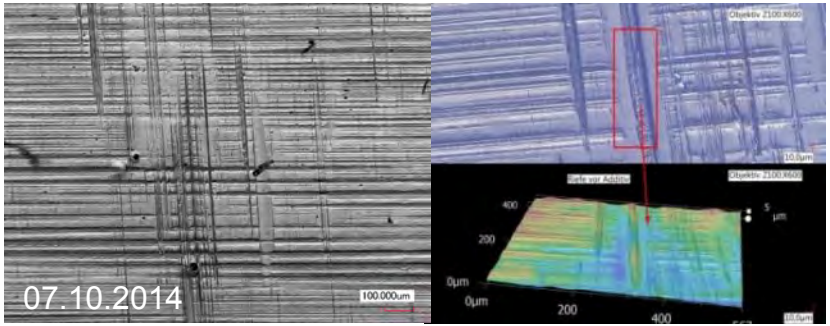


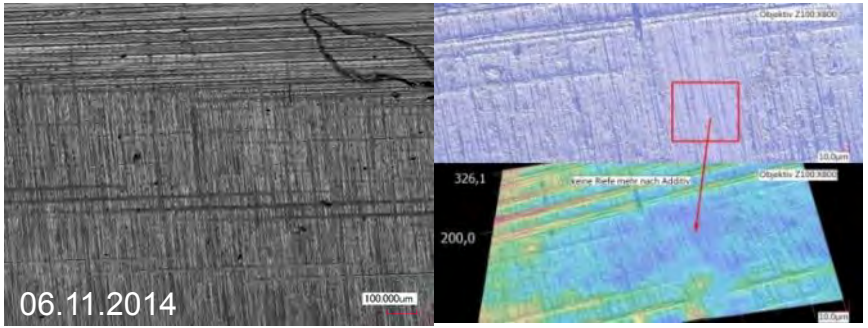
REWITEC

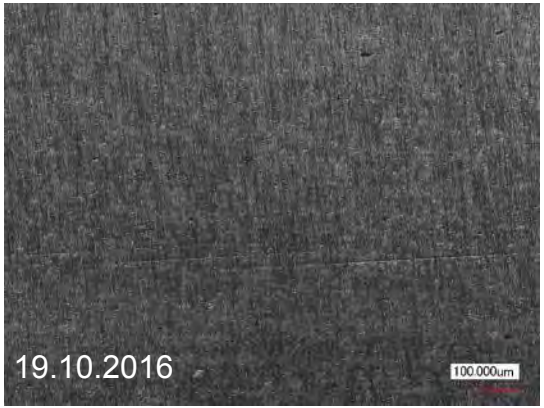
Examples of Application

Example of Application

- Wear development on a Bosch Rexroth gear tooth (GE 1.5 SL) over a period of two years





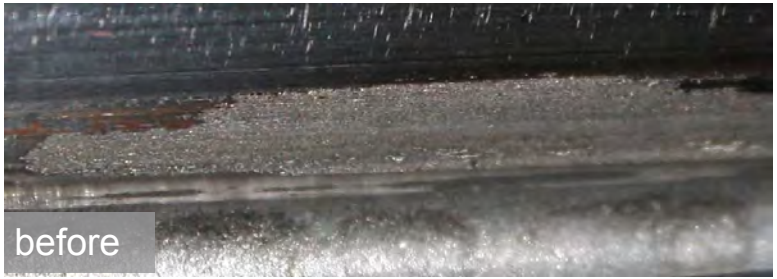


- Run through marks on the tooth flank after 4 weeks and 2 years:
  - Reduction of the surface roughness and friction force
  - Improved load carrying capacity
  - Less stress for the tooth flank

Example of a Gearbox Application

- Gearbox CSIC 2 MW VSCF

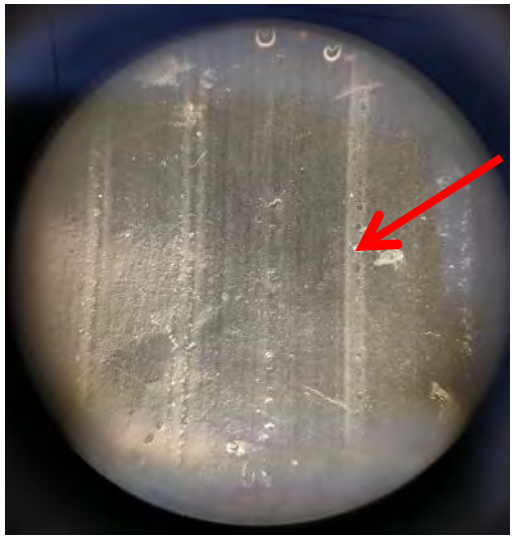
- Significant operational wear visible
- In the foot area visible micro pitting
- Oxidation visible



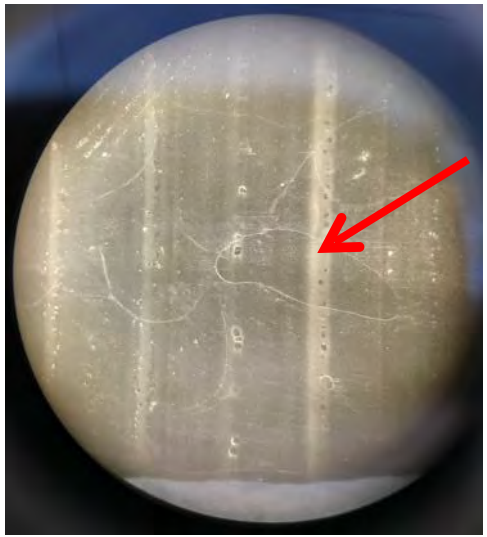
- Operational wear noticeable reduced
- Reduction of micro pitting
- The contact pattern is optimized

Coating and Analysis of a GE 1.5 MW Wind Turbine Main Bearing (Outer Ring)

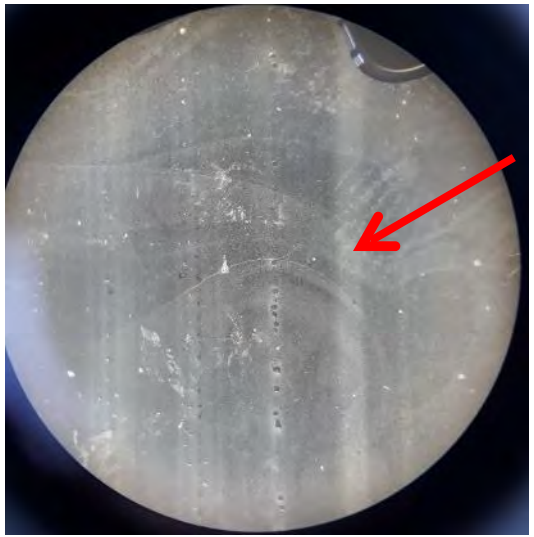
Picture: **Before** wind turbine was treated



Picture: **6 months after** wind turbine was treated with additive



Picture: **12 months after** wind turbine was treated with additive



→ Red arrow shows the same right track on the surface imprint

Coating and Analysis of a GE 1.5 MW Wind Turbine Main Bearing (Outer Ring)

Picture: **Before** wind turbine was treated

Ra = 0,556 µm (within the track)

Picture: **6 months after** wind turbine was treated with additive

Ra = 0,403 µm (within the track)

Picture: **12 months after** wind turbine was treated with additive

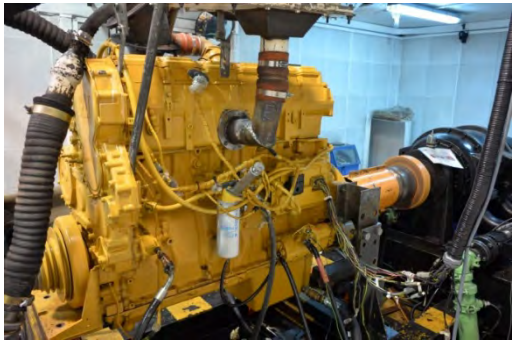
Ra = 0,225 µm (within the track)

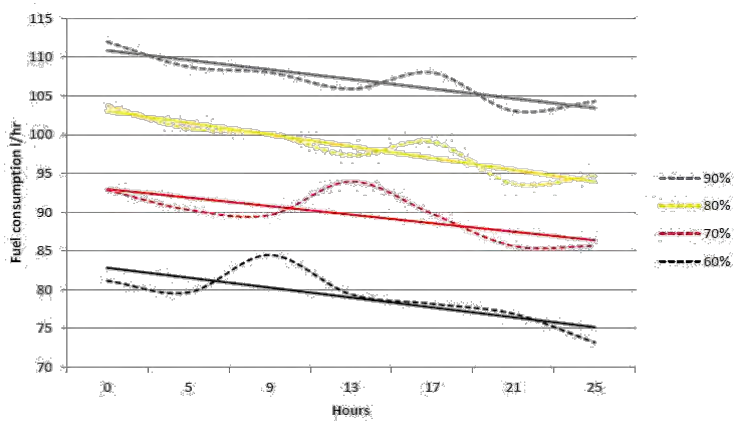
Red arrow shows the same right track on the surface imprint

Coating and Analysis of a Diesel Generator

- Task:
  - Fuel saving

- Result:
  - In long-term testing with certificated measurement instruments, the following was noted:
    - Up to **9 %** fuel savings in the tested diesel generator





Komatsu 980E-5 Truck

Cummins Engine - Chinalco Peru SA Mining Company

Aim:

✓To evaluate the performance of **DuraGear ® 50 additive** in Mobil SHC 680 OH synthetic oil in the final drives of the **Komatsu 980E-5 truck fleet** .

Results :

✓Reduction of iron (Fe) and PQ wear in the oil after application of the additive.

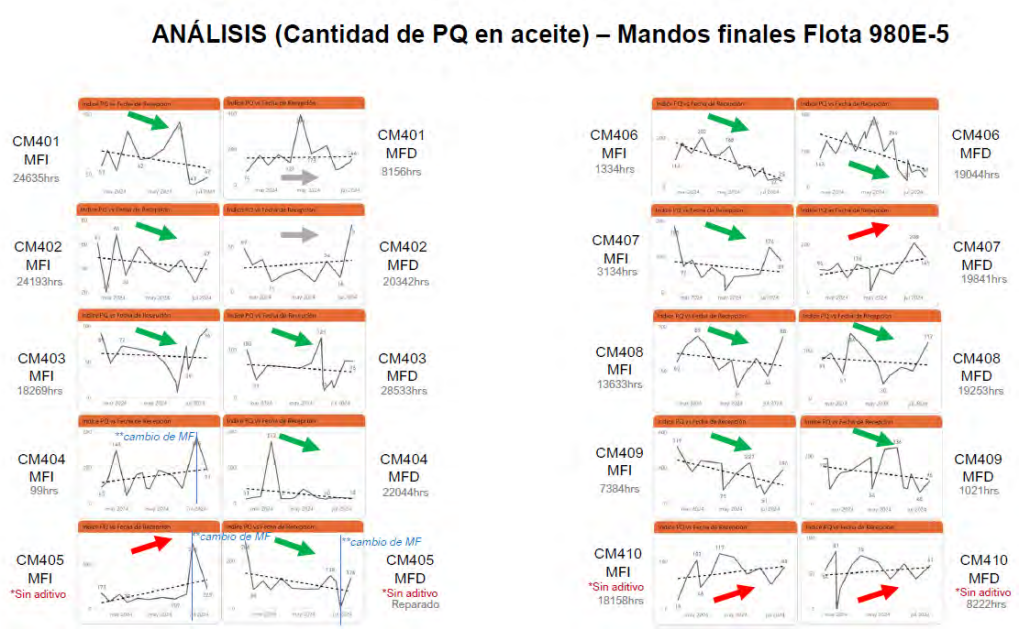
✓Less ferrous debris in magnetic plugs.

✓Stability in the viscosity index of the oil.

✓Trucks without additive showed greater wear and PQ generation.

Benefits :

✓With a combined strategy of using the **DuraGear ® 50 additive** and microfiltration, the PCR of the final drives was increased from 20,000 hours to 22,000 hours.



Caterpillar ® 777G Truck

Caterpillar C32 Engine - Chinalco Peru SA Mining Company

Aim :

✓Evaluate the performance of the **PowerShot ® 20 additive** in the engine oil of the CM207 truck (model: **CAT ® 777G)** to perform the economic analysis in the decision-making process to extend the PCR by 18,000 hours.

Results :

✓**Reduced wear:** Decreased wear rate of Fe, Pb, Sn, Cr and Cu in SOS results, which shows an increase in the protection of crankshaft main and connecting rod bearings, compression rings and timing gear surfaces.

✓**Improved alkaline reserve (TBN):** Increased the oil's ability to neutralize acids, which improves its stability.

✓**Reduced Internal Friction:** Engine temperatures have been reduced, suggesting less friction between components and increased fuel economy.

Benefit :

✓Customer saves dealer repair costs and extends engine PCR up to +26,000 hours (until the component goes out of service)

Caterpillar ® 797F Truck

Caterpillar C175-20 Engine - Chinalco Peru SA Mining Company

Aim :

✓**PowerShot ® 50** additive in the engine oil of the CM121 truck (model: **CAT ® 797F)** to perform the economic analysis in the decision making of expanding the PCR (1.2 million gallons of fuel burned)

Results :

✓**Improved alkaline reserve (TBN):** Increased the oil's ability to neutralize acids, which improves its stability.

✓**Soot generation reduction:** Soot was kept below 80 UFM (dealer-indicated damning limit).

✓**Stability in oil viscosity:** The oil maintained its viscosity more stably.

✓**Reduction in fuel consumption:** Minestar records showed that the engine had lower fuel consumption than the fleet average.

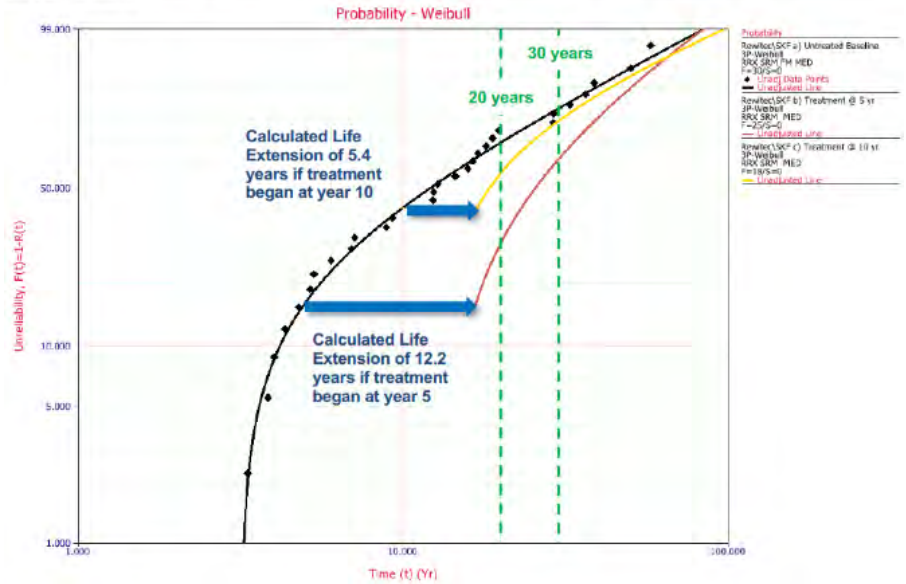
Benefit :

✓Engine exceeded PCR (2.1 million gallons of fuel burned)

Lifetime Calculation

Calculated Life Extension of up to 17 Years

Acciona AW1500 Generator Side Mainshaft bearing – SKF 23188

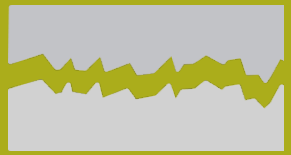


- **Results:**
  - Significant reduction in the probability of failure of a main bearing by REWITEC®
  - Less roughness
  - Less friction
  - More even load distribution
  - Lower local pressure/stress

The earlier the application, the greater the lifetime extension

Our Services

Technical consulting, up-tower inspections



Component surface imprinting

Component damage analysis and reporting

Conclusion

- Less surface roughness, friction and temperature in the drive train system means:
  - Less stress and wear for gearboxes and bearings
  - Less stress and longer life for the lubricants
  - Repairing and protection effect
  - Significant lifetime improvement
  - Optimized performance
  - Reduction in fuel consumption
  - Higher efficiency
  - Higher reliability and availability, no downtime
  - Reduction of oil consumption
  - Cost savings, higher earnings

Do you need more information?

Please do not hesitate to contact us.

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