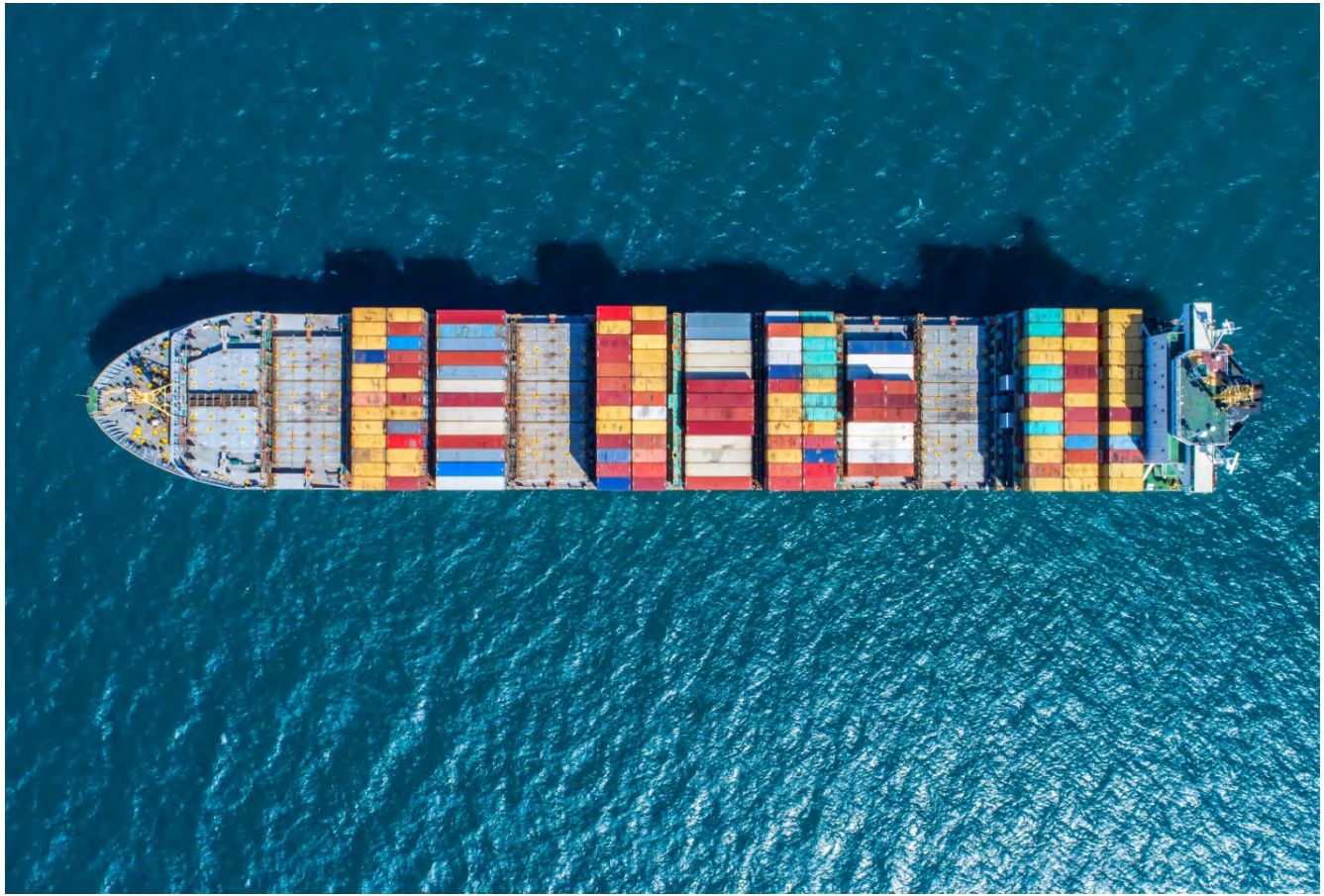


Higher Efficiency and Longer Service Life for Gears and Bearings - Marine

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

REWITEC

Target Markets

- **Marine**
  - **Shipping**
  - **Barges**
  - **Yachts**
  - **Submarine**

- Wind energy
  - Onshore
  - Offshore

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

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

REWITEC Products

DuraGear™

Gears

GR400

Bearings

PowerShot™

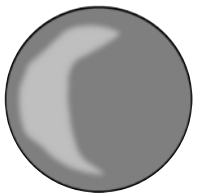
Engine Oils

Sprays

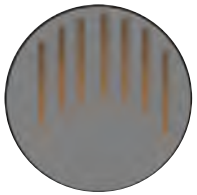
Multi-purpose

REWITEC

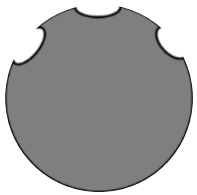
Typical Damage to Gears & Bearings



Micropitting/ grey staining

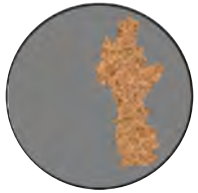


Fretting corrosion

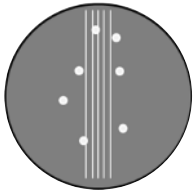


False brinelling

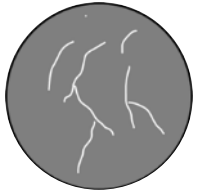
Smearing and scuffing



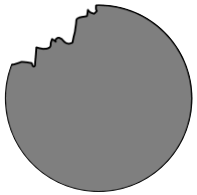
Chemical corrosion



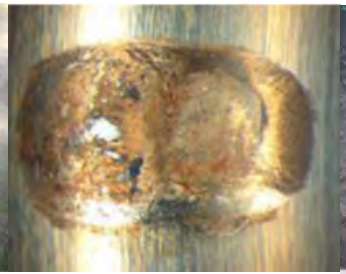
Electric damage



White etching areas/ cracks



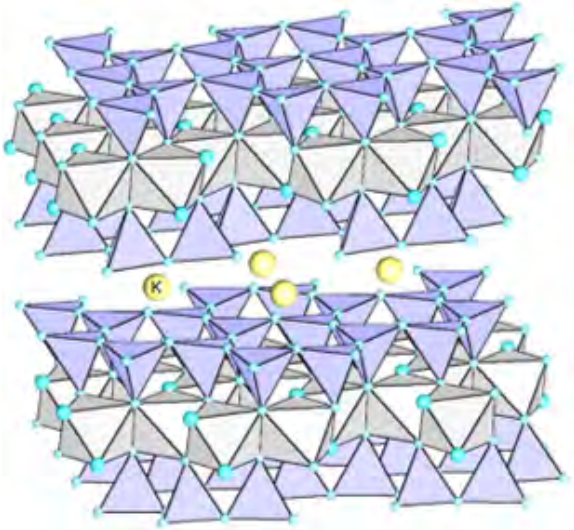
Macropitting



REWITEC Technology

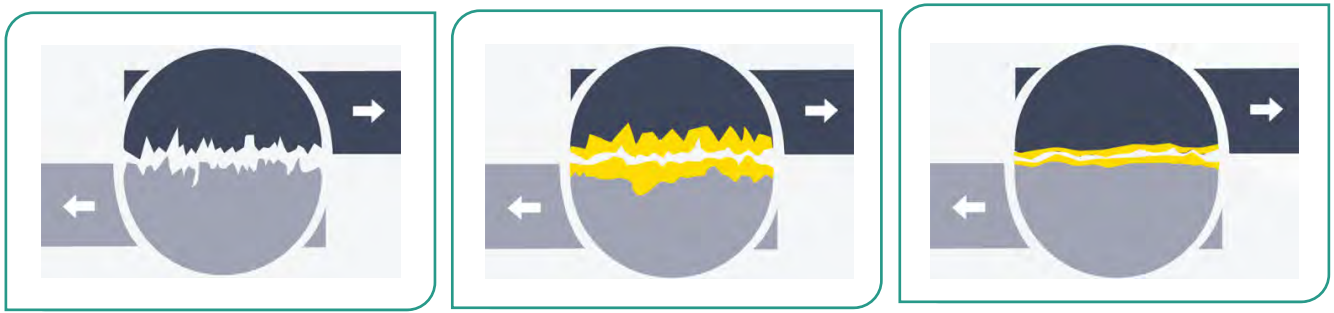
Phyllosilicate Based Particle Additives

- 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:

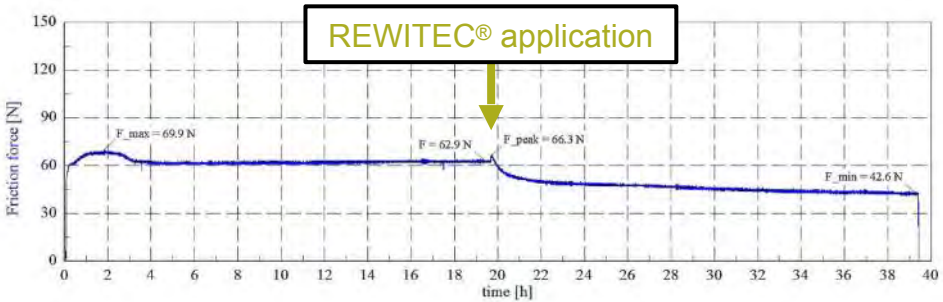
- Compatibility with all common lubricants
- Temperature independent
- No chemical interactions with other lubricant components
- Low dosage

Scientific Tests

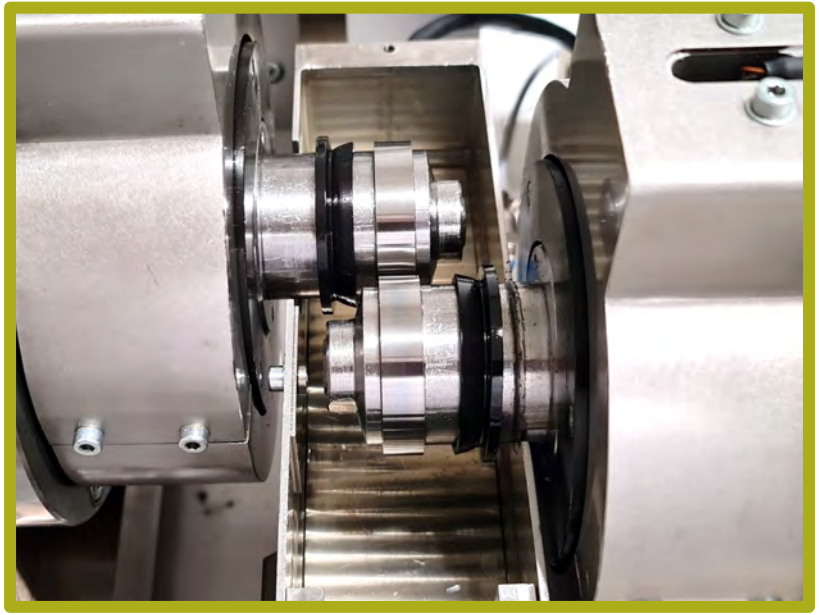
2-Disc Assembly Rolling Wear Test – Gear Oils

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

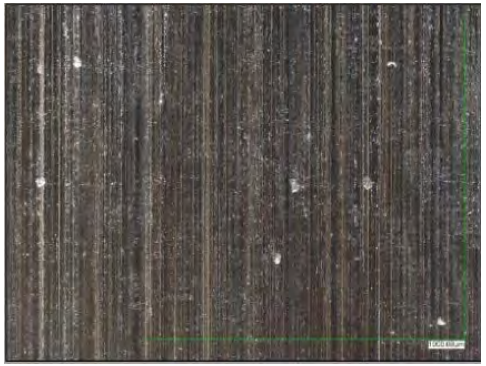


2-Disc Assembly Rolling Wear Test – Gear Oils

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 %

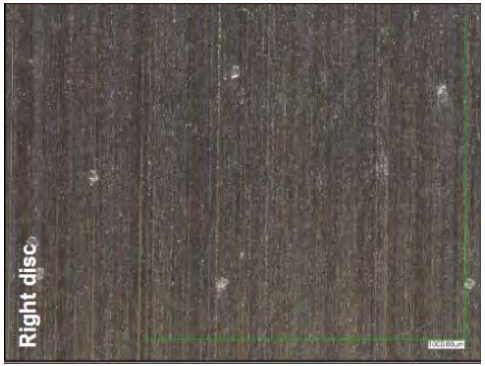
2-Disk surface roughness:
Ra reduced by 34 % / Rz reduced by 40 %

Blank disk



Ra = 0.30 µm
Rz = 2.70 µm

Gear oil + Phyllosilicate

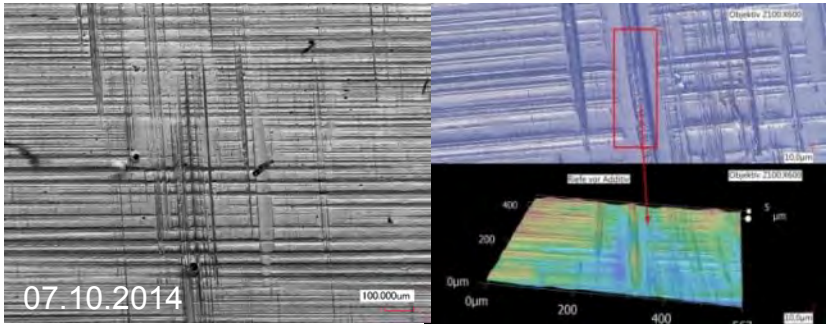


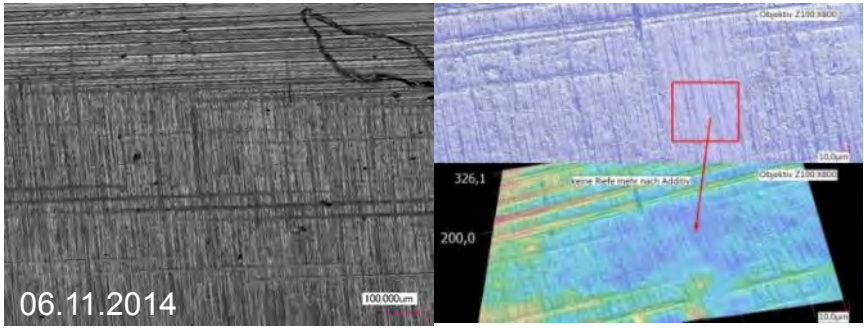
Ra = 0.20 µm
Rz = 1.62 µm

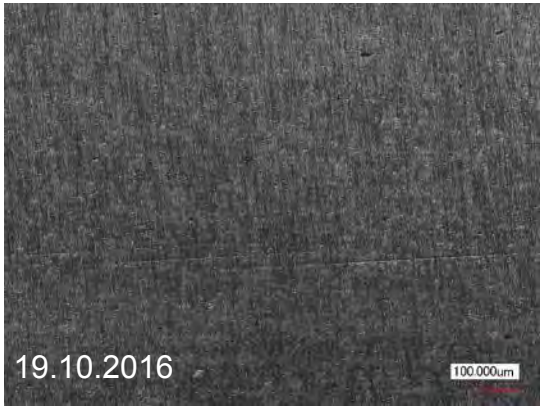
Examples of Application

Example of Application

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



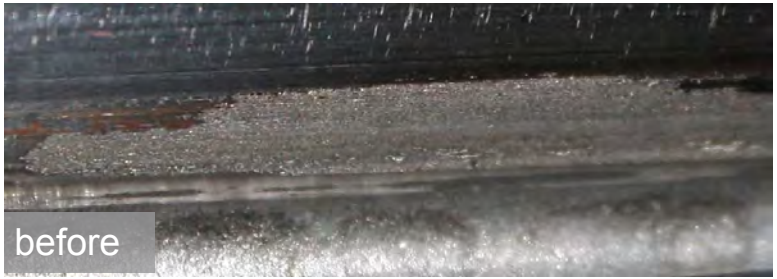




- Run through marks on the tooth flank after 6 weeks and 2 years:
  - Reduction of the surface roughness and friction force
  - Improved load carrying capacity
  - Less stress for the tooth flank

Example of a Gearbox Application

- Gearbox CSIC 2 MW VSCF

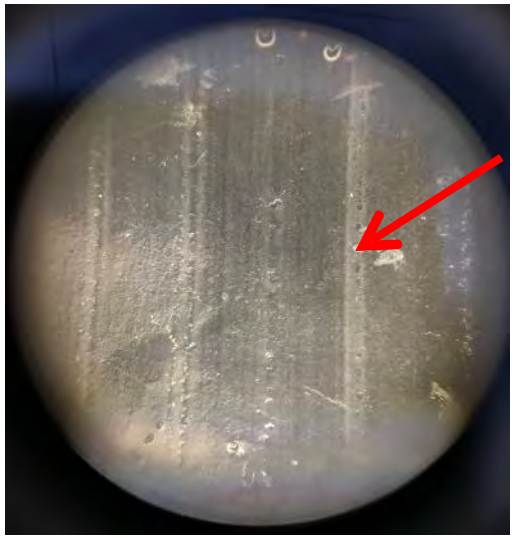


- Significant operational wear visible
- In the foot area visible micro pitting
- Oxidation visible

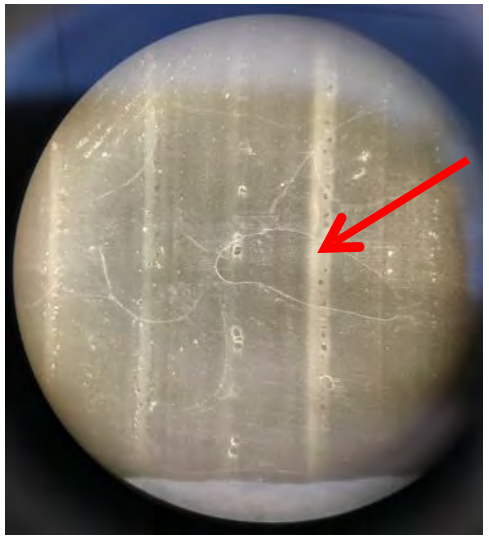
- Operational wear noticeable reduced
- Reduction of micro pitting
- The contact pattern is optimized

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

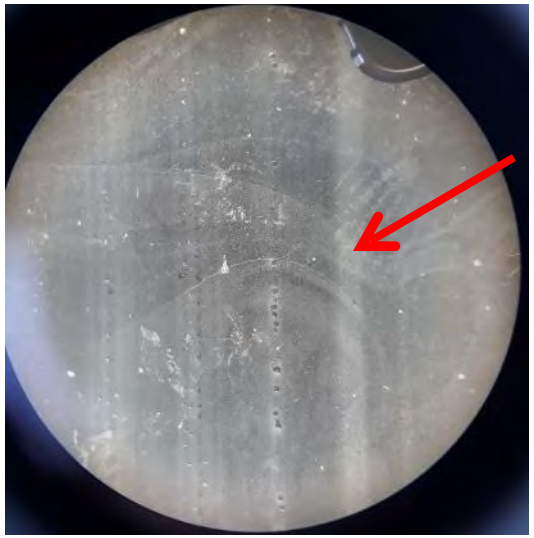
Picture: Before wind turbine was treated



Picture: **5 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: 5 months after wind turbine was treated with additive

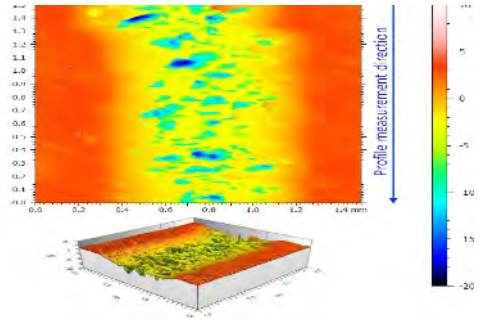
Ra = 0,403 µm (within the track)

Picture: 12 months after wind turbine was treated with additive

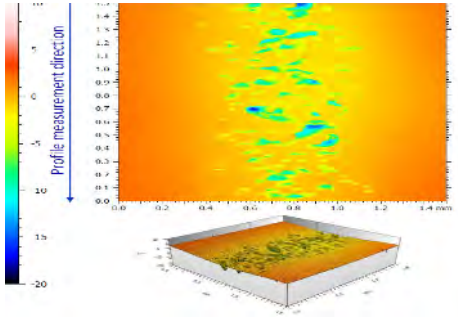
Ra = 0,225 µm (within the track)

Red arrow shows the same right track on the surface imprint

Main Bearing (Outer Race) on GE 1.5 MW Wind Turbine



Before wind turbine was treated with additive

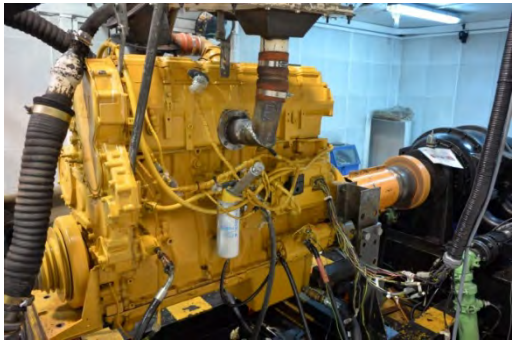


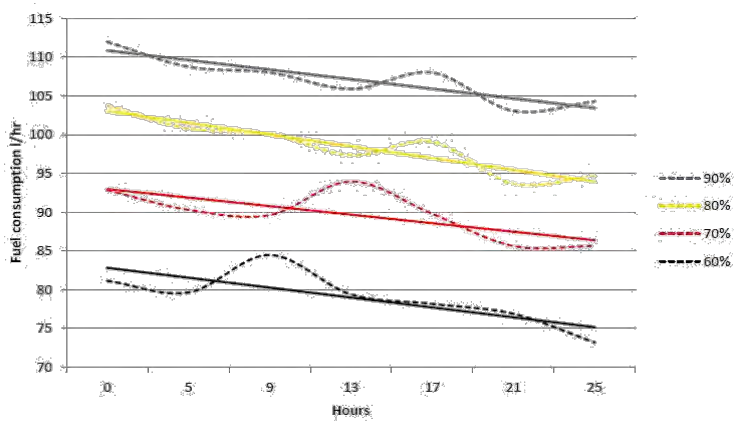
6 months **after** wind turbine was treated with additive

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

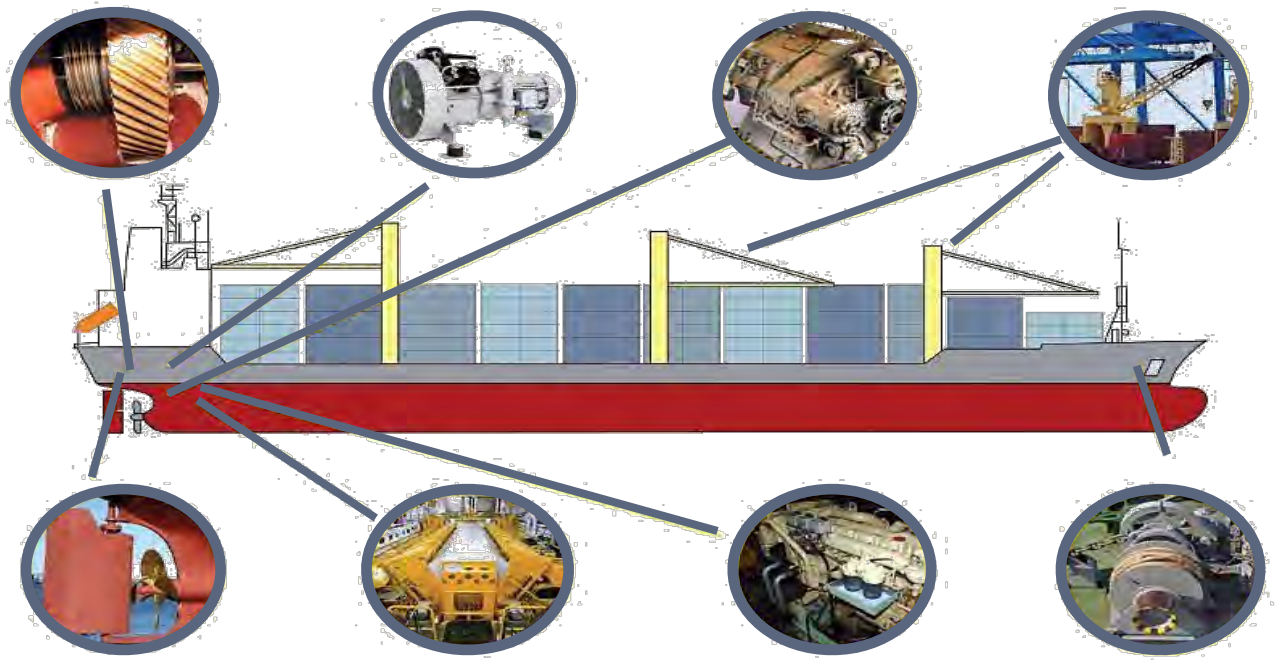




Ships and Boats

- Main engines (2- and 4-stroke)
- Auxiliary diesel engines
- Gears of all kind
- Rudder gearbox and variable-pitch propellers
- Separators
- Compressors
- Bearings of all kind
- Lloyds Register Certification (in preparation)

- Seperators
- Compressor
- Main gearbox
- Crane gearbox



- Rudder gearbox and variable-pitch propellers
- Main engines
- Auxiliary engines
- Winch gearbox

REWITEC

Application on 2-Stroke Ship Main Engine

Cylinder 1:
treated with REWITEC

Engine: CMD-MAN B&K 8K80ME-C MK9

*Both Cylinders have similar low amount of running hours before the first treatment

Cylinder 2:
No REWITEC treatment

Inside Cylinder 1
(with REWITEC)

Imprint Cylinder 1
(with REWITEC)

Inside Cylinder 2
(without REWITEC)

Imprint Cylinder 2
(without REWITEC)

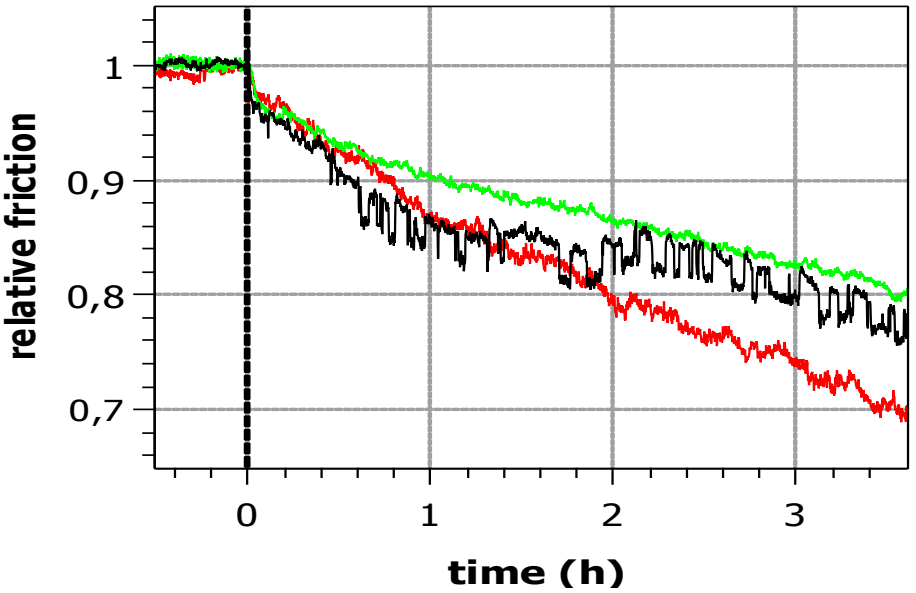
Coating and Analysis of a Ship Generator

- Task:
  - Fuel saving

- Result:
  - In long-term testing with certificated measurement instruments, the following was noted:

  - Significant fuel savings in the tested diesel generator „Daihatsu 6 DK28“ → 3,8 % fuel consumption reduction

Pin-on-Disc Test – Exxon Marine Oils



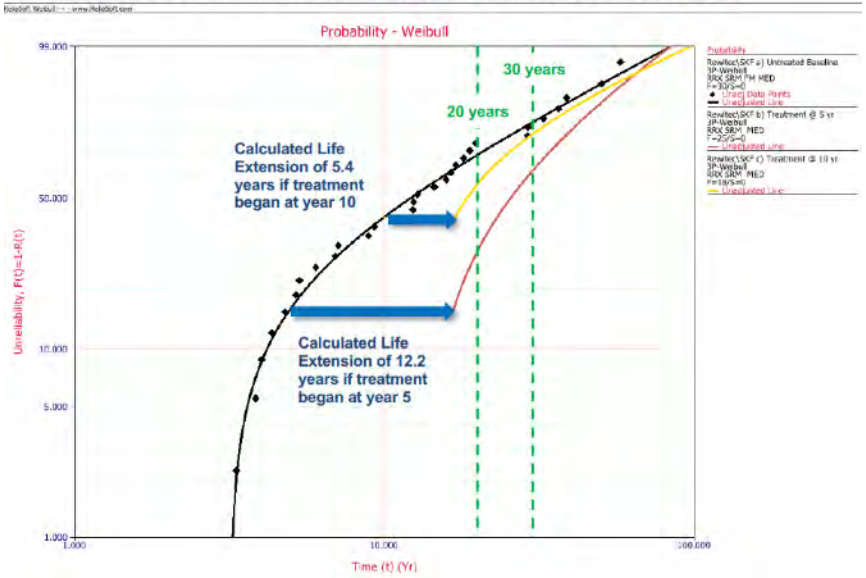
- Oil Mobilgard 412 for A/E
- Oil Mobilgard 300C for M/E Circ.
- Oil Mobilgard 5100 L.O. Cyl.

- Parameter:
  - 70° C; 7 N; 2,500 min-1

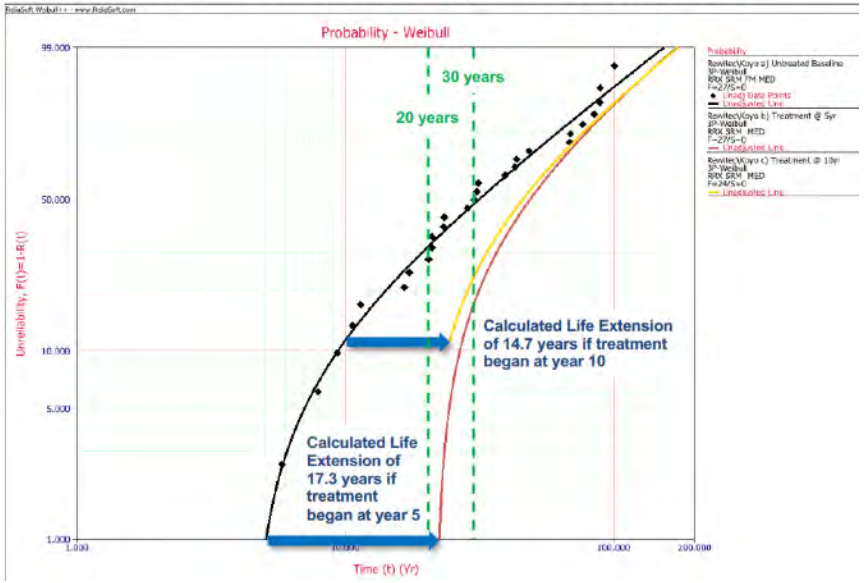
Lifetime Calculation

Calculated Life Extension of upto 17 Years

Acciona AW1500 Generator Side Mainshaft bearing – SKF 23188



GE Energy 1.6/1.7-100 Mainshaft bearing – KOYO Model 240/710

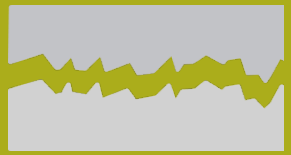


Significant reduction in the probability of failure of a main bearing post application

The earlier the application, the greater the lifetime extension

Our Services

Technical consulting



Component surface imprinting

Component damage analysis and reporting

Conclusion

- Less surface roughness, friction and temperature in the system means:
  - Less stress and wear for gearboxes, bearings and engines
  - Higher efficiency
  - Repairing and protection effect
  - Less stress for the lubricants
  - Higher reliability and availability, less downtime
  - Significant equipment lifetime improvement
  - Cost savings, higher earnings

Do you need more information?

Please do not hesitate to contact us.

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