REWITEC® Surface Technology

Wear Protection and Refinement of Metal Surfaces in Tribologic Systems




Who we are

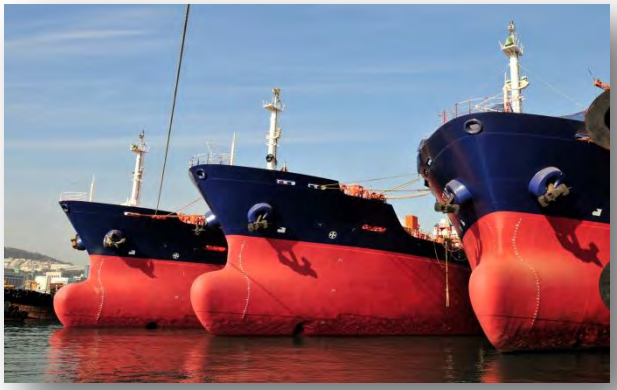
REWITEC® is developer, manufacturer and distributor of active ingredients on nano and micro bases for surface refinements, which are used to reduce friction and wear on metal surfaces in tribologic systems.

- Establishment in 2003
- Since then dealer based and direct sales world-wide
- Founder and Managing Partner: Stefan Bill

Our target groups

wind energy

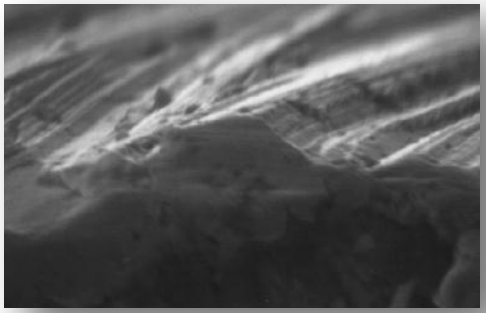
marine



industry

automotive

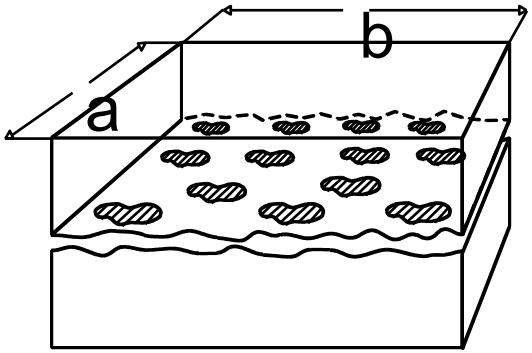
Tribology, friction, wear



• **Tribology:**
The science and engineering of interacting surfaces in relative motion. It includes the study and application of the principles of friction, lubrication and wear (→ Wikipedia).

• **Friction:**
„Outer friction“, also known as *Solid Body Friction*, because it appears between contact surfaces of touching solid bodies. It is devided in *static friction, sliding friction and rolling friction.*

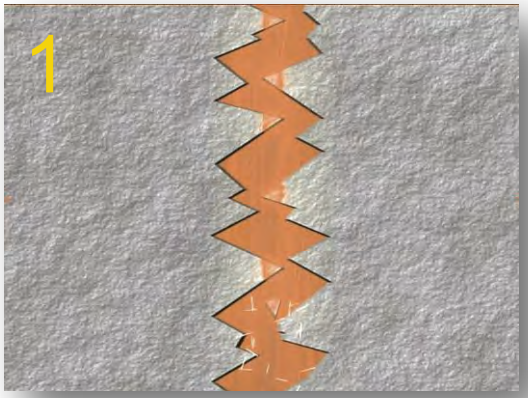
• **Wear:**
Wear (abrasion) is the mass loss (surface erosion) of a material surface due to grinding, rolling, hitting, scraping, chemical or thermal load



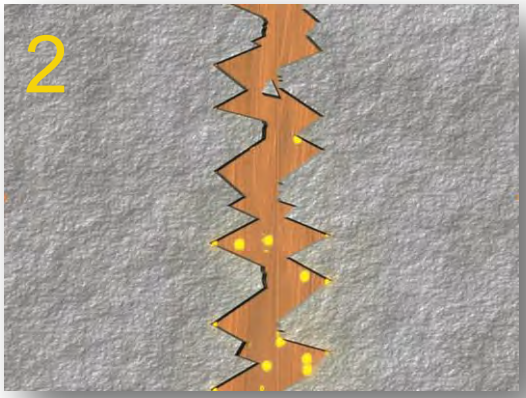
Our products

- Synthetic and mineral silicate-based active ingredients in nano and micro segment
- Reducing friction, temperature and roughness of metal surfaces in tribologic systems (e.g. combustion engines, gears, bearings etc.)
- Replacing the friction pair *Metal/Metal* by *Metal Ceramic/Metal Ceramic*

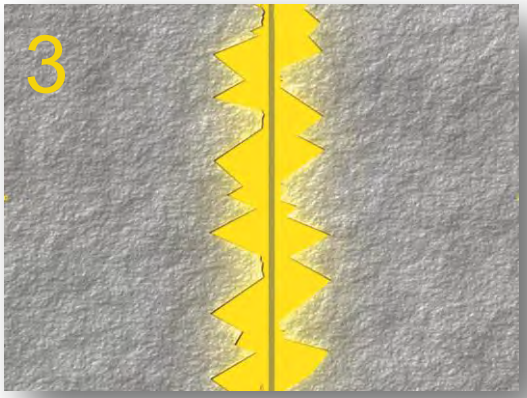
The coating process



Friction and pressure in engines, gears and bearings generates high temperature on metal surfaces that trigger the physical-chemical bonding process of the REWITEC® coating.



The nano-micro particles remove dirt from the rubbing metal surfaces and react with the metal atoms to form a smooth and protective layer on the surface.



The final result is a new and very smooth metal surface structure. Their properties, in turn, give the machine higher efficiency and longer life-time.

Advantages of our technology

- Reduction of abrasion and wear of rubbing metal surfaces
- Surface optimization „hot plug-in“ without down-time
- Significant improvement of the original material properties
- Increase of machine performances
- Decrease of friction, vibrations and temperature

Advantages of our technology

- Cost savings by
  - increase of durability
  - reduction of repairs
  - prolongation of maintenance intervals

- Optimization of efficiency
  - improvement of energy efficiency up to 33% *)
  - cutting of fuel consumption up to 11% **)
  - reduction of emissions (particles, CO_2, HC and NO_x) up to 64% **)
  - emergency running properties in case of oil loss

- and more…

*) in mixed friction, University of Mannheim (9/2012)
**) University of Applied Science of Frankfurt (2/2007)

An additive?

Yes and no…

- REWITEC® is applied to the lubricant…
  …and does not change it's original properties!
- The substance reduces the friction on metal surfaces…
  …and uses the lubricant as a medium carrier
- The product is dosed very low…
  …and compatible with all mineral and synthetic oils

Insofar more a high grade surface refinement than a simple lubricant add-on!

An additive?

REWITEC®

e·on | Engineering

Fuel- and lubricant analytics

Org.einheit: OSF
Name: Ertelt
Datum: 04.02.2009
Seite 1 von 1
Telefon: 0209-601 6443
Telefax: 0209-601 6403

Lubricant – complete analysis

CW/Bloc	Analyse No.	Description of testing	Appearance	Water KF mg/kg	NZ mg KOH/g	Refraction index n 25 D	LAV min	Corrosion Grade	Aging IR 1723cm $^{-1}$	Foam test 24° C Ml	
	Date Probe-Nahme	Remark	Type of oil	Solid particles 0,45 µm mg/l	Viscosity 40°C mm^2/s	Colour 510 nm	WAV s	Corrosion Remark	Phenol-inhibitor M.-%	Foam test 24°C time	Tributyl-phosphate M.-%
Internal Analyses	61830	Rewitec special test	yellow, clearly	25	0,08	1,4766	3,0	-	< 0,50	< 10	-
	14.11.08	Unused oil	BP Turbinol X 46	240	45,5	0,023	75	-	0,07	00' 25"	-
	Results:										
Internal Analyses	61831	Rewitec special test	brownish, clearly	25	0,08	1,4759	3,0	-	< 0,50	110	-
	14.11.08	Unused oil with 2,5M.-% Additiv IGx Coating concentrate	BP Turbinol X 46	390	43,7	0,136	75	-	0,07	01' 46"	-
	Results:										

NZ: Neutralization index
LAV: Air separation capability
WAV: Water separation capability

Remarks: The important oil data NZ, LAV and WAV will not be changed. Appearance and colour are changed due to the coating concentrate. Viscosity and foam test show only a slightly change, but in tolerances. Rewitec is no oil additive, but a surface refinement.

Fields of application and opportunities

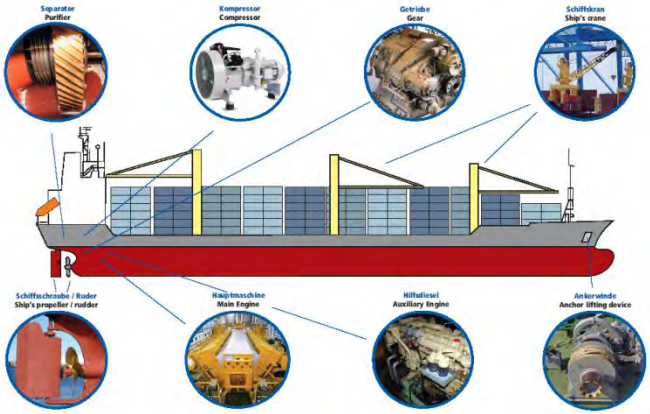
Wind turbines and industrial equipment:

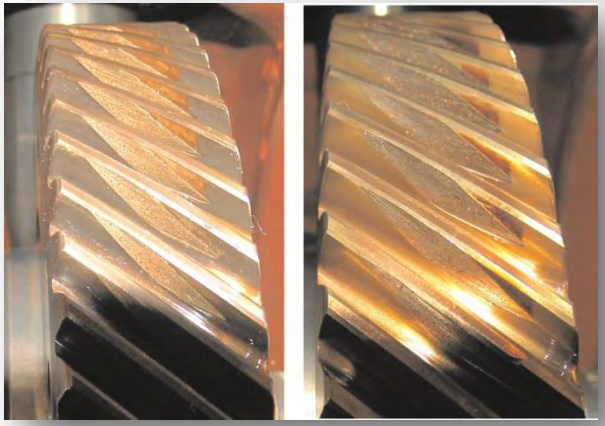
- Gears of all kind
- Bearings of all kind
- Combustion engines
- Compressors
- Hydraulic pumps and engines
- Vacuum pumps
- Chain conveyors
- Pinions
- Gear racks
- and many more…

Fields of application and opportunities

Ships and boats:

- Main engines (2- and 4-stroke)
- Auxilliary diesel engines
- Gears of all kind
- Separators
- Compressors
- Bearings of all kind





Fields of application and opportunities

Commercial and rail vehicles:

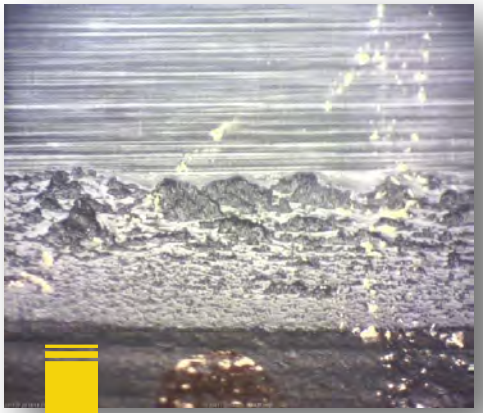
- Gasoline and diesel engines
- Gears
- Rear axles an differentials
- Joints and shafts
- Compressors
- Bearings of all kind

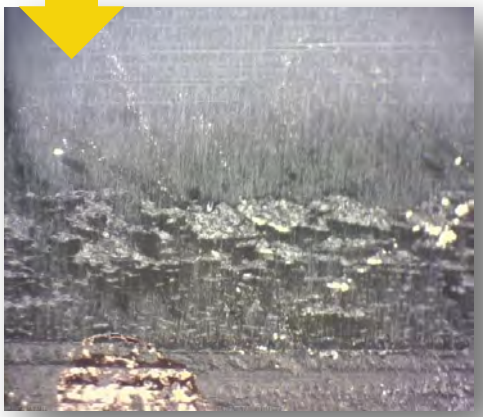
Fields of application and opportunities

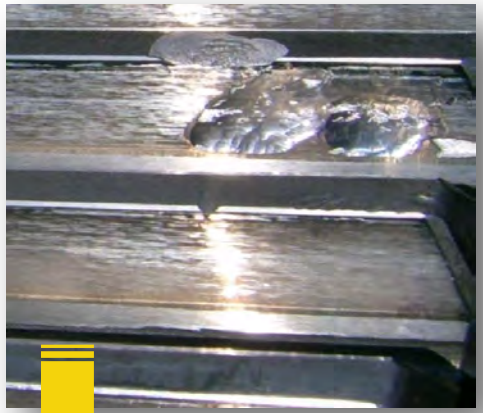
Passenger cars, oldtimer, sports cars, bikes…

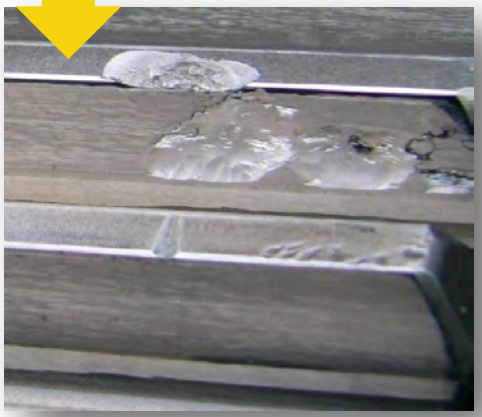
- Gasoline and diesel engines
- Gear boxes
- Rear axles, differentials
- Joints and shafts
- Bearings of all kind
- Drive chains

Before/after comparison (wind turbine gears)

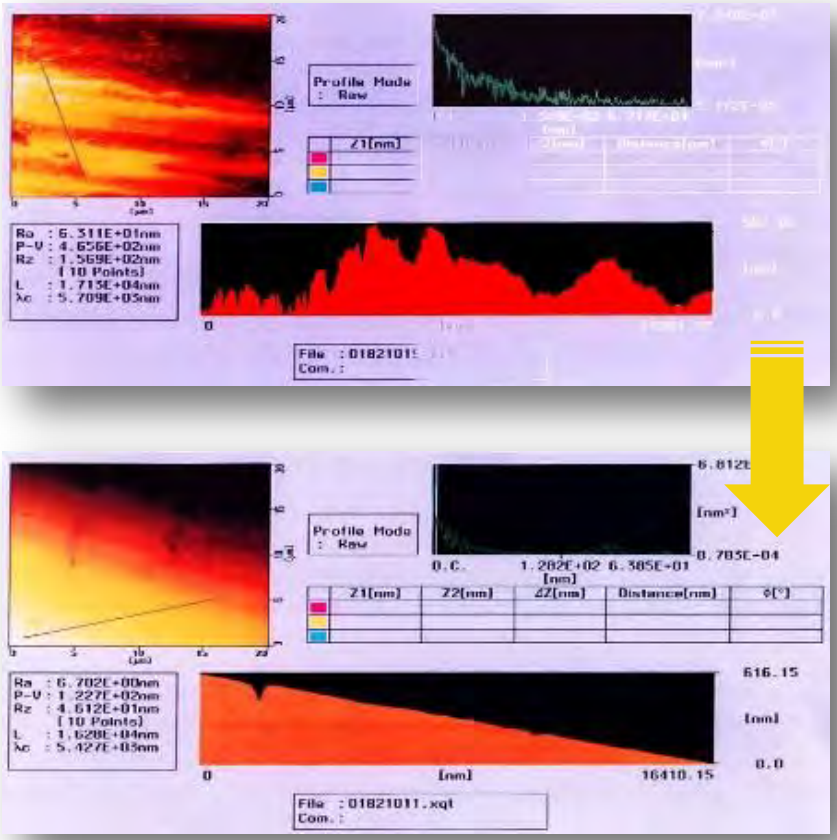


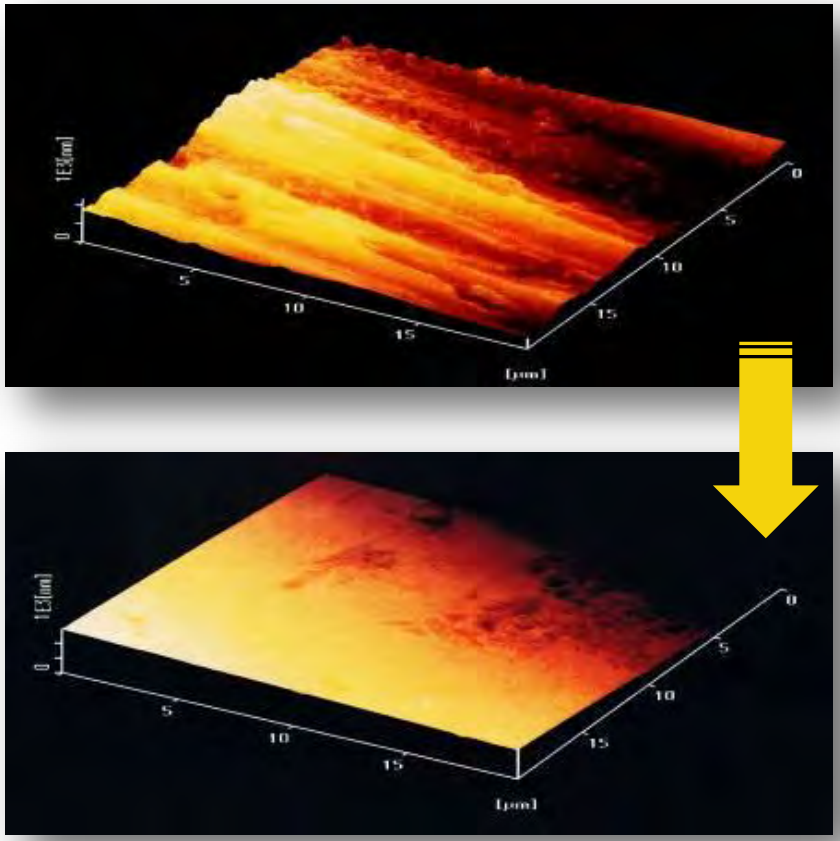




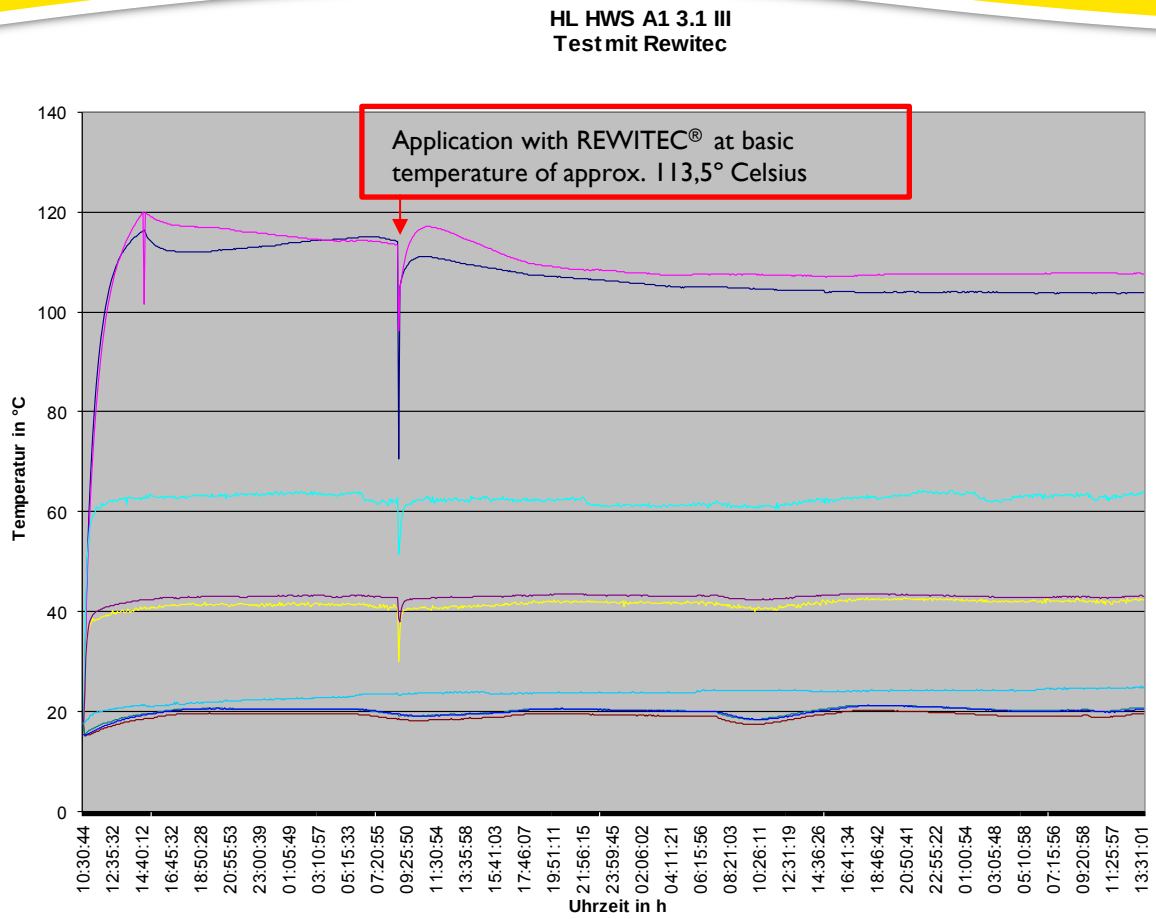


Before/after comparison (gear surface)





Testings on wind turbine gears



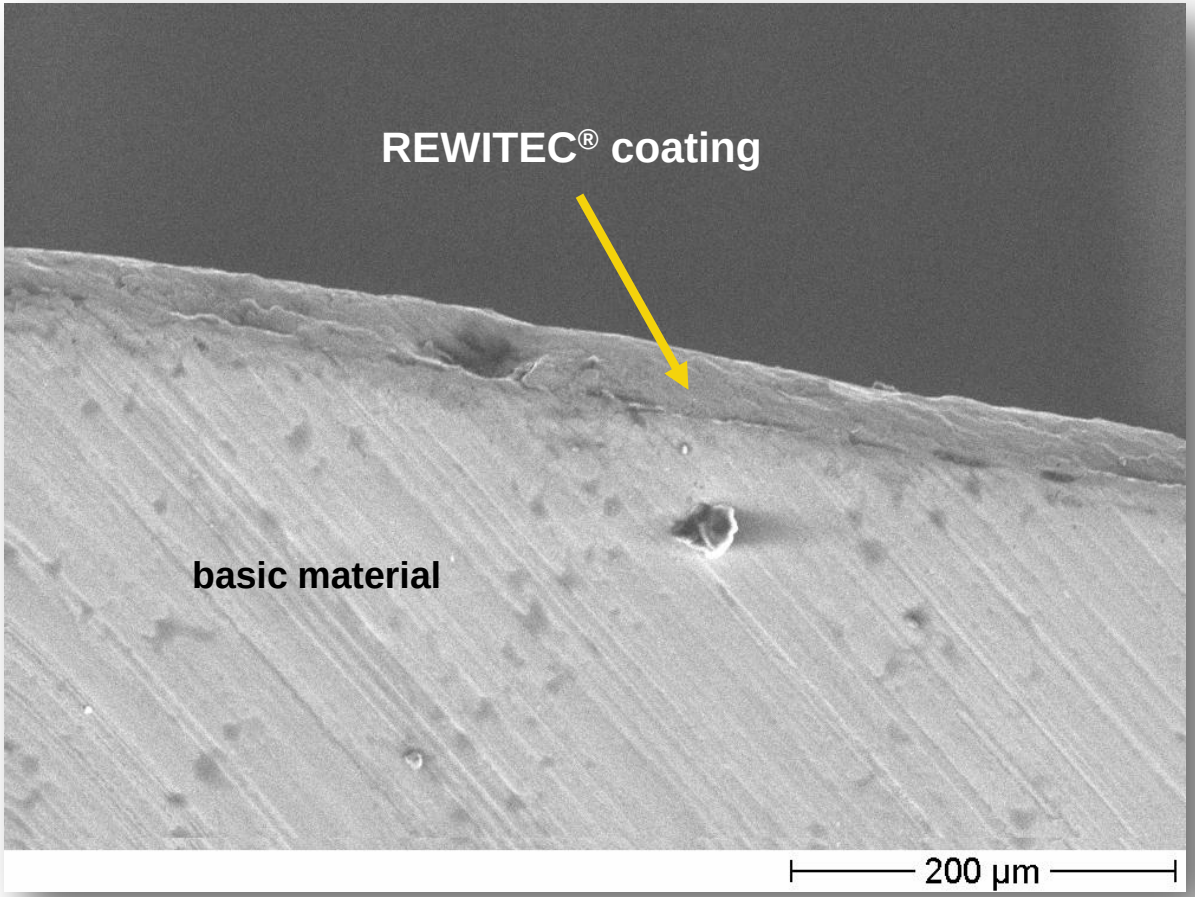
Oil temperature 1: 107,7° Celsius

Oil temperature 2: 103,5° Celsius

Temperature profile of two new Tandler gears with different oils **with** and **without** REWITEC®

→ **reduction of temperature of 6-10° Celsius**

Analysis bearing shell



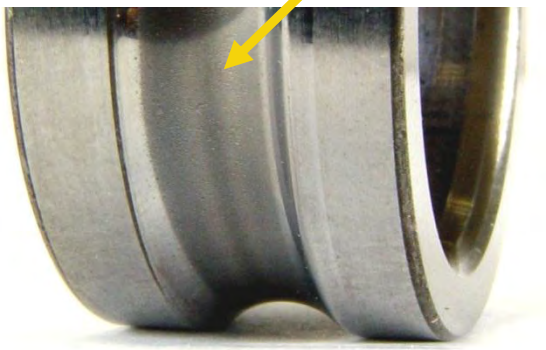
The cross-section shows the running surface of a worn out ball bearing of a planet gearbox after 250 hrs of operation in an area of fatigue. *)

The REWITEC® coating up to 30µm can be obviously seen.

*) Zollern gear box in a Nordex wind turbine

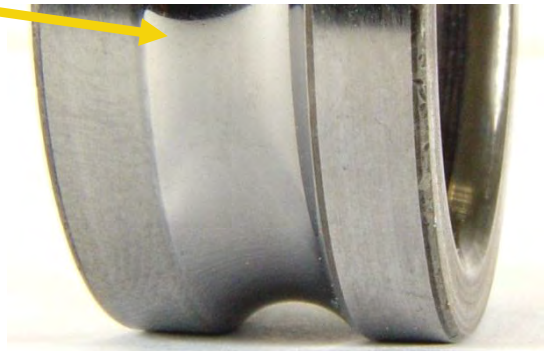
Load test of ball bearings

Images of the raceway of ball bearings after 50hrs of operation in a range of fatigue



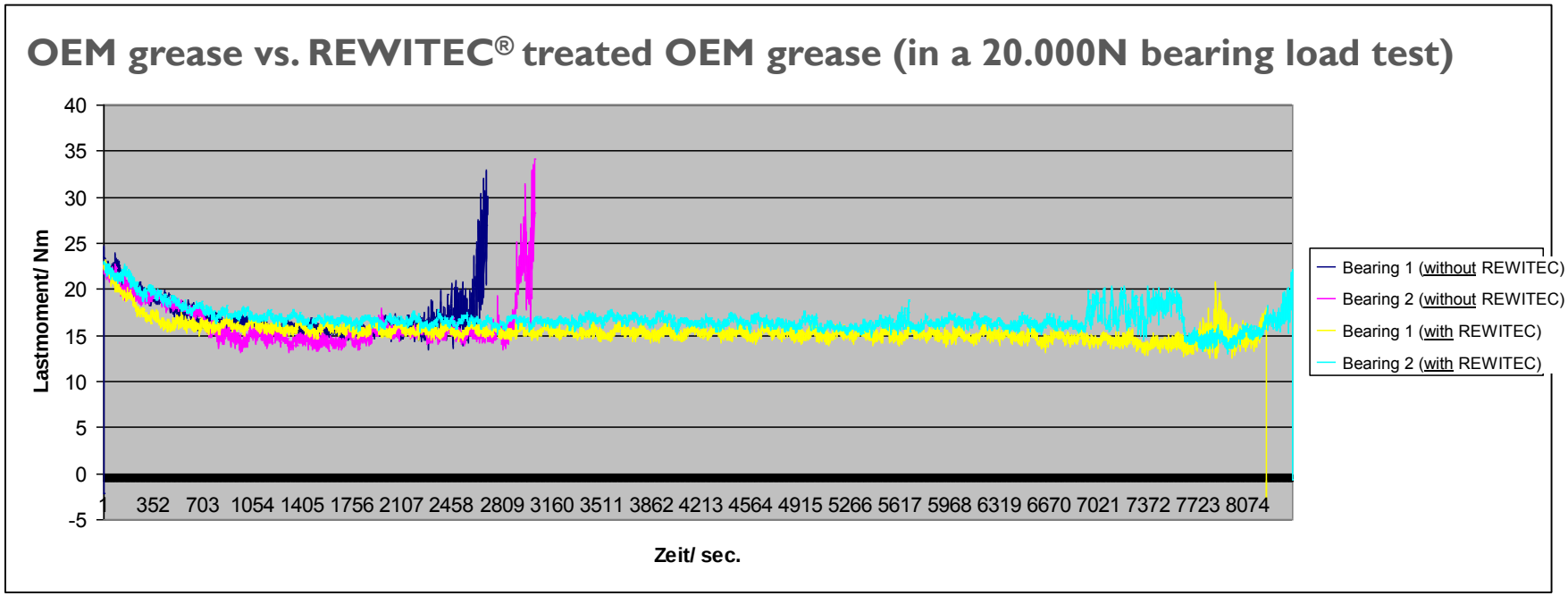
Without REWITEC®: The ball bearing shows damage due to wear and tear. The running surface of the balls clearly shows pitting.

- Bearing type: No. 6205 (d=25mm D=52mm)
- Lubricant: Special bearing grease (original)
- Rotatinal speed: 500 min^{-1}
- Nominal load: 5000 N radial (range of fatigue)



With REWITEC®: This ball bearing does not show any wear. The running surface of the balls clearly shows a wear resistant coating.

Bearing load test comparison



Friction measurement at new NTN axial bearings (type 81105):

Results: Bearings with untreated grease failed after about 43 min. load test. Bearings with REWITEC®-treated grease last over 19 hrs.!

Examples of use

Coating of generators (auxilliary diesel) on ships:

Problem:

Fuel savings with additional prolongation of life-time an investment protection *)

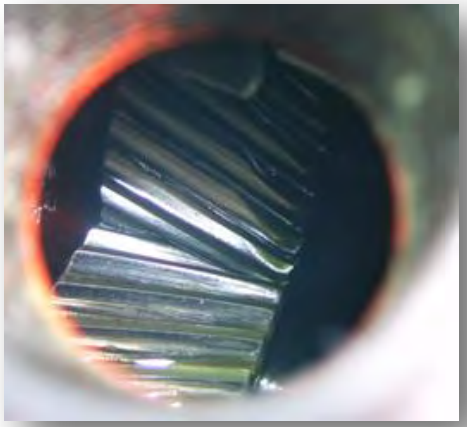
Results:

In long-term testings with certificated measurment instruments significant fuel savings were verified (with pay-back periods of only a few months!). With simultanious reduction of friction and wear within the engines, what guides to conservation of value and descent of maintenance costs, as well. Not only the shipowner, but also the engine manufacturer Daihatsu supports the use of REWITEC® products in their fleet.

*) approx. 14.000,-- US$ extrapolated on one year usage of the tested generator diesel „Daihatsu 6 DK28“

Examples of use

Coating of drillhead gears in the engine production area (VW Salzgitter, Germany):



Problem:

Short life-time, extremely high costs in case of idleness and breakdown (25.000,-- €), higher oil temperature (> 50° C). Emergency run problems due to oil leakage.

Results:

Oil and filter are clean with nearly no metal particles. After REWITEC® treatment, the oil temperature was reduced by approx. 6°C to max. 45°C. Due to a system leakage, drilling emulsion went into the gearbox, but the REWITEC® coating prevented the system against damages and the emergency running featuires were proven.

Examples of use

Coating of a thermal power station (Senertec):

Problem:

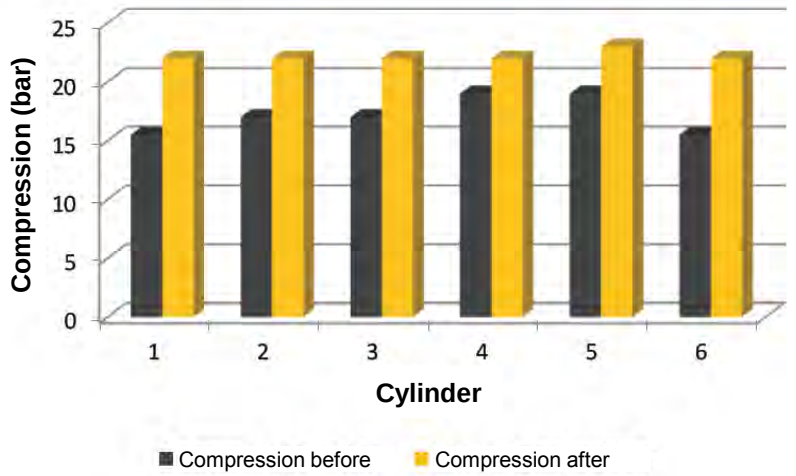
High oil consumption and temperatures, loud operating noise, engine wear and high repair costs

Results:

Reduction of oil consumption from 7 ltrs. per 2,700 operating hours to 1 ltr. per 2,700 operating hours. Significant decrease of operating noise. In sum, thanks to the use of REWITEC®, 1,600,-- € repair costs were saved!

Examples of use

Treatment of a wheel loader „Caterpillar 966D" (Limassol/Cyprus):



Objectives:

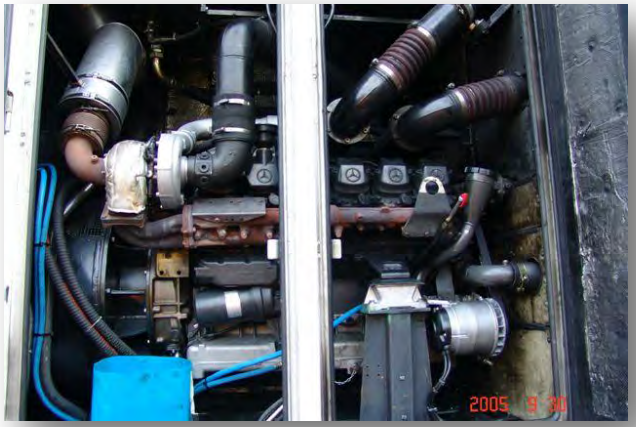
Improvement of the engine condition, optimization of compression, fuel savings and prolongation of life-time and maintenance intervals

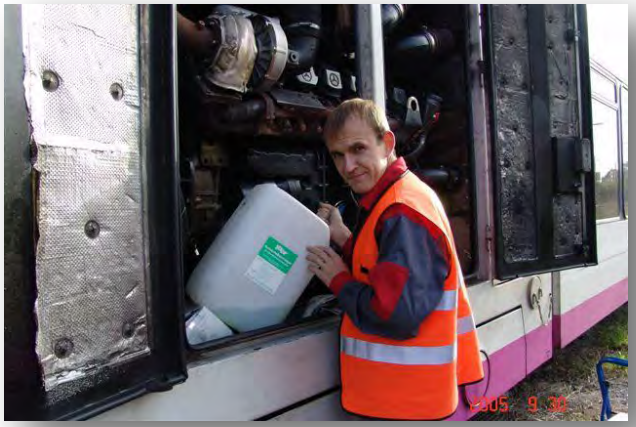
Results:

Massive increase of compression, reduction of diesel consumption, savings of maintenance costs, optimization of power and torque, as well as smoother running at lower oil temperature.

Examples of use

Coating of an engine of a diesel railcar (SBB):





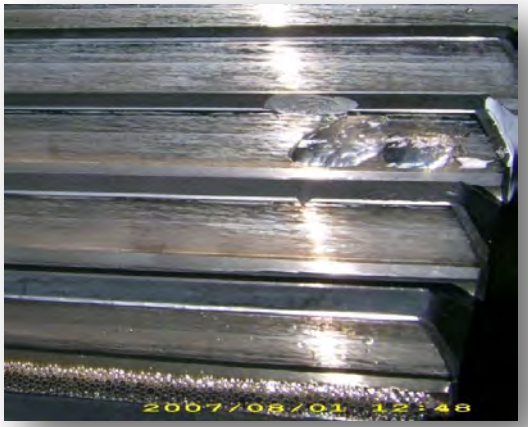
Objective:
REWITEC® treatment of the diesel engine (1,320,-- €) in comparision to the major overhaul „W6“ according to MTU/Mercedes specification (approx. 31,000,-- €).

Results:
Better engine power and a smooth running (by the locomotive engineer‘s admission).

Advantages:
Notable cost savings and full avalability!

Examples of use

Coating of a wind turbine gear (Tacke TW250):



Objectives:

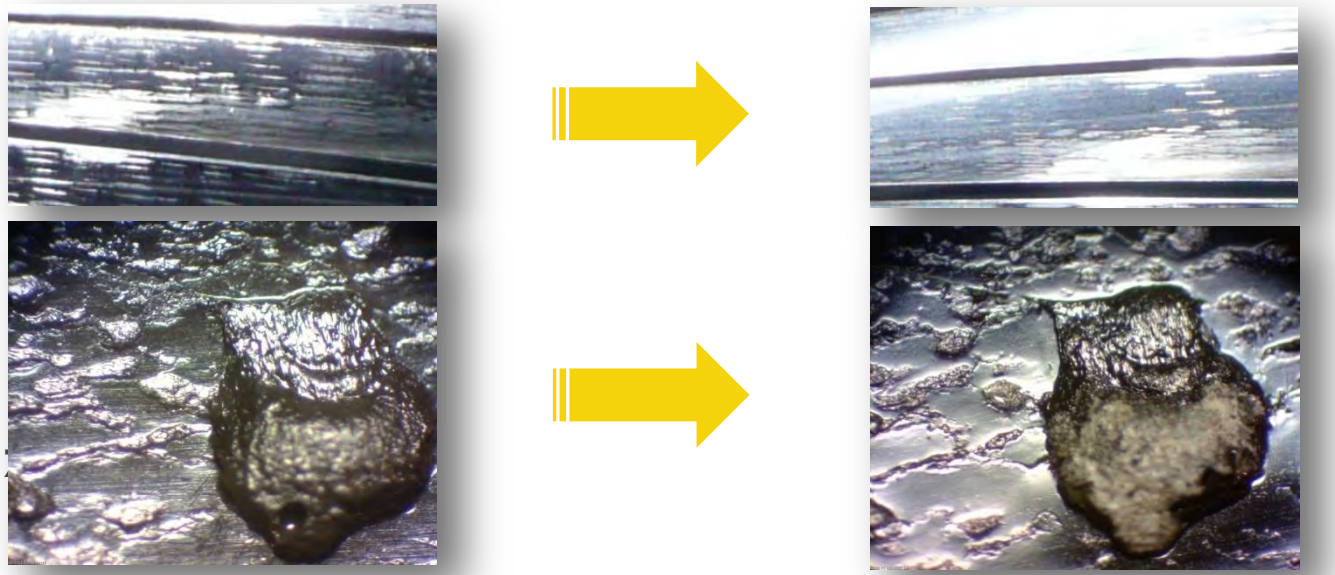
- Rebuilding of worn out teeth surfaces
- Reduction of grey stoking
- Protection against further wear and prolongation of life-time

Results after approx. 700 operating hours:

- The teeth surfaces are much smoother and more shiny (replicas before / after)
- The damages are less sharp-edged
- The coated teeth surfaces had a higher electric resistance of about 50 Ω

Examples of use

Coating and analysis of a wind turbine gear (Tacke TW600):



Goal of application:

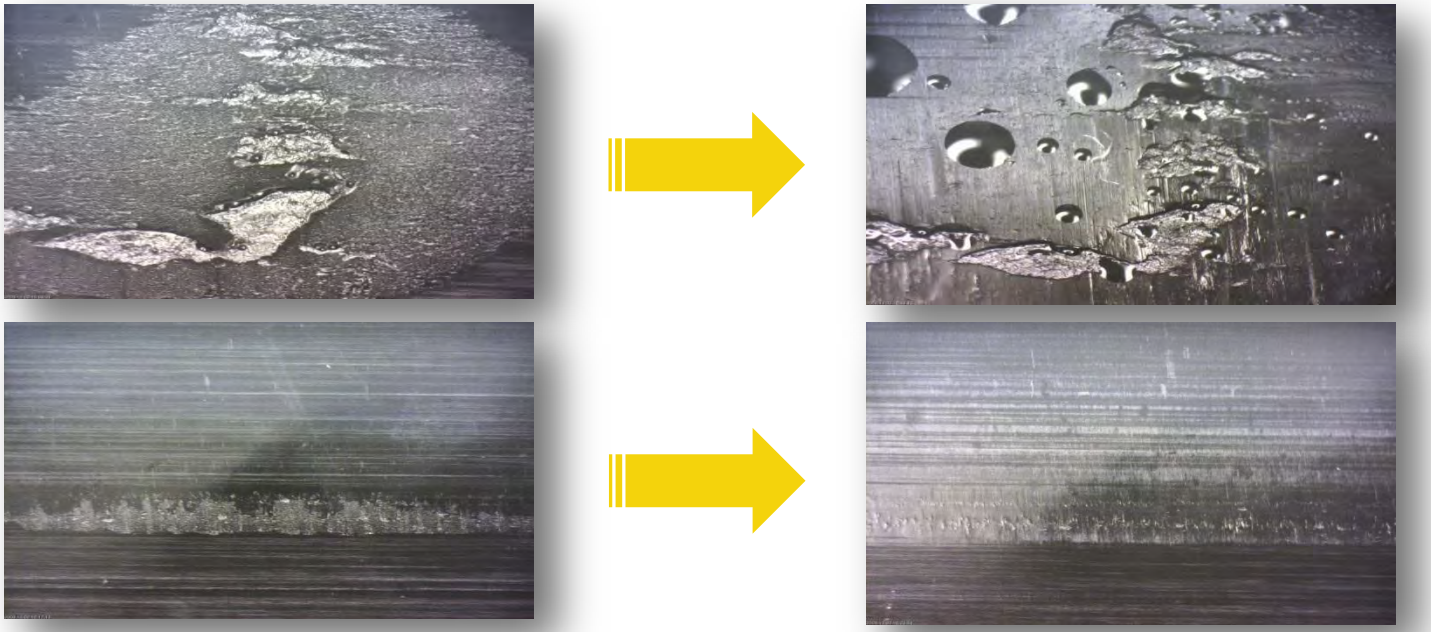
- Reduction of micropitting
- Protection against further wear and prolongation of life-time

Condition after 2 years operating time:

- The teeth surfaces are much smoother and more shiny (replicas before / after)
- The coated teeth surfaces had a higher electric resistance of about 100 Ω

Examples of use

Coating and analysis of a wind turbine gear (HSW1000):

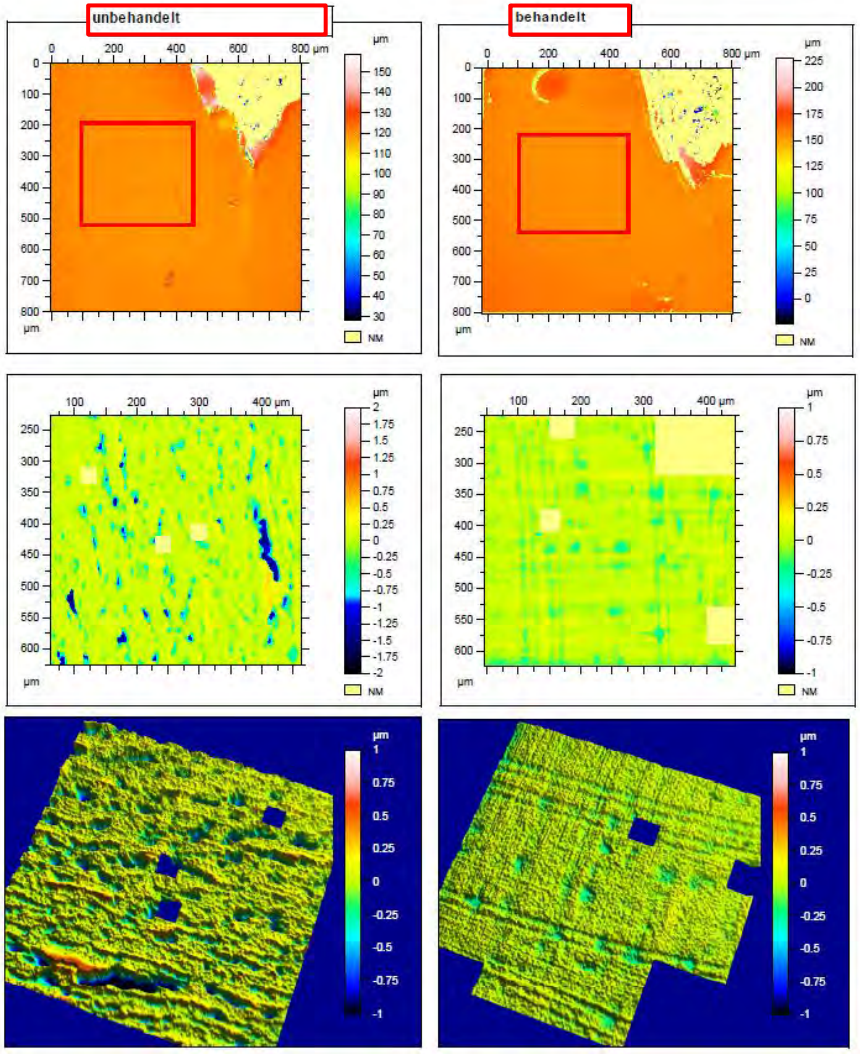


Results after 150 days:

- The teeth surfaces are much smoother and more shiny (replicas before / after)
- The coated teeth surfaces had a significant higher electric resistance of about 150 Ω
- The 3D topography analysis from NanoFocus AG with „µsurf“ technology confirms the equalization of the surface and the 18-times magnification of the load carrying tooth area (→ see next page)!

Examples of use

3D topography analysis from NanoFocus AG of both „HSW1000“ samples:

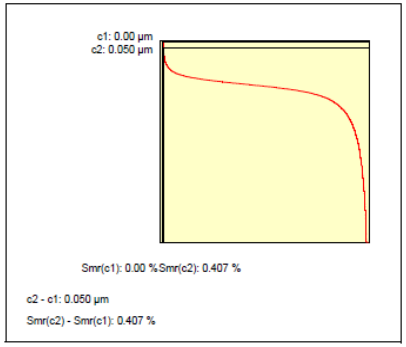


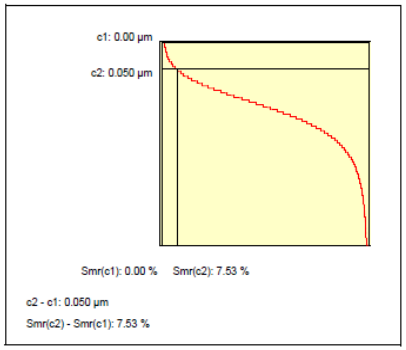
EUR 15178N		
Funktions-Parameter		
Sk	0.215	µm
Spk	0.130	µm
Svk	0.583	µm
Sr1	9.03	%
Sr2	79.8	%
Spq	0.0863	
Svq	1.09	
Smq	90.6	

EUR 15178N		
Amplituden-Parameter		
Sa	0.141	µm
Sq	0.238	µm
Sz	1.78	µm
Ssk	-3.12	
Sku	15.5	
Sp	0.473	µm
Sv	1.39	µm
St	1.87	µm

EUR 15178N		
Funktions-Parameter		
Sk	0.121	µm
Spk	0.0453	µm
Svk	0.0979	µm
Sr1	8.27	%
Sr2	85.5	%
Spq	0.0493	
Svq	0.160	
Smq	93.2	

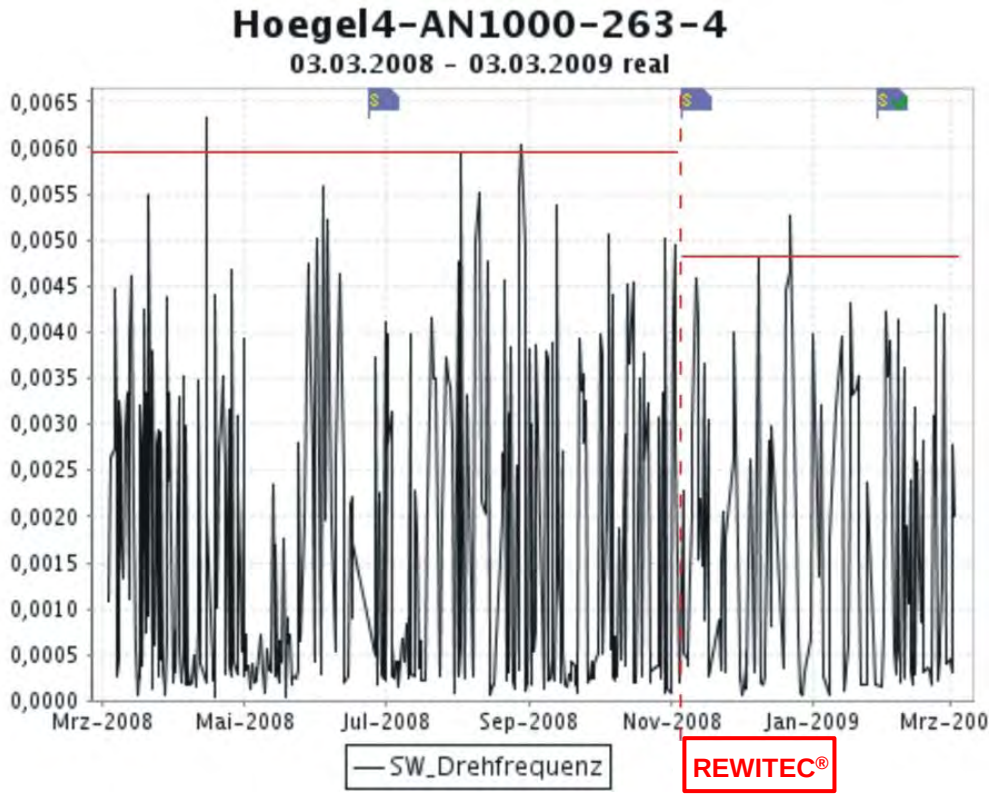
EUR 15178N		
Amplituden-Parameter		
Sa	0.0457	µm
Sq	0.0605	µm
Sz	0.348	µm
Ssk	-0.885	
Sku	4.75	
Sp	0.126	µm
Sv	0.243	µm
St	0.369	µm





Examples of use

Coating of a wind turbine (AN Bonus 1MW):



Goal of application:

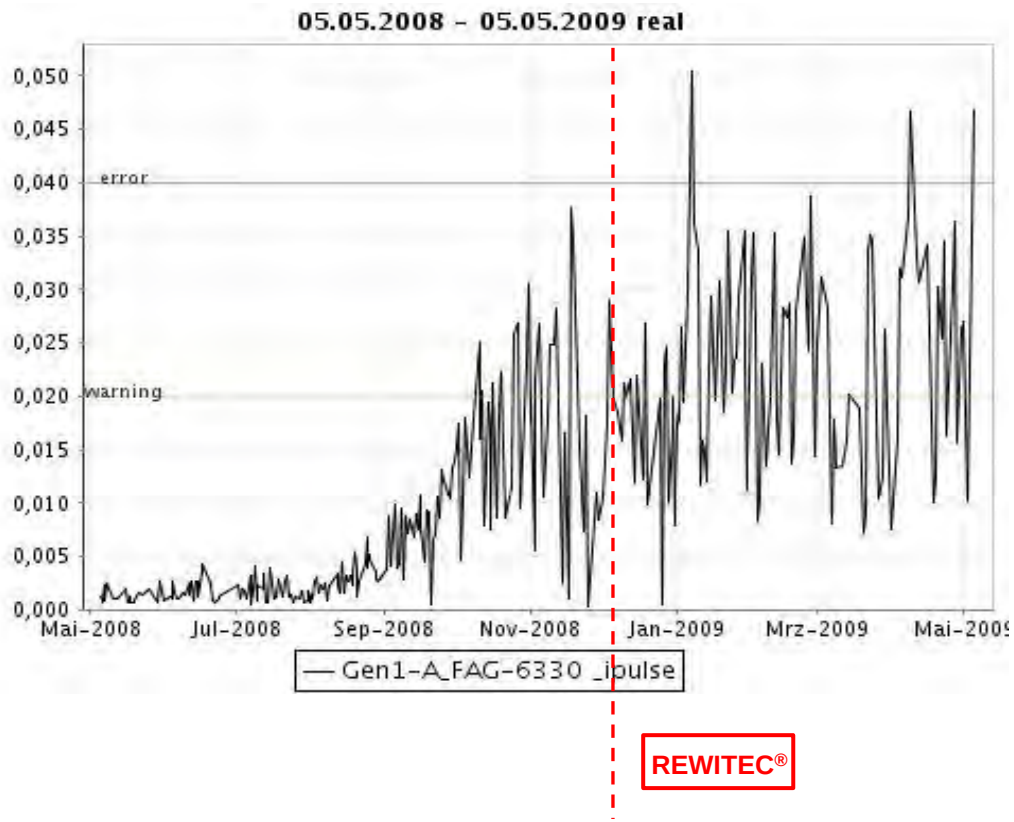
- Rebuilding of worn out teeth surfaces and reduction of micropitting
- Analysis via µ-Sen CMS (Condition Monitoring System)
- Protection against further wear and pro-longation of life-time

Results after 700 operating hours:

- The teeth surfaces are much smoother and more shiny (replicas before / after)
- The coated teeth surfaces had a higher electric resistance of about 50 Ω
- The µ-Sen CMS shows a 20% reduced damage frequency and noise within the system

Examples of use

Coating generator bearing (AN Bonus 1MW):



Goal of application:

- Wear protection of generator bearing due to use of REWITEC® coating grease in December 2008
- Analysis via µ-Sen CMS (Condition Monitoring System)
- Protection against further wear and pro-longation of life-time

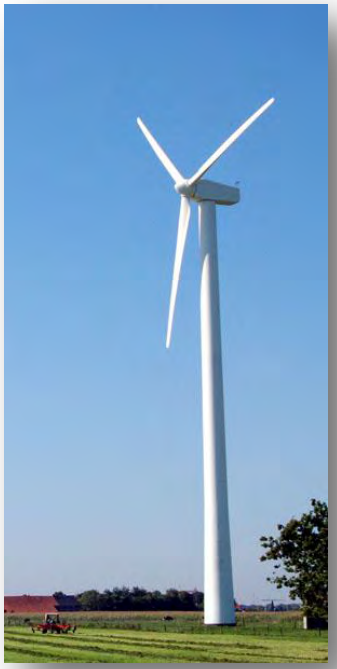
Results after 6 months:

- The µ-Sen CMS shows clearly the stop of the progressive increase of the damage frequency in the generator bearing

Pay-off period calculation

Using the example of a wind turbine:

Wind turbine power	1.500 kW
Output per year [1])	3.500.000 kWh
Output per day	10.822 kWh
Payment	9,8 Ct / kWh
Payment per day	940,-- €
Treatment costs	6.000,- €
Pay-off period (at interuption of operation)	6,4 days
Pay-off period (at life-time prolongation) [2])	approx. 4 months



1) Output according to a reference location with an average anual wind speed of 6,5mtr per second
2) Life-time prolongation at an interest rate of 6% and costs for a new gear unit of 300.000,- €
Source: BWE Bundesverband Wind Energie

Recommendations

Leading insurance companies and component manufacturers are recommending their customers the usage of our products resp. confirming the harmlessness, amongst others:

MARSH

Allianz

HDI GERLING

Gothaer

Basler Versicherungen

We, as Basler Versicherung AG, have been working successfully in the industrial sector for many years and recommend the use of REWITEC products. On the basis of scientific studies, done recently by the University of Mannheim and experience gained in working with REWITEC GmbH, we have been able to see how effective they are, highlight the benefits thereof to our customers with improved machine running times and thus approve and recommend their use. "We keep you safer"

winergy

Scientific testings

KOMPETENZZENTRUM tribologie MANNHEIM

University Mannheim (Sept. 2012)

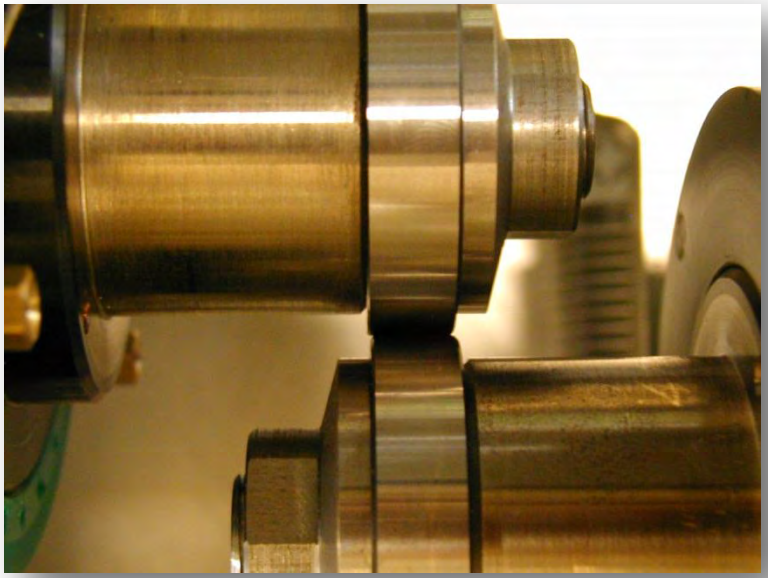
2 Disc Assembly

Rolling Wear Test

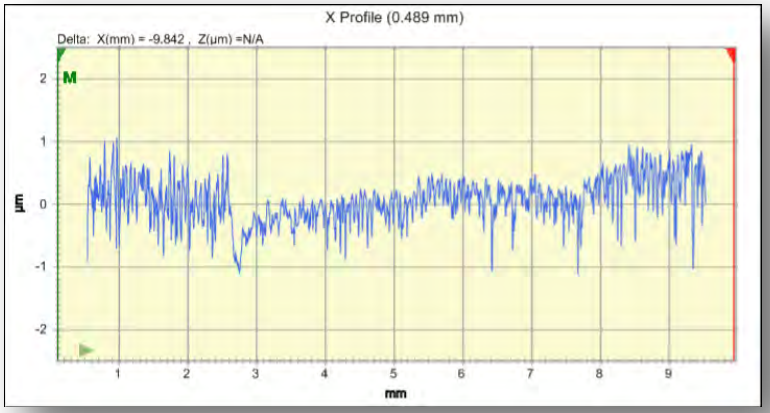
Scientific testings

How does friction, temperature and surfaces are changing if REWITEC® is applied to the gear oil?

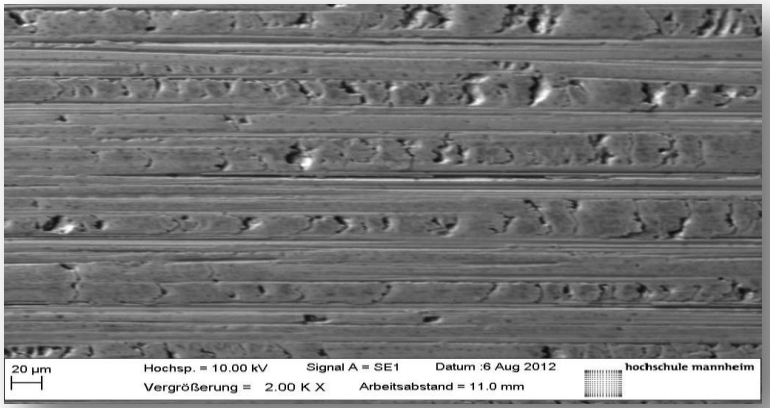
- Short-term and long-term tests with two types of oil from Agip (viscosity ISO VG 150 and 320)
- Evaluated with white-light interferometer, SEM etc.

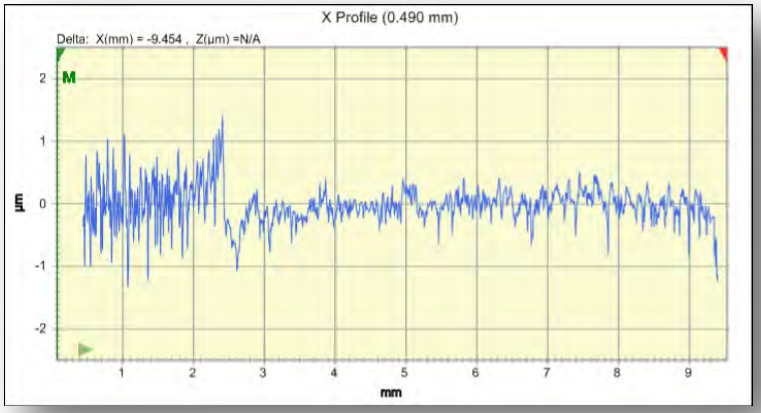


Scientific testings

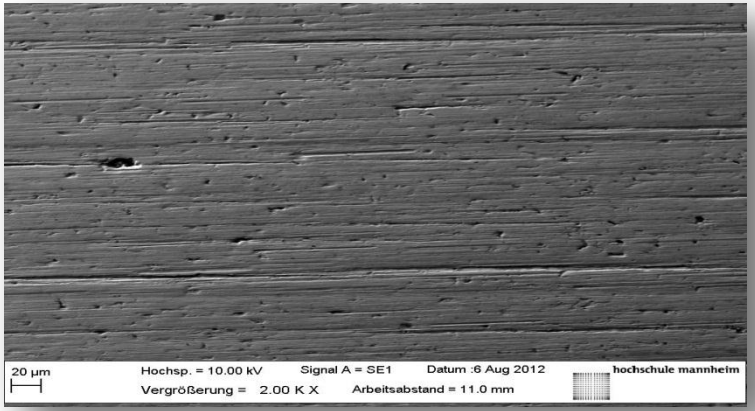


Test 1: Agip Blasia 150 **without** REWITEC®

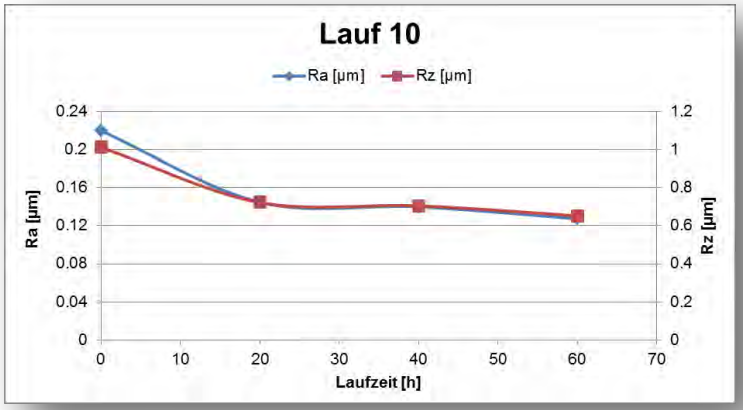




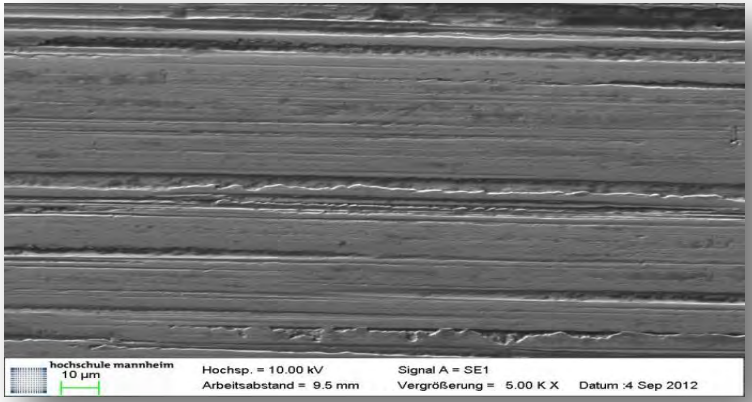
Test 2: Agip Blasia 150 **with** REWITEC®

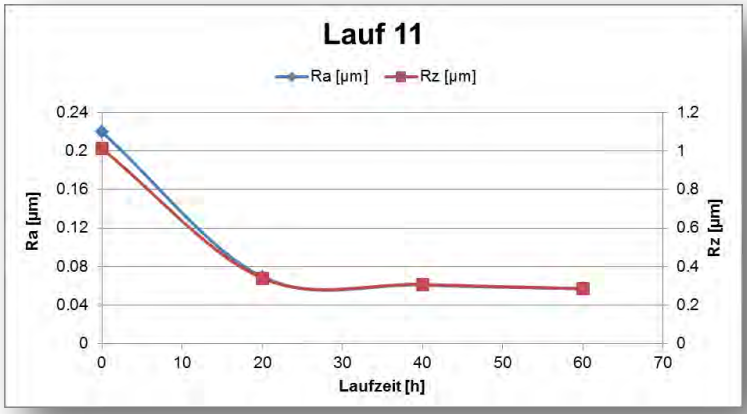


Scientific testings

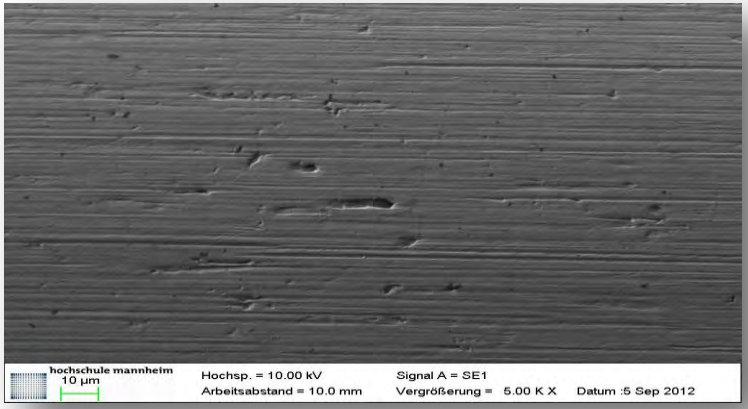


Test 10: Agip Blasia 320 **without** REWITEC®



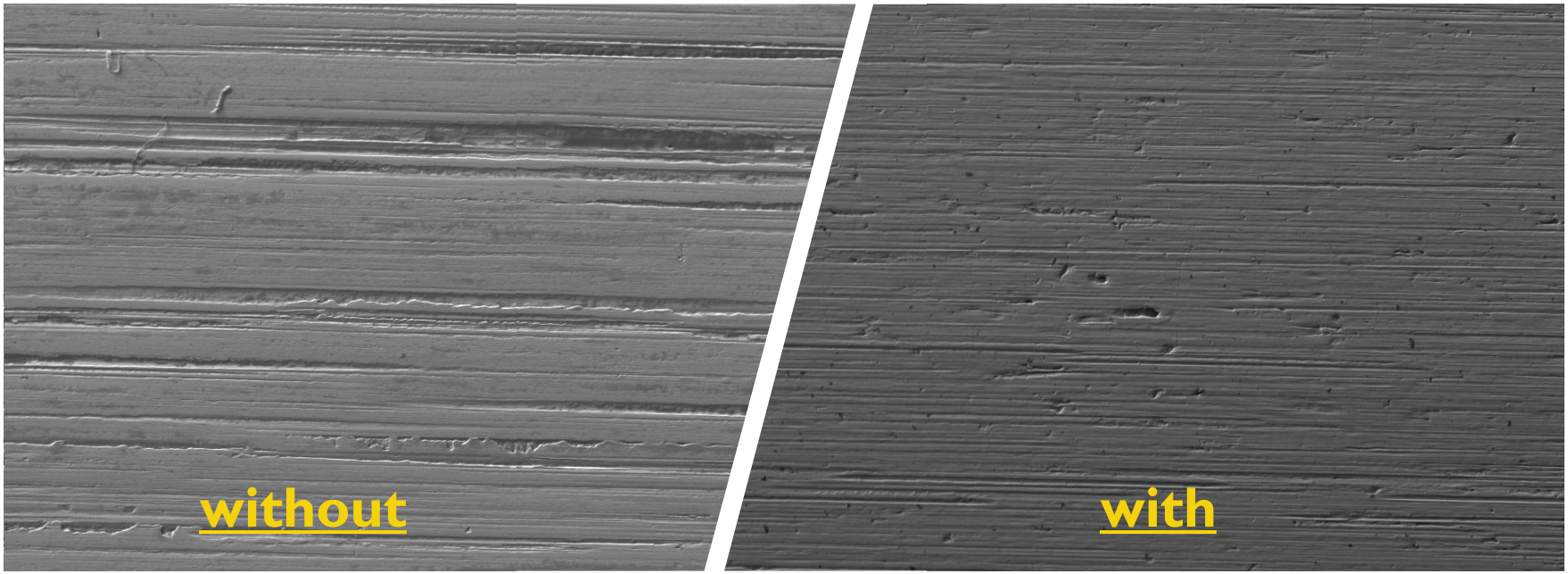


Test 11: Agip Blasia 320 **with** REWITEC®



Scientific testings

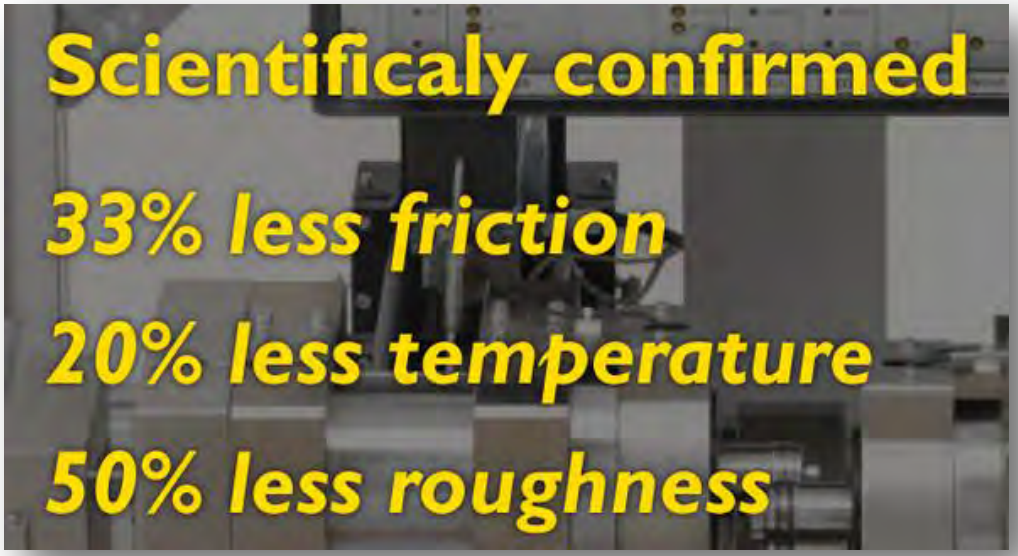
SEM images after the long-term testings in 1:1 comparison:

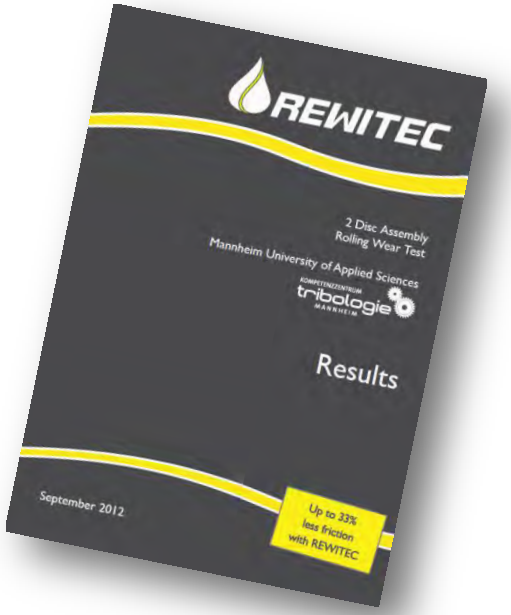


REWITEC® coating

Scientific testings

University Mannheim *)
confirms after conclusion of the testings:

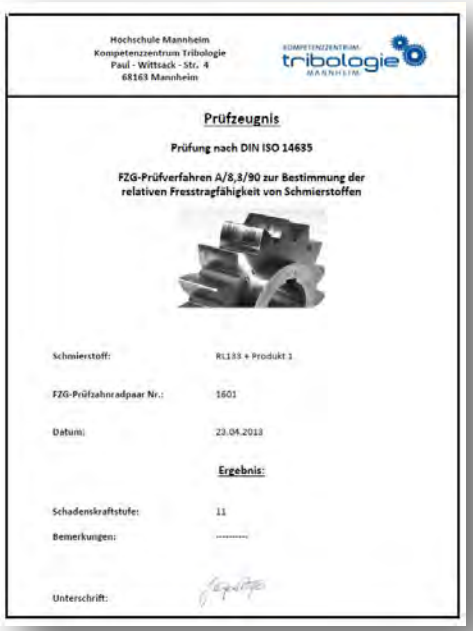




*) Prof. Dr.-Ing. Paul Feinle

Scientific testings

FZG test method A/8,3/90 (according to DIN ISO 14635) for determination of the relative scuffing load capacity of lubricants (04/2013)



Hochschule Mannheim
Kompetenzzentrum Tribologie
Paul - Wittsack - Str. 4
68163 Mannheim

Prüfzeugnis

Prüfung nach DIN ISO 14635

FZG-Prüfverfahren A/8,3/90 zur Bestimmung der relativen Fresstragfähigkeit von Schmierstoffen

Schmierstoff:	RL133 + Produkt 1
FZG-Prüfzahnradpaar Nr.:	1601
Datum:	23.04.2013

Ergebnis:

Schadenskraftstufe:	11
Bemerkungen:	----------

Unterschrift:

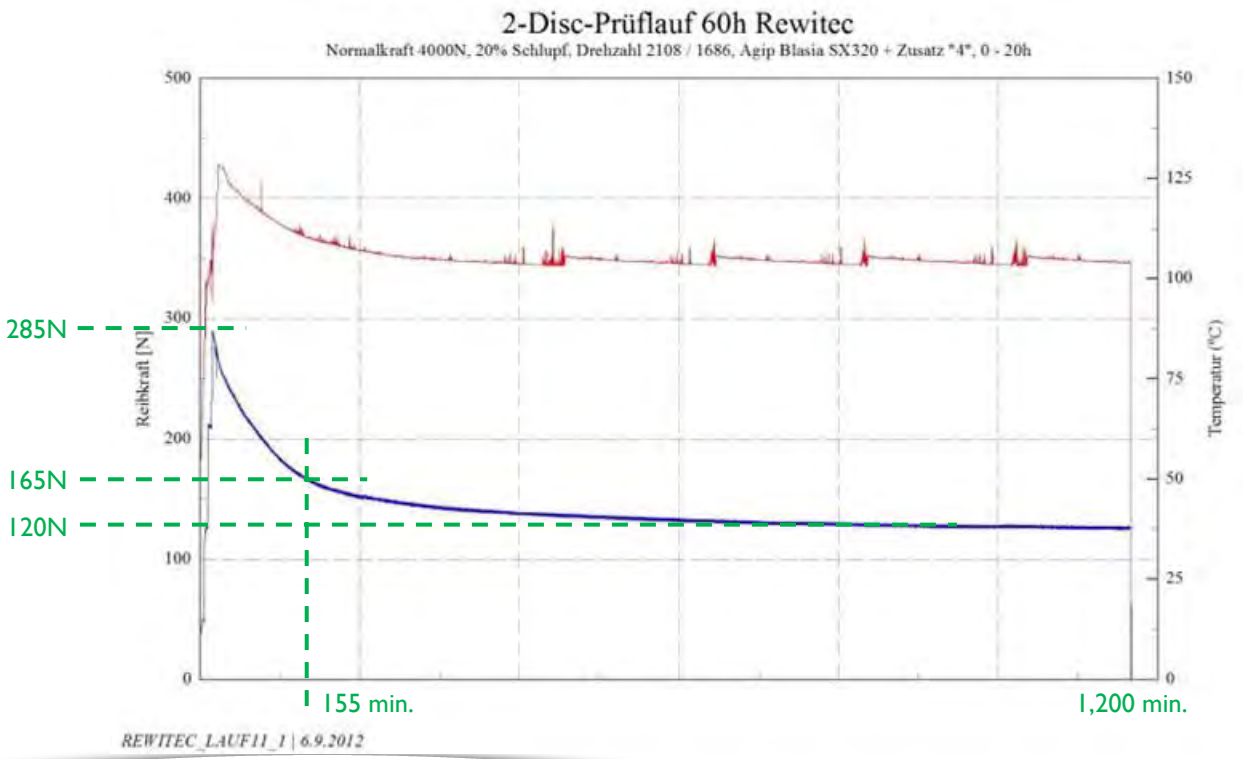
Even though the time-frame (till our product shows it's full effectiveness) is about 1,200 min., the results of this particular test is proving that even **after only 155 min.** the damage power step is raised from 10 to 11!

Scientific testings

Testing (60 hrs.) with 2-disc assembly rolling wear test

Friction at the start: 285N

after155 min.: 165N after1.200 min.: 120N

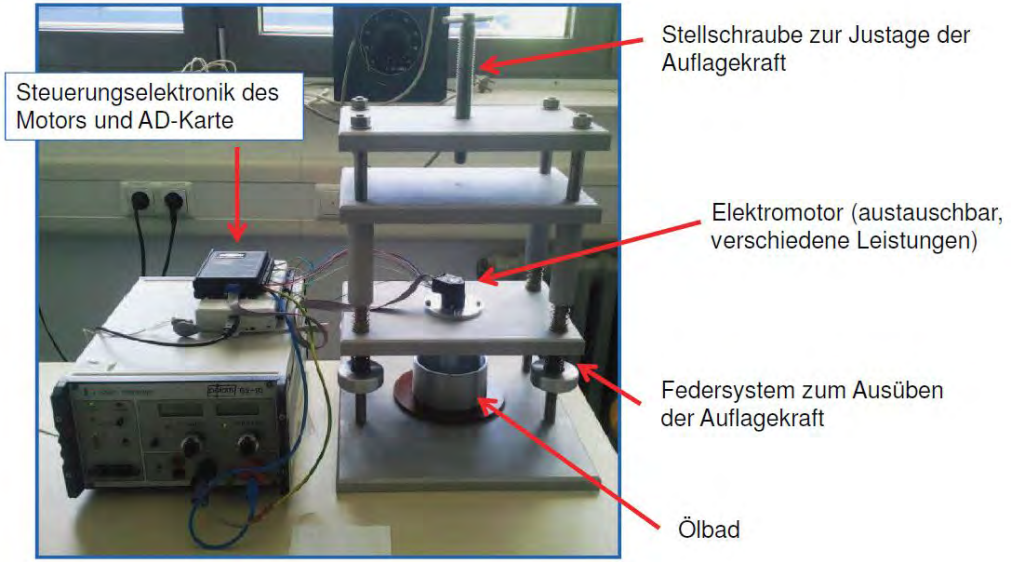


Scientific testings

JUSTUS-LIEBIG-UNIVERSITÄT GIESSEN

Justus-Liebig-University Gießen
TransMIT Project Area
Surface Nano Analytics
Prof. Dr. Andre Schirmeisen

Objectives:
„Tribologic mechanisms of REWITEC® additives at oil-lubricated steel/steel contacts“



Scientific testings

JUSTUS-LIEBIG-UNIVERSITÄT GIESSEN

Justus-Liebig-University Gießen
TransMIT Project Area
Surface Nano Analytics
Prof. Dr. Andre Schirmeisen

Tribologic experiments:

- Observing of the running-in behavior of oil-lubricated steel/steel contacts with contact areas in the range from aprox. 1mm² till approx. 1cm²
- Quantification of influence of additives on friction and wear dependent on contact area, pressure and sample- and oil temperature
- Preparation of suitable sample systems for additional researches with microscopic and spectroscopic mehtods
- Analysis of the rubbing contacts using AFM, SEM, XPS and SIMS

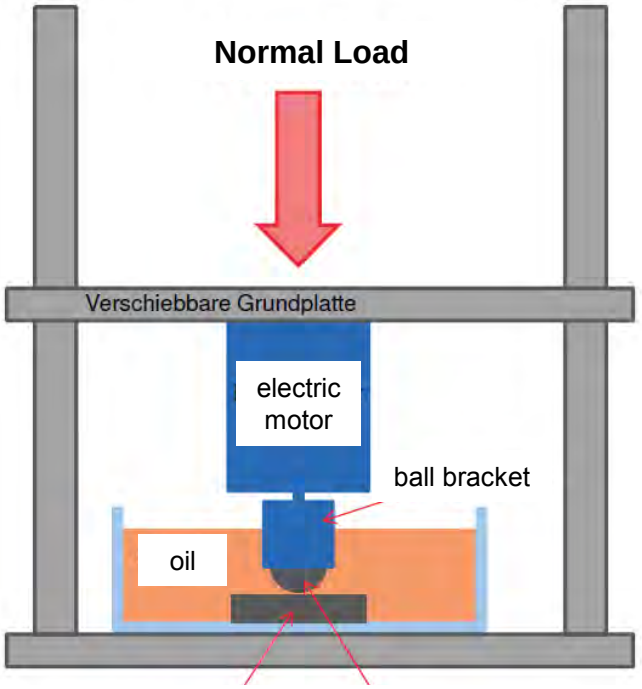
Scientific testings

JUSTUS-LIEBIG-UNIVERSITÄT GIESSEN

specimen

contact point
(minimal wear)

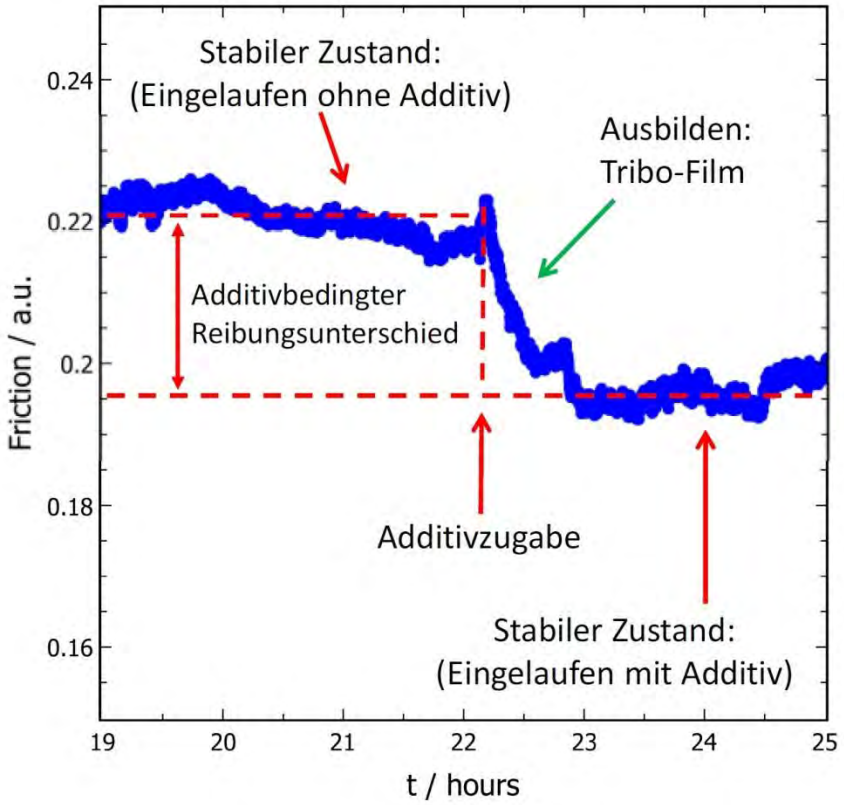
Schematic
test set-up:



Scientific testings

JUSTUS-LIEBIG-UNIVERSITÄT GIESSEN

Analysis of the influence of the REWITEC® supplementary:



REWITEC® products

1. The PowerShot® family
(suitable for 2- and 4-stroke combustion engines of all kind)

1.1. Consumer products:

PowerShot® S / M / L

1.2. Industry products:

PowerShot® 10 / 15 / 20 / 50

REWITEC® products are compatible with all kind of mineralic and synthetic oil, grease and lubriucant varnish. Also customizing of client's lubricants is possible!

REWITEC® products

2. The DuraGear® family
(suitable for industrial gears of all kind)
DuraGear® 5 / 10 / 20 / 50 / 100

DuraGear® W100 (especially for wind turbines)

REWITEC® products

3. G5
(suitable for automotive gearboxes and differentials till 5 ltr. oil volume)
Concentrate in syringe

4. GR400
(suitable for bearings of all kind)
Synthetic high-temperature coating grease in 400g cartridge

REWITEC® products

5. Sprays

5.1. REWITEC®-PowerSpray
(Multi purpose spray in 100ml aerosol can)

5.2. REWITEC®-ChainSpray
(100ml aerosol can for chains and pinions of all kind)

REWITEC® products

Overview:

Conclusion

- Very versatile fields of application in wind industry, shipping, general industry, automotive and many more
- Usage „hot plug-in“ without downtime
- High saving potentials for lubricants and fuel etc.
- Increasing the energy efficiency
- Longer maintenance intervals and machine runtime, as well as investment protection
- Optimization of sustainability due to reduction of pollutant and particle emissions

Awards

- Finalist of the 28th Innovation Price of the German Economy 2008
- 1st HUSUM WindEnergy Award 2009

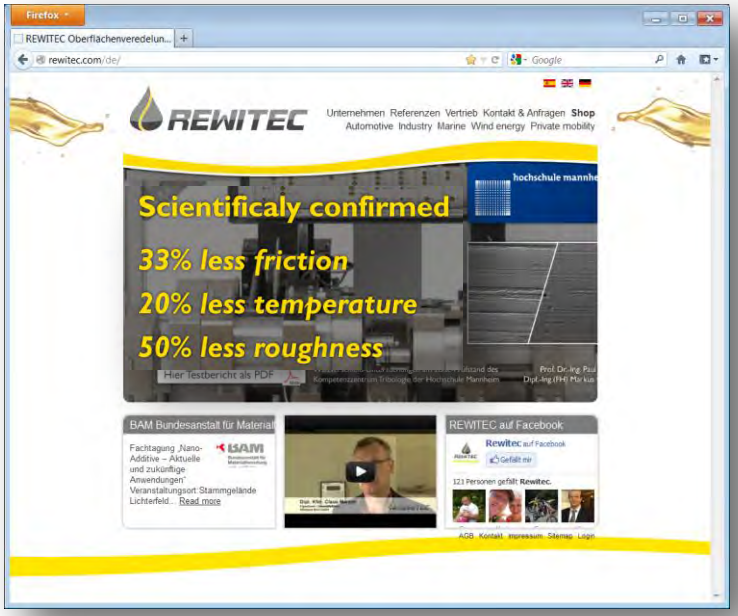
Innovationspreis
der deutschen Wirtschaft
Erster Innovationspreis der Welt®

Extract of partners and customers

...and many more!

More informationen…

…available on our website www.rewitec.com as well as on our YouTube-Channel and on facebook!



Many thanks for your kind attention!