

# **REWITEC Nanocoating**

**Durable Wear Protection and Reconditioning  
for high loaded  
Gearboxes and Bearings in  
Windturbines**

**INNOVATIONS FOR INDUSTRY  
Session Nanotechnology  
Hannover, 6th April 2011**

**That is our world...**



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## REWITEC-Technology



**REWITEC presents the unique possibility**

**to coat, to protect and to recondition new and worn out metal surfaces!**



# What happens to the lubricant?



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Fuel- and lubricant analytics

Org.einheit: OSF  
Name: Ertelt  
Datum: 04.02.2009  
Seite 1 von 1  
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## Lubricant – complete analysis

CW/Bloc	Analyse No.	Description of testing	Appearance	Water KF mg/kg	NZ mg KOH/g	Refraction index n <sub>D</sub> <sup>25</sup>	LAV min	Corrosion Grade	Aging IR 1723cm <sup>-1</sup>	Foam test 24°C MI	Tributyl-phosphate M.-%
	Date Probe-Nahme	Remark	Type of oil	Solid particles 0,45 µm mg/l	Viscosity 40°C mm <sup>2</sup> /s	Colour 510 nm	WAV s	Corrosion Remark	Phenol-inhibitor M.-%	Foam test 24°C time	
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.

U:\Eigene Dateien\REWITEC\Produkte\Analyse\en\_on.doc

## Targets of REWITEC Technology



**Replacement of the friction pair „metal-metal“ by „metal ceramic-metal ceramic“**

### **Advantages:**

- ➔ Reduction of abrasion and wear of rubbing metal surfaces
- ➔ Coating process during system is running, without down time
- ➔ Obvious increase and smoothening of load carrying areas
- ➔ Prolongation of gearbox and bearing life time

## Advantages of REWITEC Technology

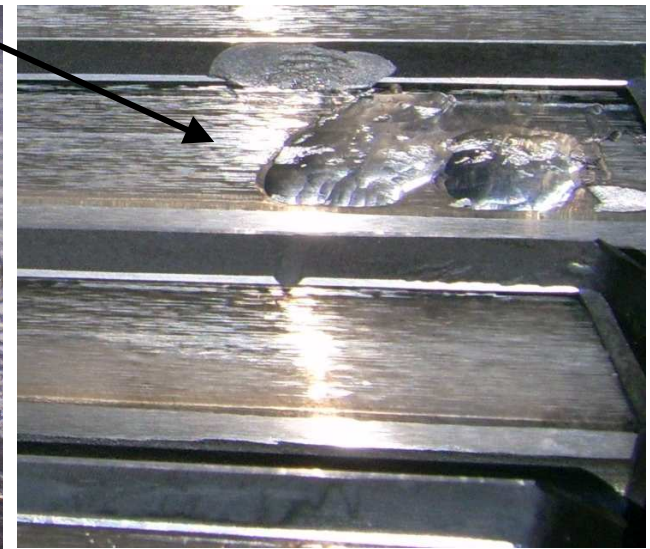
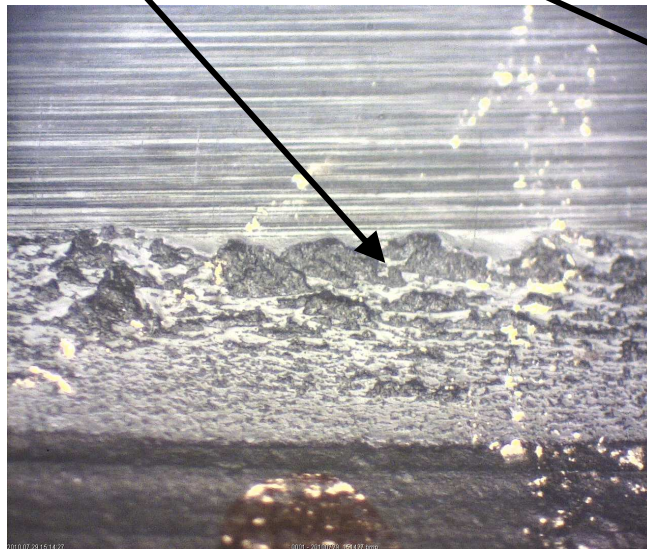
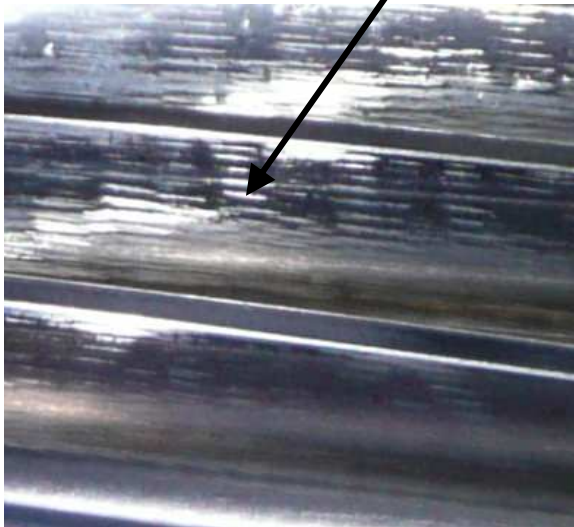


- ➔ Reduction of friction, vibration and noise
- ➔ Cost saving by:
  - Extension of lifetime
  - Reduction of repairs
  - Prolongation of maintenance intervals
  - Bridging of delivery times/ Planned exchange possible
- ➔ Improvement of efficiency:
  - Savings of energy and fuel up to 11 %
- ➔ Reduction of emissions (Diesel soot, CO<sub>2</sub>, HC und NO<sub>x</sub>)
- ➔ Emergency running properties in case of oil loss

## Damages of gear wheels before Rewitec



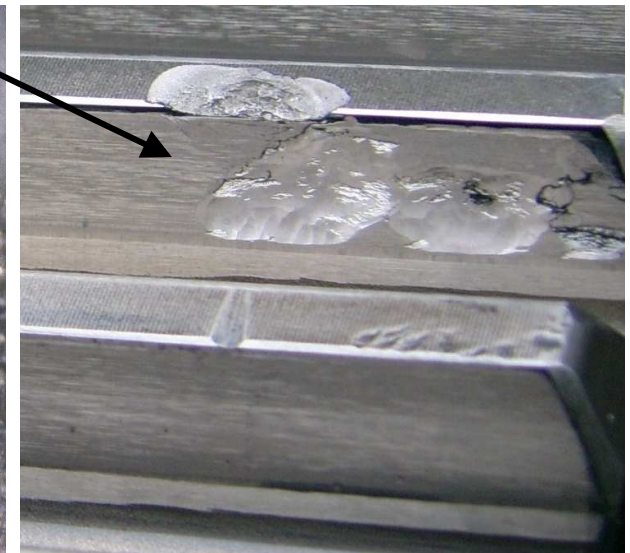
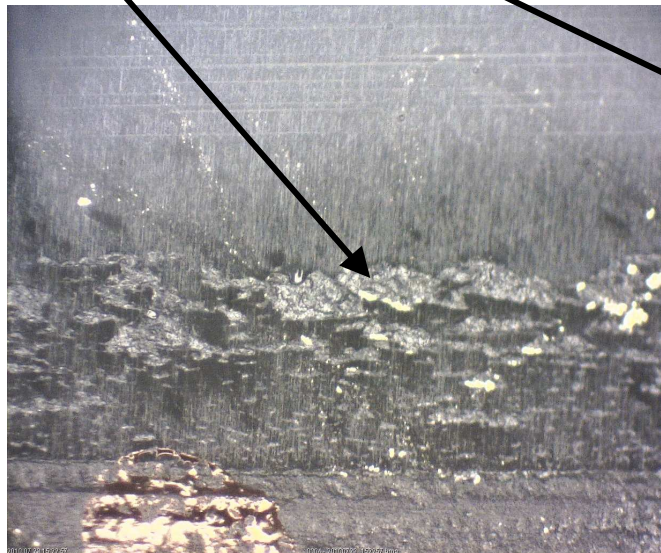
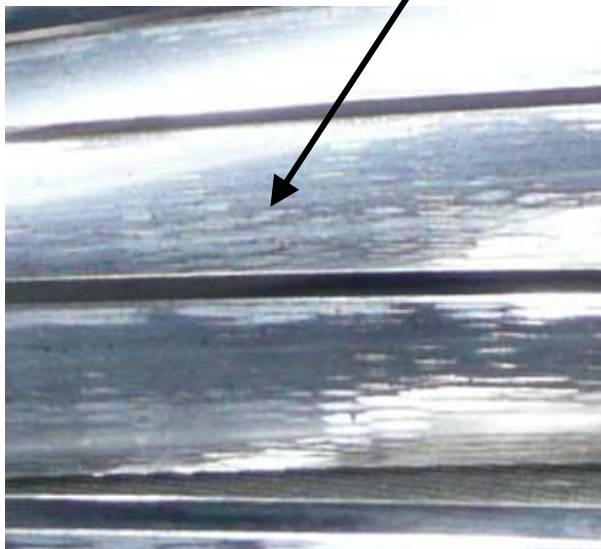
➤ **Repair, freeze, better prevent damages!**



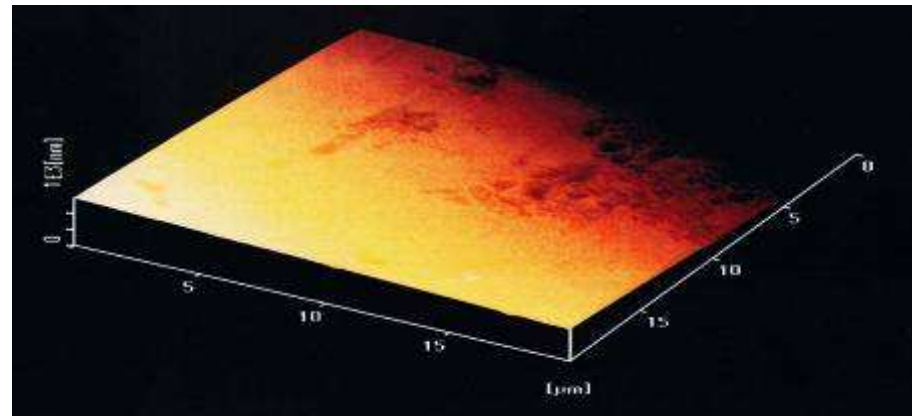
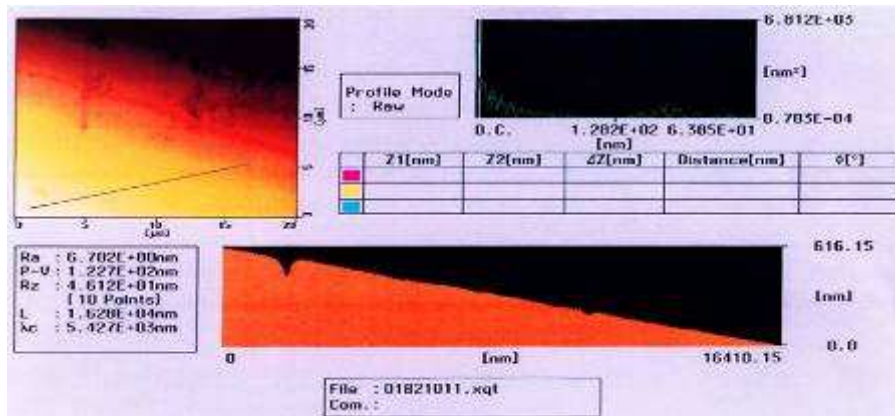
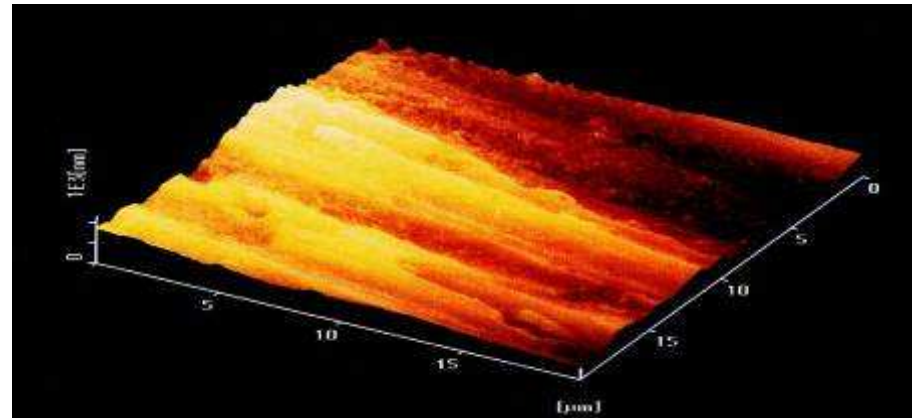
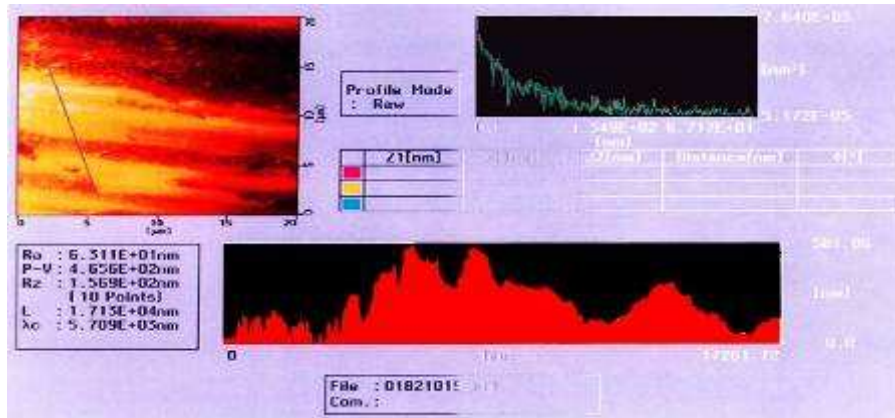
# Damages of gear wheels after Rewitec



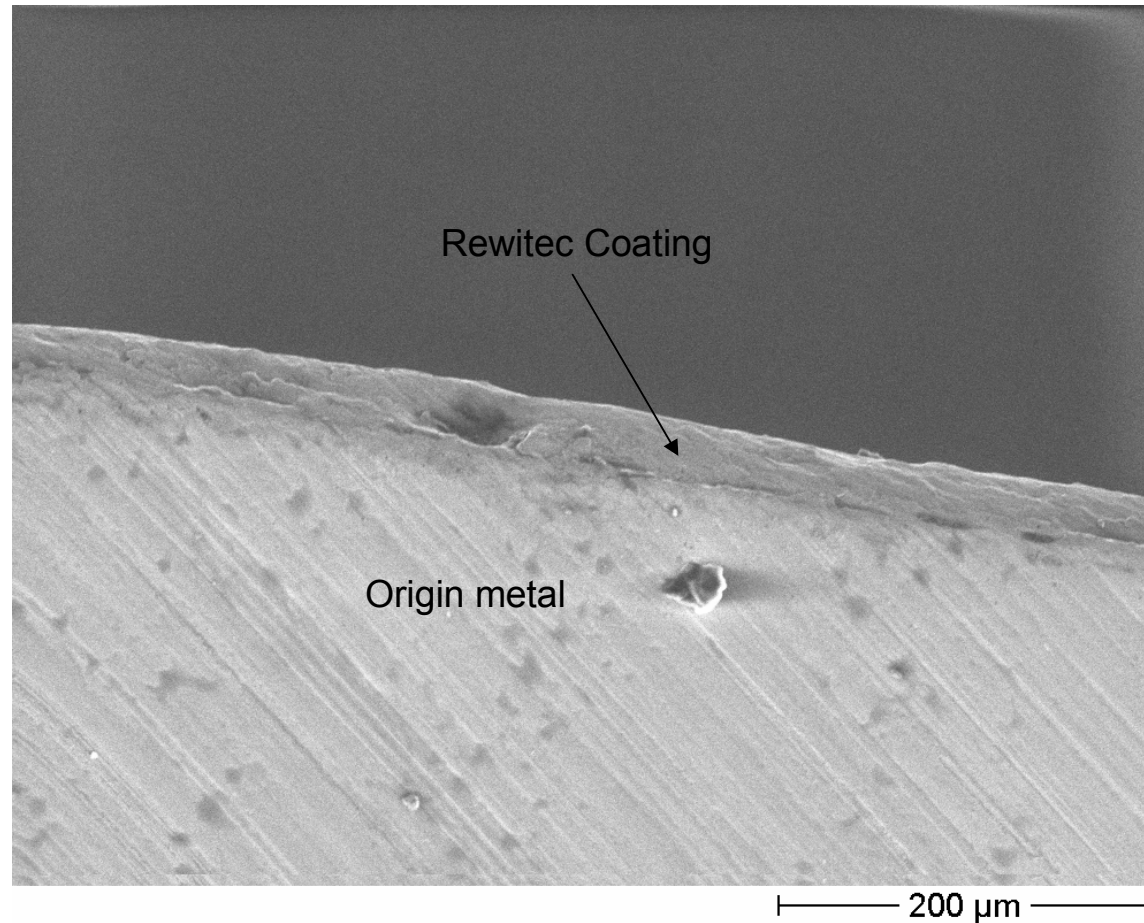
➤ **Repair, freeze, better prevent damages!**



# Gear teeth before and after REWITEC Treatment

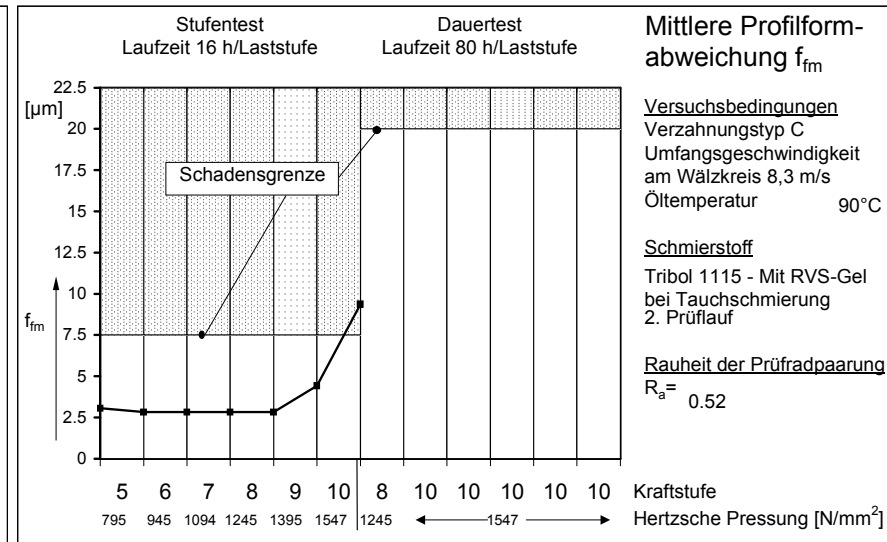
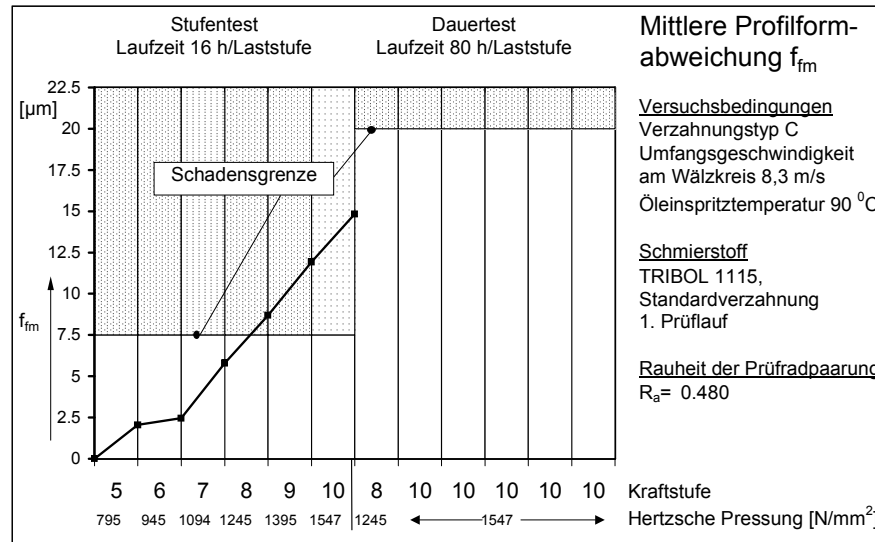


## Microsection of a ball bearing surface



The microsection shows the running surface of a ball bearing of a planet gear box after 250 hours of operation in an area of fatigue. The Rewitec Coating up to 30μm could be obviously recognized.

# Tests at University in Bochum



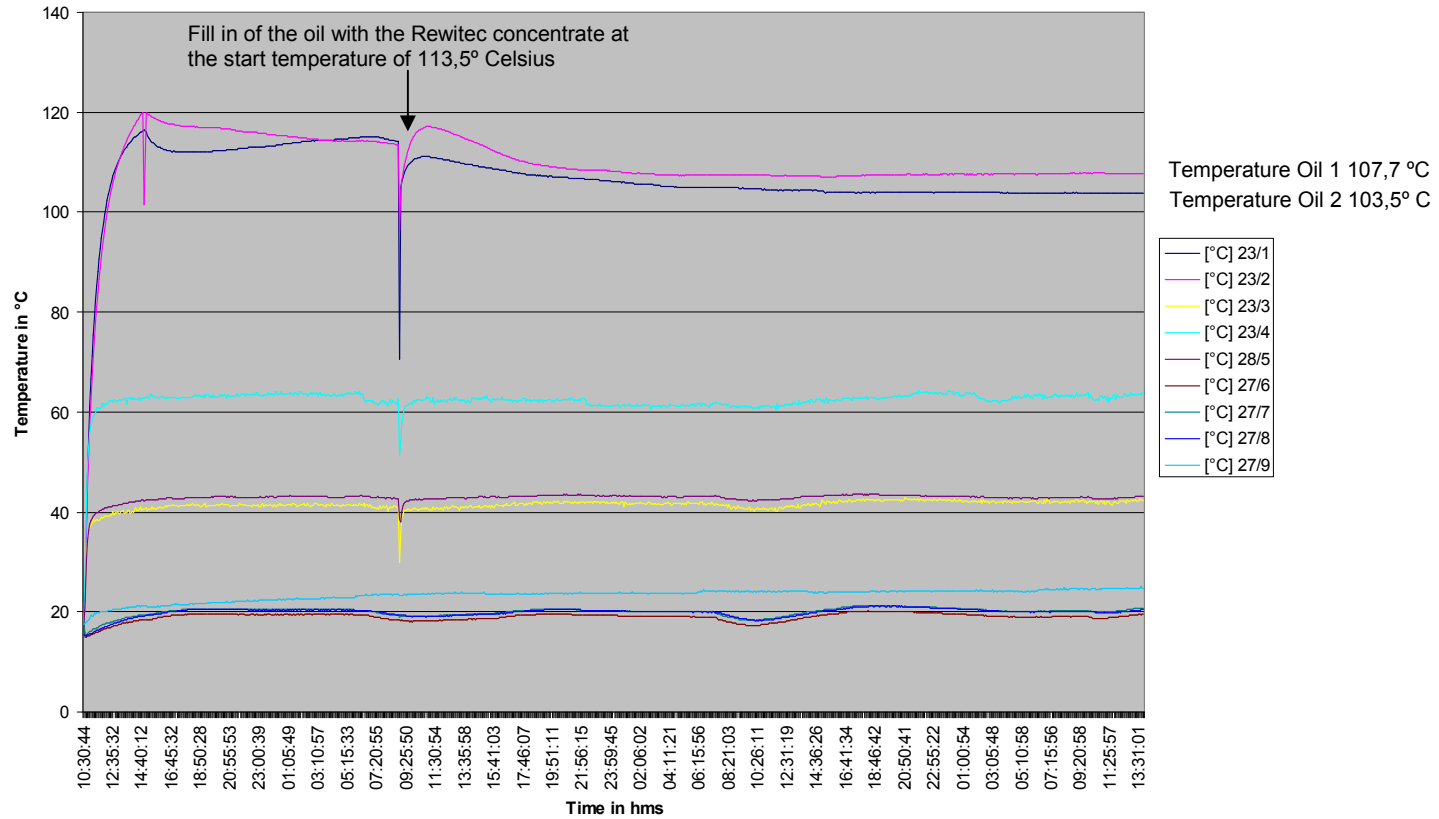
## FVA Micropitting Test

**Results:** Increase of 2 load steps, reduction of roughness by 17%, reduction of changing profile by 37%, reduction of pitting area by 8% and reduction of weight loss by 30%!

# Test on 2 gears of company Tandler



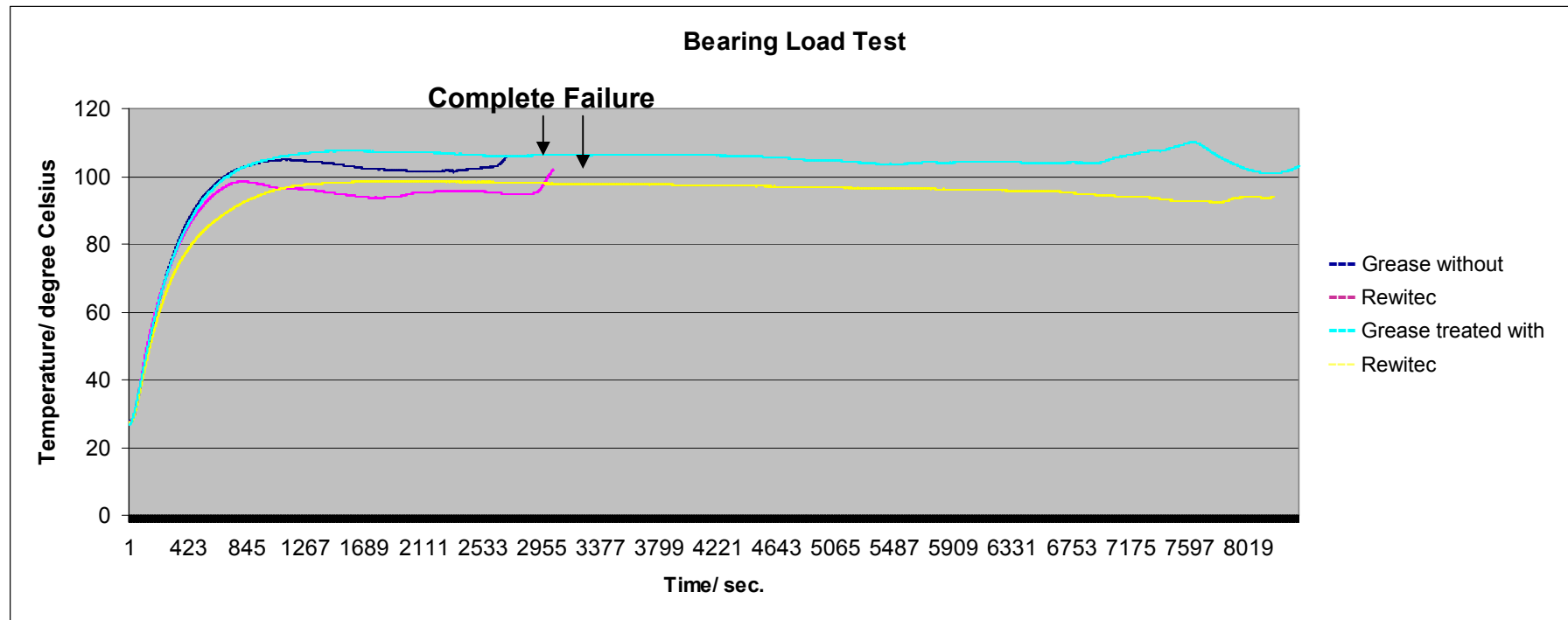
HL HWS A1 3.1 III  
Tests with Rewitec



**Temperature trend of the 2 Tandler gears with 2 different oils with and without Rewitec**  
- Temperature reduction of 6 – 10 °Celsius

# Bearing load test comparisen

## OEM grease versus REWITEC treated OEM grease in a 20.000 N bearing load test

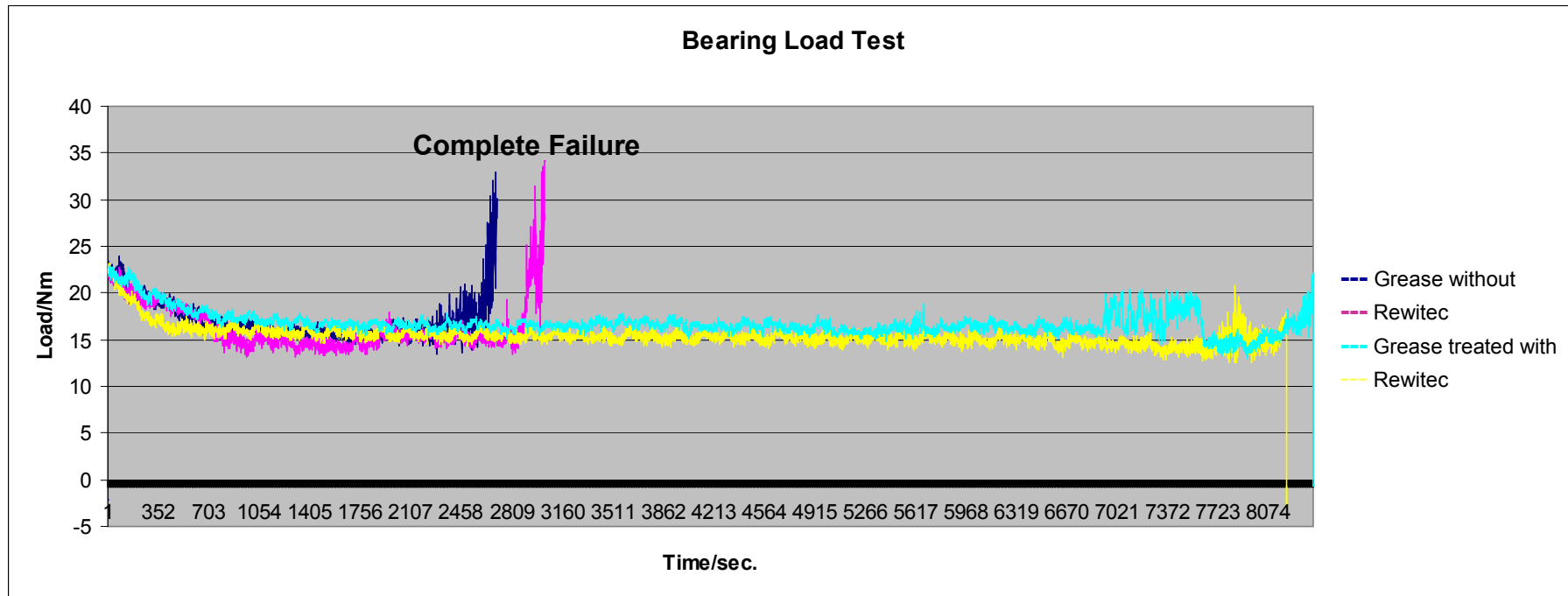


### Temperature measurement at axial bearings type 81105:

Results: Bearings with untreated grease failed after about 7 hours load test. Bearings with Rewitec treated grease did not fail for over 19 hours. The bearings running with Rewitec lasted for around 2.7 times longer.

# Bearing load test comparisen

## OEM grease versus REWITEC treated OEM grease in a 20.000 N bearing load test



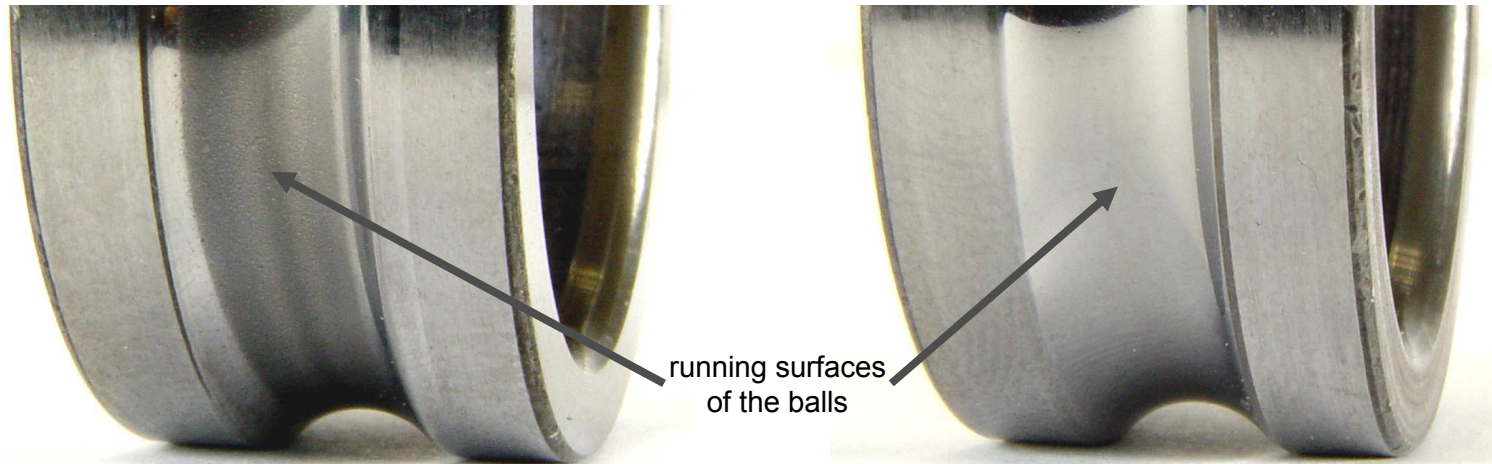
### Friction measurement at axial bearings type 81105:

Results: Bearings with untreated grease failed after about 7 hours load test. Bearings with Rewitec treated grease did not fail for over 19 hours. The bearings running with Rewitec lasted for around 2.7 times longer.

# Load Test of Ball Bearings



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Photos of the raceways of two ball bearings after 50 hours of operation in a range of fatigue

This ball bearing shows damage due to wear and tear. The running surface of the balls clearly shows pitting

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

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Bearing type: No. 6205 (d=25mm D=52mm)  
Lubricant: Special bearing grease  
Operating time: 50 hours  
Rotational speed: 500 min<sup>-1</sup>  
Nominal load: 5000 N radial (range of fatigue)

---

Bearing type: No. 6205 (d=25mm D=52mm)  
Lubricant: Special bearing grease **treated with REWITEC**  
Operating time: 50 hours  
Rotational speed: 500 min<sup>-1</sup>  
Nominal load: 5000 N radial (range of fatigue)

## Range of Applications



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Industry

Shipping

Automotive



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# Range of REWITEC applications



## Industry:

- Gears
- Combustion engines
- Compressors
- Bearings
- Hydraulic pumps/ -motors
- Vacuum pumps
- Chain drives
- Gear racks, pinions





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## Range of REWITEC applications

### Utility vehicles:

- Gasoline- and diesel engines
- Gears
- Rear axles, differentials
- Universal shafts
- Compressors
- Roller-, slide bearings

### Railways:

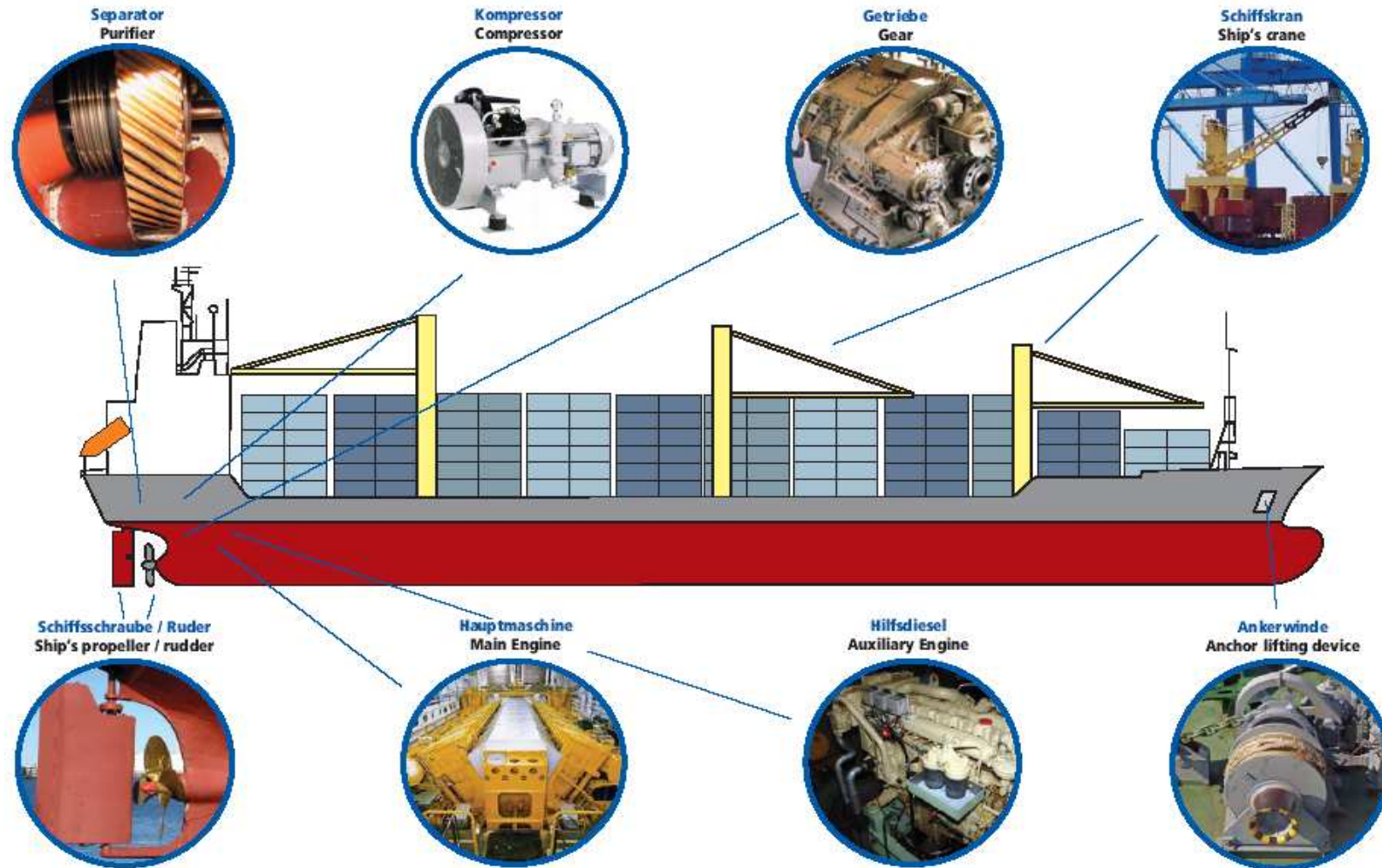
- Diesel engines
- Gears
- Compressors
- Bearings



# REWITEC applications in shipping business

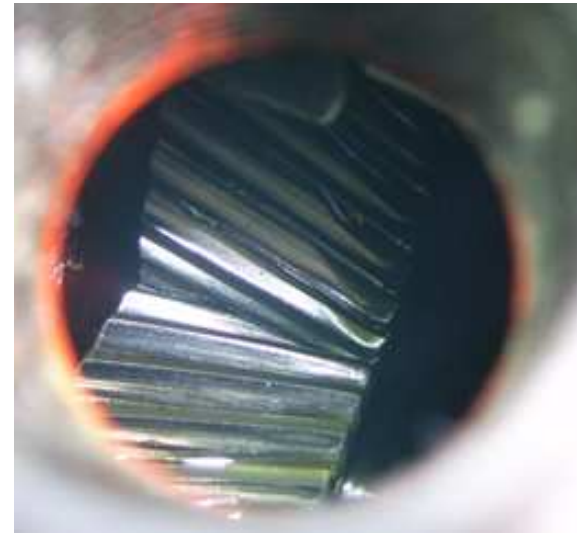


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## Treatment of 2 drill head gears at Volkswagen engines produktion line in Salzgitter



*Savings of about 100,000 Euro p.a.  
Treatment costs are 149 Euro per gearbox*

### **Problem:**

Short lifetime, extreme high costs in case of idleness and breakdown (>25.000,-€), higher oil temperature (51°C). Emergency run problems due to oil leakage.

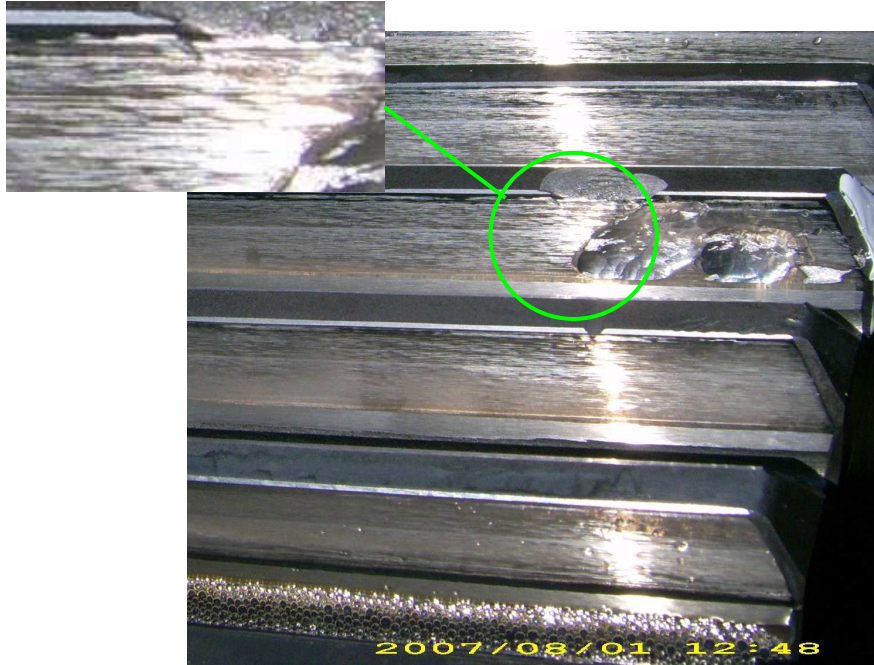
### **Result:**

Oil and oil filter are clean with nearly no metal particles. After REWITEC coating oil temperature was reduced by about 6°C to max. 45°C. Due to a system leakage drilling emulsion went into the gearbox. The REWITEC Nanocoating prevented the system against damages.

## Coating of a wind turbine gearbox of a Tacke TW250



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### Goal of application:

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

*Savings of about 80,000 Euro  
Treatment costs are 1,200 Euro*

### Results after about 700 hours operating time:

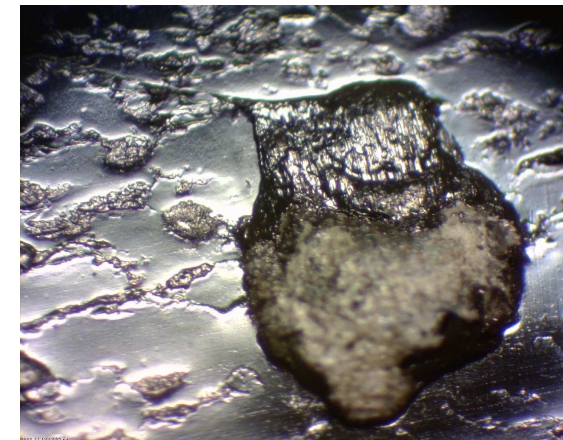
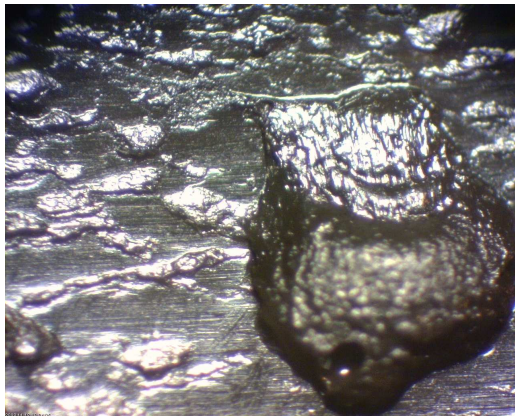
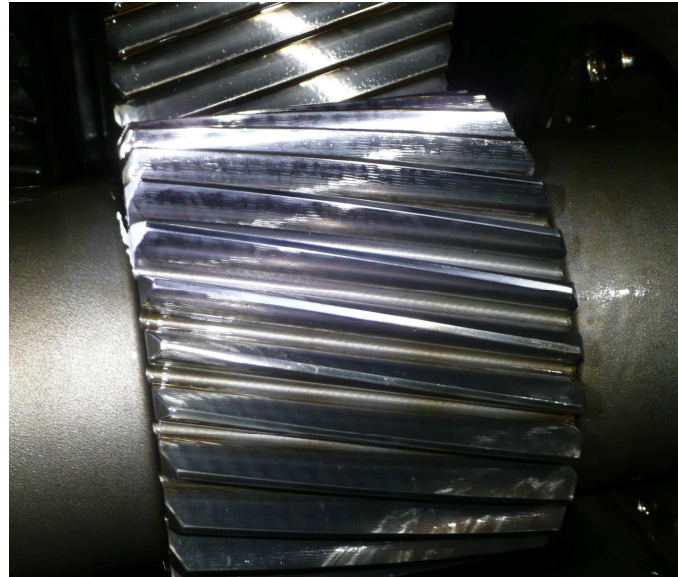
- The teeth surfaces are much smoother and more shiny (replicas before and after)
- The damages are without sharp edges
- The coated teeth surfaces had a higher electrical resistance of about 50  $\Omega$

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# Coating and analyses of a 600KW wind turbine gearbox



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## Goal of application:

- Reduction of grey staining
- Protection against further wear and prolongation of life time

## Condition after 64 days operating time:

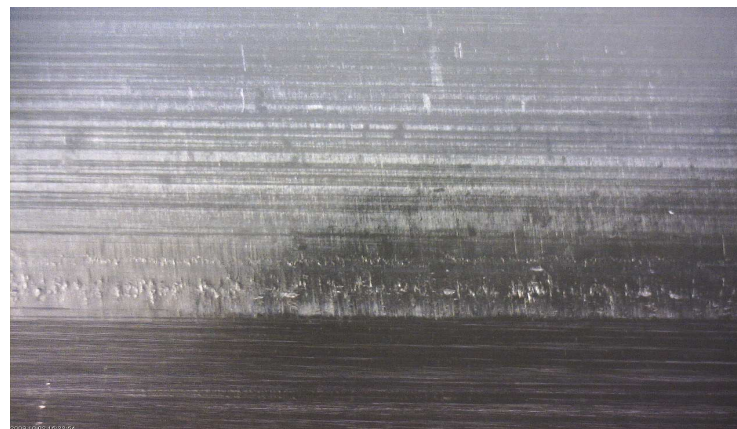
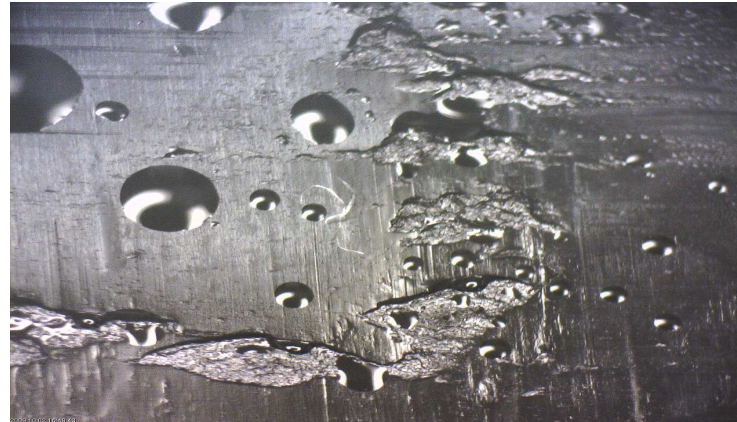
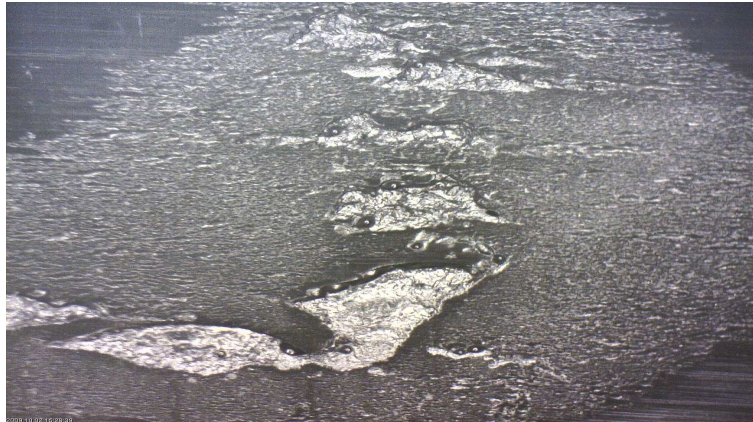
- The teeth surfaces are much smoother and more shiny (replicas before and after)
- The damages are without sharp edges
- The coated teeth surfaces had a higher electrical resistance of about 100  $\Omega$

*Savings of about 150,000 Euro  
Treatment costs are 2,560 Euro*

# Coating and analyses of 1MW Windturbine gearbox



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Before Rewitec treatment at 17.03.2009

After Rewitec treatment at 23.09.2009

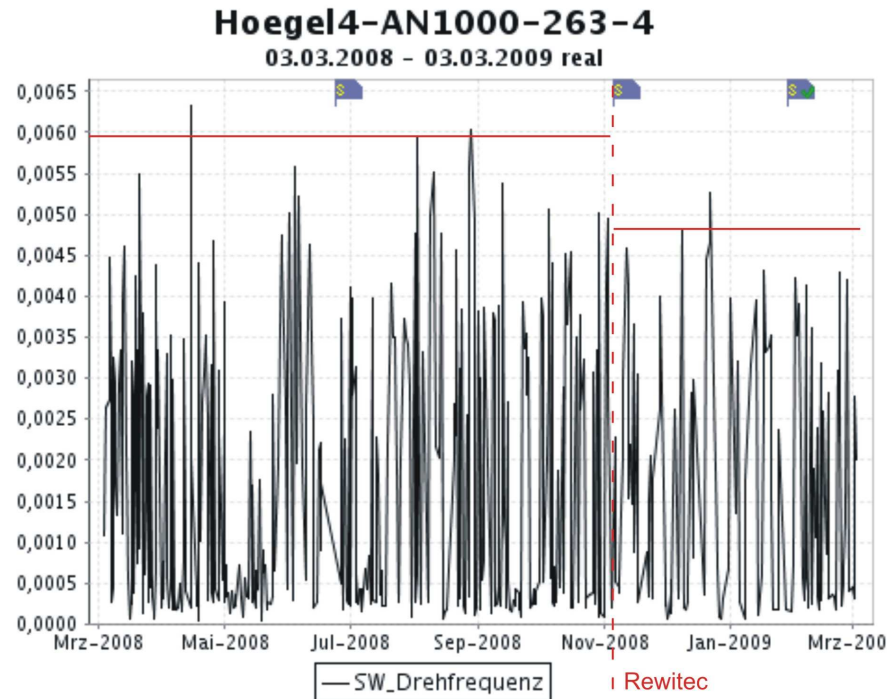
Topography

## Results after 150 days:

- The teeth surfaces are much smoother and more shiny (replicas before and after)
- 3D-Topografie-Analyses of NanoFocus AG with  $\mu$ surf-Technologie proves that the surface smoothing/ refinement and results in a **18-times** bigger load carrying tooth area!

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# Coating of a AN Bonus 1MW wind turbine gearbox



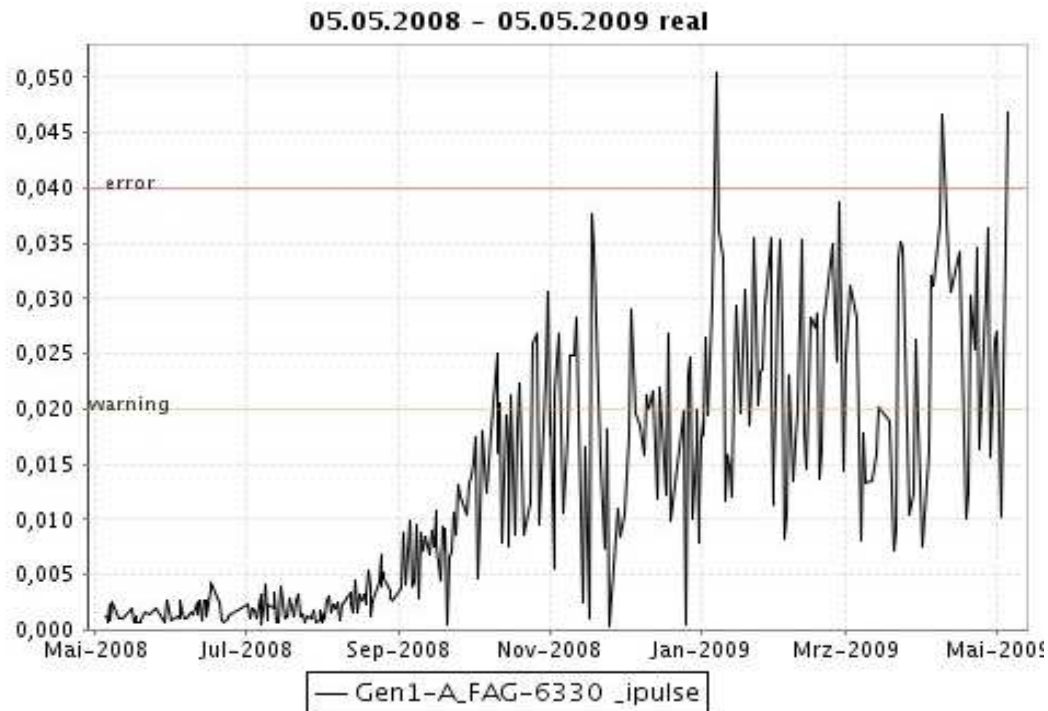
## Goal of application:

- Rebuilding of worn out teeth surfaces and Reduction of grey stoking
- Anaylsis via  $\mu$ -Sen CMS
- Protection against further wear and prolongation of life time

## Results after about 700 hours operating time:

- The teeth surfaces are much smoother and more shiny (replicas before and after)
- The coated teeth surfaces had a higher electrical resistance of about 50  $\Omega$
- $\mu$ -Sen CMS shows a 20% reduced damage frequency and noise in the system

# Coating of a AN Bonus 1MW wind turbine generator bearing



## Goal of application:

- Wear protection of generator bearing, due to use of Rewitec coating grease in December 2008
- Analysis via  $\mu$ -Sen CMS (Condition Monitoring System)
- Protection against further wear and prolongation of life time

## Results after 6 months:

- $\mu$ -Sen CMS shows clearly the stop of the progressive increase of the damage frequency in generator bearing



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## Already treated wind turbines

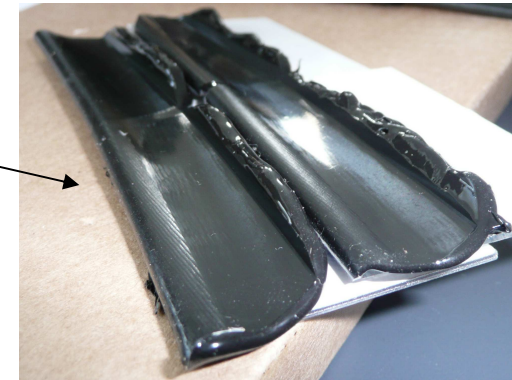
**We have treated already about 600-700 wind turbines:**

<b>AN Bonus</b>	1,0MW, 1,3MW
<b>DeWind</b>	D4, D6
<b>GE</b>	1,5MW
<b>Gamesa</b>	G47
<b>HSW1000</b>	1,0MW
<b>NEG Micon</b>	NM48, NM60, NM82
<b>Nordex</b>	S70, S77, N90, N54
<b>Repower</b>	5M
<b>Suzlon</b>	different types
<b>Tacke</b>	TW250, TW600, 1.5s
<b>Vestas</b>	V20, V25, V39, V47, V66, V80

# Proof of REWITEC Technology



- Surfaces pictures, endoscopies
- Oil analyses
- Measurements of the electrical resistance of the coated surfaces
- Imprints of tooth- and bearing surfaces
- Condition Monitoring



## 28. Innovation Award of German Economy Wirtschaft



On 19th of January 2008 REWITEC was announced as finalist of 28. German Innovation Award 2007. The Award for one of the best innovations in 2007 was presented to REWITEC from the Ministry of Economics and Technology in the „Old Opera“ in Frankfurt.



Die Finalisten der Kategorie Start-up

# 1st Husum WindEnergy Award 2009



REWITEC was Finalist of the 1st HUSUM WindEnergy Award 2009. REWITEC's „Nanocoating for Tribosystems“ is belonging now to one of the best innovations for wind industry.



# Present cooperations and customers



 Hapag-Lloyd	 Peter Döhle Schiffahrts-KG	 RICKMERS	 Leonhardt & Blumberg	 <b>EO</b> OLDENDORFF CARRIERS
 PHOENIX REEDEREI	 F. LAEISZ	 FAIRPLAY TOWAGE	 Peterson & Söhne	<b>Hatlapa</b> Marine Equipment
 Windstrom Unternehmensgruppe	 CSO ENERGY Services for Green Technologies	 VOITH	 VW	 ASTON MARTIN
 ZOLLERN BEWEGT	 FLENDER	 SUZLON	 ThyssenKrupp	 SALZGITTERAG Stahl und Technologie
 ArcelorMittal	 CEMEX Building the future™	 TEUTONIA ZEMENTWERK AKTIENGESELLSCHAFT	 Holcim	<b>HEIDELBERGCEMENT</b>
 KALI	 Leitz	 Continental	 e.on	<b>EnBW</b> Die Energie-AG.

# Thank you for your attention!

**Stefan Bill, Managing Director**

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