

How do environmental conditions at sea affect components of offshore wind turbines?

First results of methodology and investigation of test materials and oils

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Funded on the base of an act
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Supervisor

Coordination

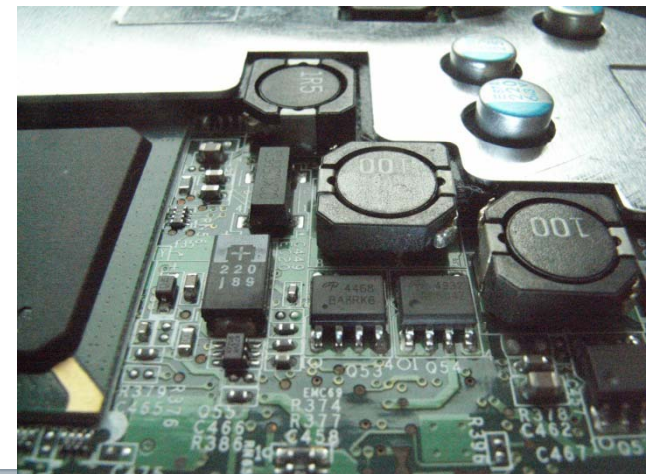


Bundesministerium
für Umwelt, Naturschutz
und Reaktorsicherheit



Introduction

- Introduction to the project UFO
- First results
 - Salt accretion on material samples
 - Analysis of oil specimen
 - Examination of touch tests
 - Investigation of microbial impact
- Outlook



Partners and site comparison

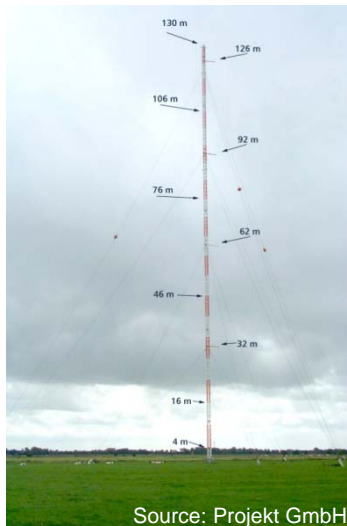
Project partners:

fk-wind: Hochschule Bremerhaven and IMARE gGmbH

AREVA Wind GmbH, Repower Systems SE

DEWI GmbH, MPA Bremen, Projekt GmbH, GL Garrad Hassan

Comparison of results at four different sites:

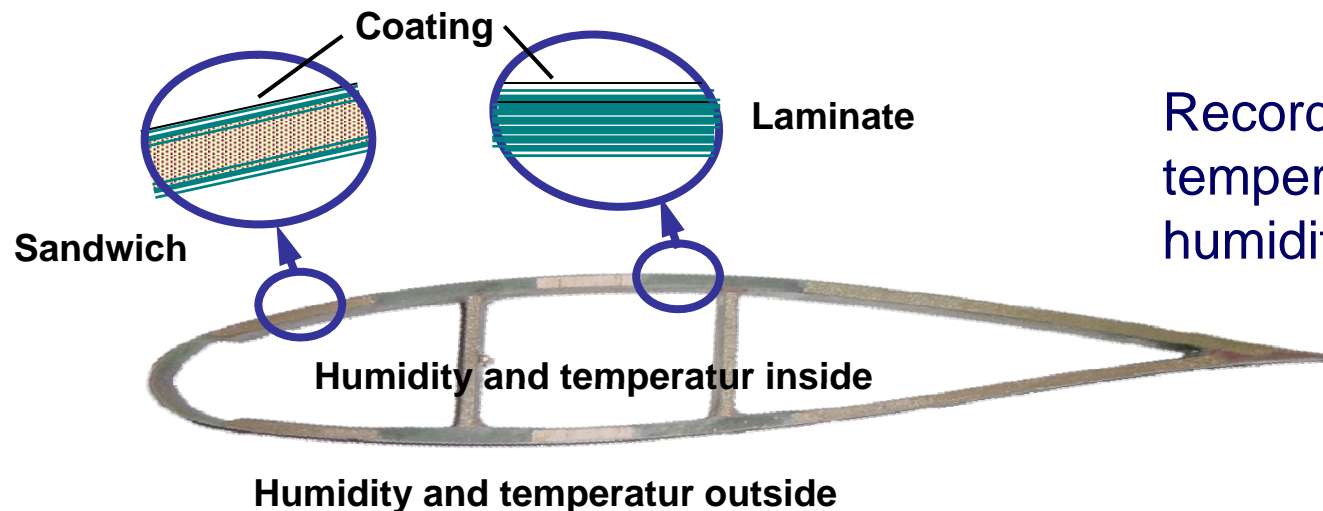


UFO - Research topics

Mounting and examination of material samples in respect to salt accretion

Validation of microorganisms on the surface of components and material samples

Analysis of gear and hydraulic oils



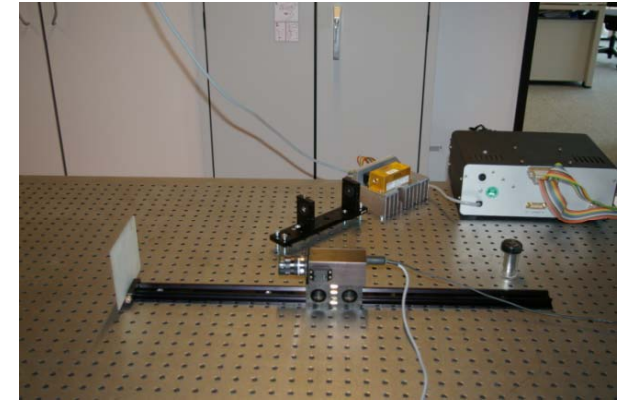
Recording of time series of temperature and relative humidity within rotor blades



Different detection of salt accretion

Method 1:

Use of a laser based optical system for detecting the salt accretion on materials



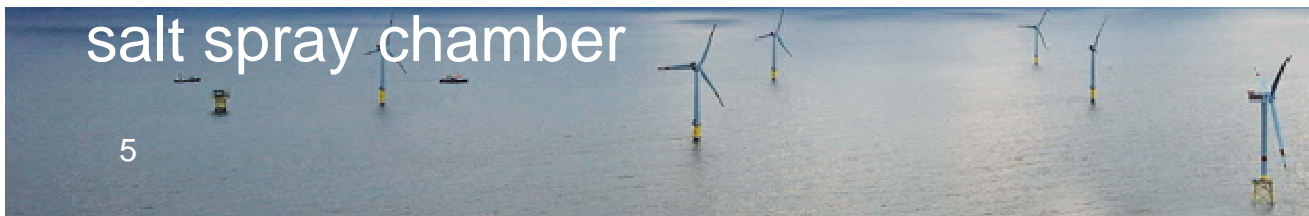
Method 2:

Mounting of samples of materials used in wind turbine components for the absorption of salt deposit



Method 3:

Examination of material samples in the salt spray chamber



Draft results of material samples

- **Sites**

Nearshore-Wind turbine
Waterfront area Bremerhaven

- **Period**

October to November 2011

- **Objective**

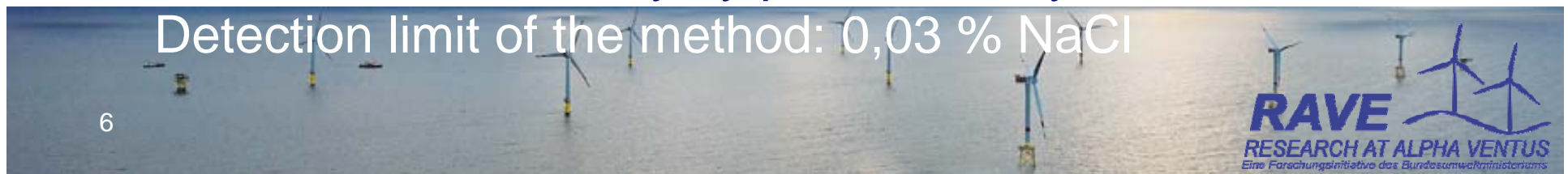
Validation of salt deposit

- **Methods applied**

Microscopy – reflected and transmitted light

Identification of salinity by potentiometry

Detection limit of the method: 0,03 % NaCl

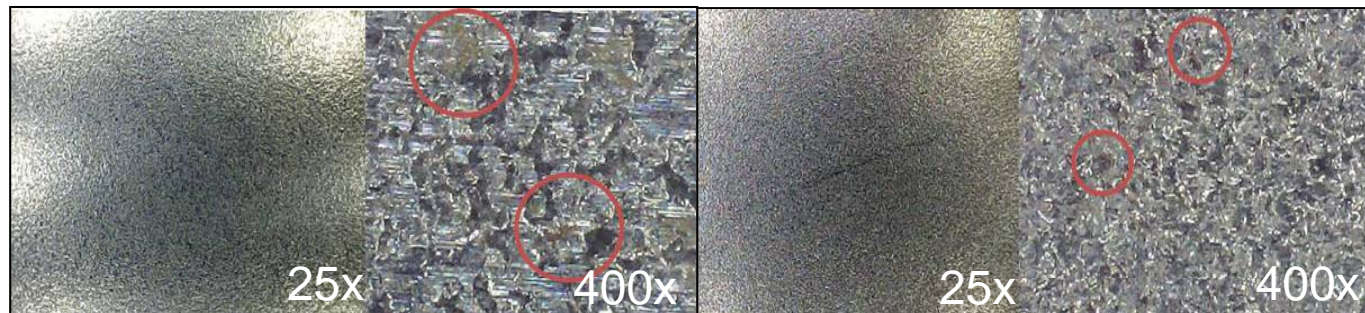


Results salt accretion on material samples

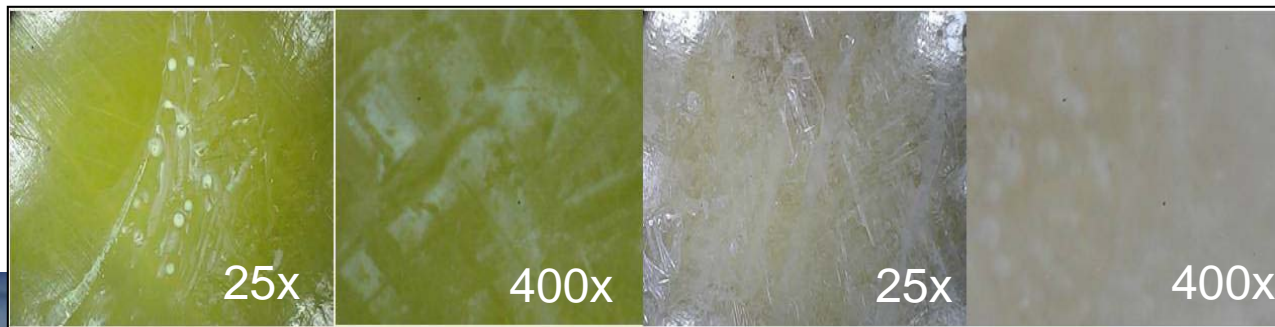
Fibre reinforced material show highest amount of salt accretion (rough surface)

Untreated steel and iron – corrodible, low salt contamination

Glass, aluminium und stainless steel – none to very low salt contamination (smooth surface)



NWT:
Left side – steel
Right side – iron



Harbour:
Left side – FRP with
UP-resin
Right side – FRP with
Epoxy

Gear and hydraulic oil samples

Site

Nearshore-Wind turbine

Operation time of the oil

about 6 years

Objective

Validation of salt, water and microbial contamination

Methods

Gas chromatography

Conductivity measurement with previous liquid-liquid extraction

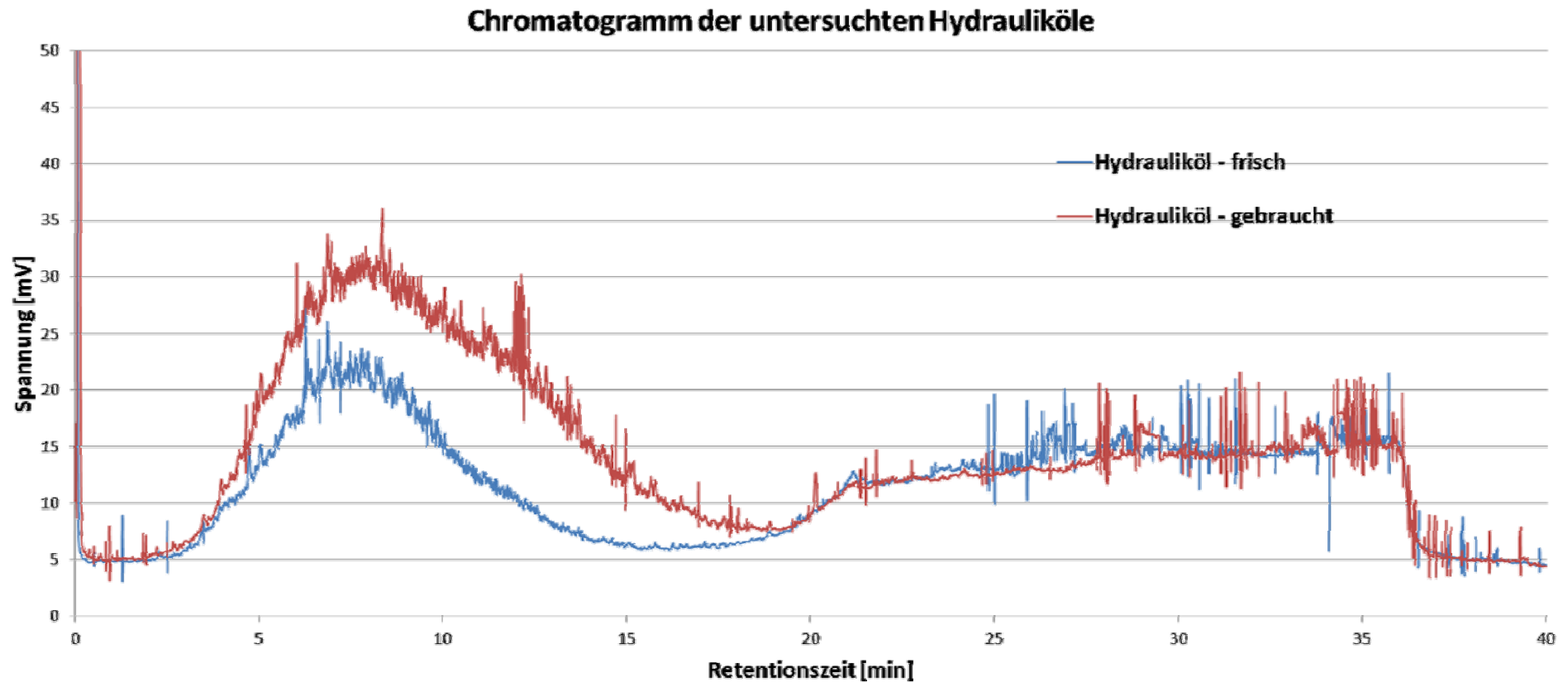
Microbiological analysis

Identification of water content



Draft results of the oil samples

Gas chromatogram of the examined hydraulic oil samples



Very complex configuration / mixture (additive)



Draft results of the oil samples

Microbiological analysis

Plating on two different media

None microbial contamination

Identification of water content

Vakuum furnace – Mass lost is between 0,27 %
und 0,54 %

Infrared spectroscopy – none water detectable



Draft results of the touch tests

Side

Nearshore-Wind turbine

Offshore-Wind turbine

Date of sampling

September and October 2011

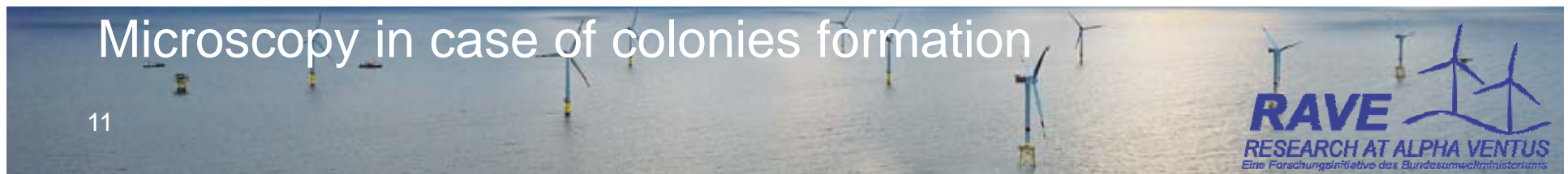
Objective

Investigation of the context between the climate conditions and a microbial contamination

Methods

Microbiological investigations – Plating on three different Media

Microscopy in case of colonies formation



Draft results of the touch tests



Maschinendach (außen)



Turminnenwand (Keller)

Touch tests of the Offshore-Wind turbine:

So far none active microbial contamination detectable

Touch tests of the Nearshore-Wind turbine:

Components:

**Roof of the nacelle
Inner wall of the tower**

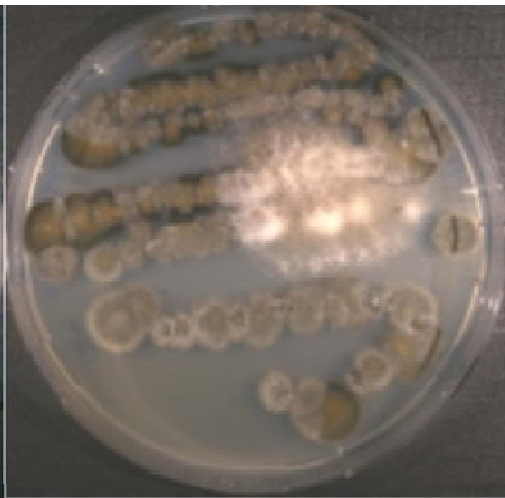
Intensity of contamination:

High to very high

Main weather side, sun, humidity



Turminnenwand (unten Westseite)



Turminnenwand (unten Nordseite)

Source: MPA Bremen



Draft results of the touch tests

**Touch tests of the Nearshore-
Wind turbine**

Components:

**Generator, compressor, beam
of the nacelle roof, ventilator**

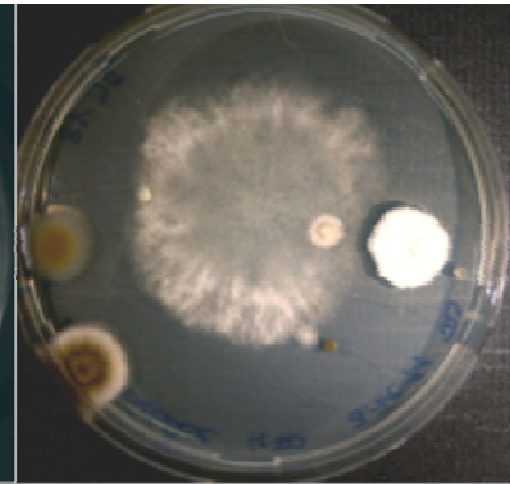
Intensity of contamination:

Very low to moderate

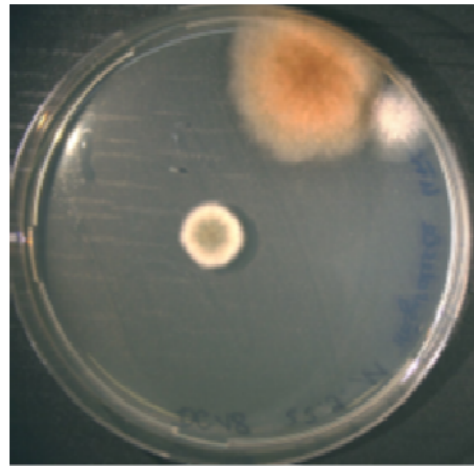
Randomly distribution



Generator



Gebläse (Keller)



Träger (Decke)

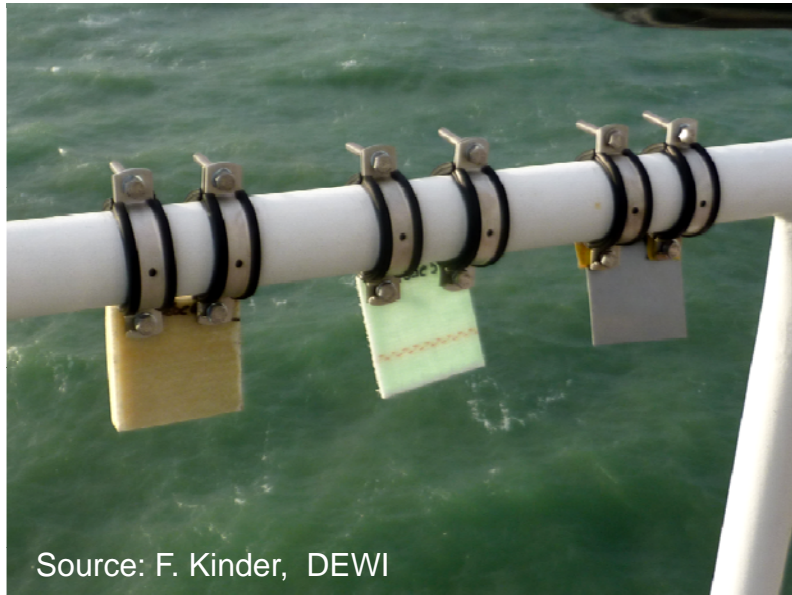


Ventilator (Trafraum)

Source: MPA Bremen



Outlook



Source: F. Kinder, DEWI

Mounting of material samples:

Nearshore

Offshore

FINO1

Recording of time series of temperature and relative humidity within rotor blades

Further development of the laser based measurement technique for the detection of salt accretion

Application of image processing technology and correlation methods

