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

First results of methodology and investigation of test materials and oils

Dipl. - Ing. Uta Kühne
M. Sc. Kristina Spasova

fk-wind: - Institut for Wind Energy
University of Applied Sciences Bremerhaven

International Conference, RAVE 2012, Bremerhaven, May 8-10, 2012
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:

fkwind: 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

Humidity and temperature inside

Humidity and temperature outside
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 – corrodesible, low salt contamination

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

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

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

Source: MPA Bremen
Outlook

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