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Droplet Erosion Protection Coatings for Offshore Wind Turbine Blades

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Introduction

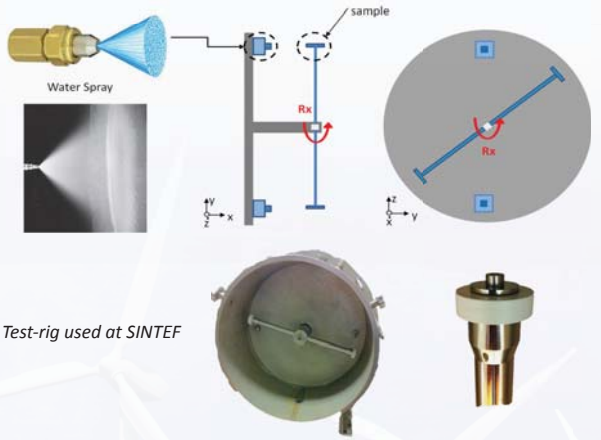
The work on protective coatings has been performed within the Norwegian Research Centre for Offshore Wind – NOWITECH. The objectives have been increased lifetime and reduced O & M costs for offshore wind turbines.

Water droplets impacting on high speed rotating blades are causing erosion of the leading edge. The deteriorated surface of the leading edge has a great impact on the aerodynamic efficiency of a wind turbine and therefore also on the economic efficiency.

Test-rig

In the present work, the droplet erosion as one type of leading edge erosion mechanism on wind turbine blades has been studied with polyurethane coatings, modified with nanoparticles (NP1 and NP2). As comparison a commercial tape and coating was used.

The test-rig allows speeds up to 180 m/s and different nozzle-shapes allow the control of drop-size. The droplet-size is characterised by a Phantom Multi Camera (160 000 Hz).



Test-rig used at SINTEF

Coatings

Dummy samples for erosion test facility

- HDPE
- PVC

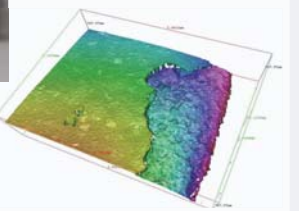
Protective surface coatings

- Industrial Wind Protection Tape
- Industrial Wind Protection Coating
- Polyurethane composite coatings
  - 100% PUR
  - Modified PUR with type N1 particles (1/ 2,5 and 5 wt%)
  - Modified PUR with type N2 particles (1/ 2,5 and 5 wt%)

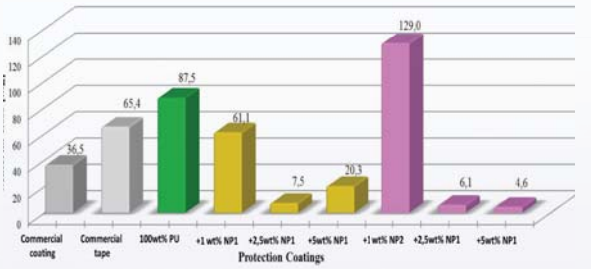
Results

After the test, the weigh loss of the samples were measured and the surface was investigated with a Confocal Infinite Focus Microscope (IFM), to study further the surface response of the coating to the droplets impact.

Illustration shows one of the modified coating proposed by SINTEF after a hazard test at 140 m/s for 60 min test duration.



Erosion pattern observed on a PU-coating doted with 5 wt% N2 at 140 m/s for 60 min.



Observed material loss on the different erosion protection coatings in mg. after test program.

Summary and conclusion

Modified polyurethane composite coatings show promising mechanical and erosion resistance properties as potential protective coatings.

Commercial coatings failed at 100 m/s impact speed, while doped PU-coatings could withstand up to 140 m/s.

All coatings started to fail at the sample edge. A new sample geometry should be considered and the environmental conditions taken into account.

Further investigations should be done into the mechanisms to understand the influence of nanoparticles on the performance of the coatings.