Droplet Erosion Protection Coatings for Offshore Wind Turbine Blades

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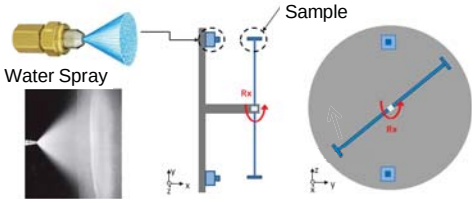
Introduction

Droplet erosion as one type of leading edge erosion on wind turbine blades, has been studied, in order to obtain a better understanding of the mechanisms and an erosion-resistant surface treatment. The target is to develop tools helping the industry to achieve a 20 year blade lifetime. Current industrial coatings and tapes have been studied and compared with new coating proposals.

Methods and materials

Home made droplet erosion test facility

- Sample velocity up to 180 m/s
- Interchangeable nozzles → numerous droplet sizes possible



Characterization

- Nanoindentation
- Adhesion testing
- IFM

Materials & coatings investigated

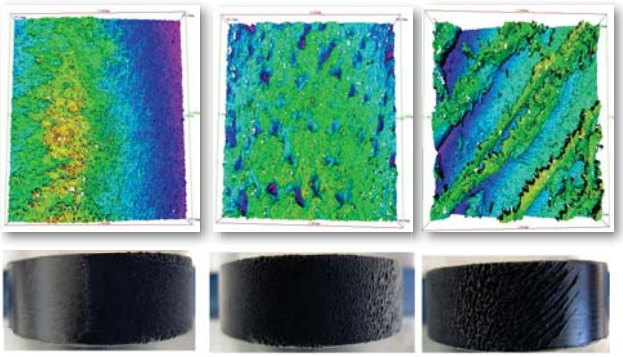
Dummy samples for erosion test facility

- HDPE
- PVC

Protective surface coatings

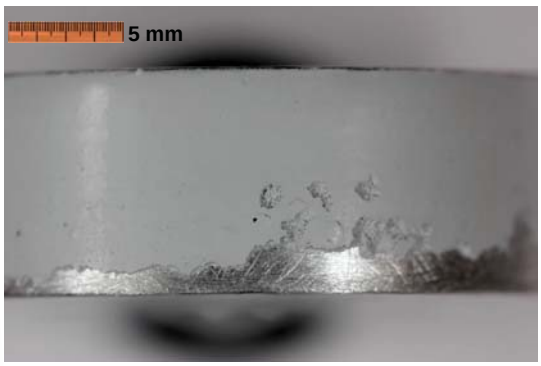
- Industrial Wind Protection Tape
- Industrial Wind Protection Coating
- Polyurethane composite coatings
  - 100% PUR
  - Modified PUR with type A particles
  - Modified PUR with type B particles

Experimental Results



Erosion pattern observed on dummy samples in HDPE after impact at 180 m/s for 180 min.

Industrial Solutions



Erosion pattern observed after impact at 100 m/s for 20 min test duration.

Investigation of erosion mechanisms

With the use of a Conofocal Infinite Focus Microscope (IFM), surface response to droplets impact can further be studied.

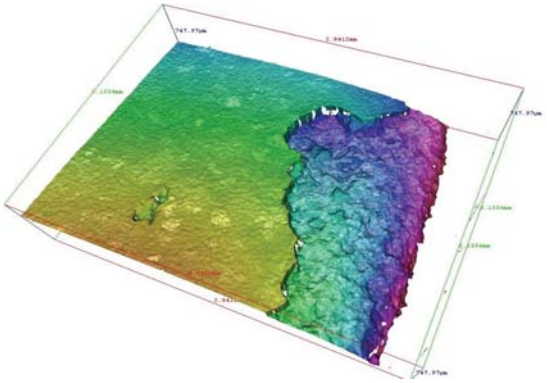


Illustration shows one of the modified coating proposed by SINTEF after a hazard test at 140 m/s for 60 min test duration.

Conclusions

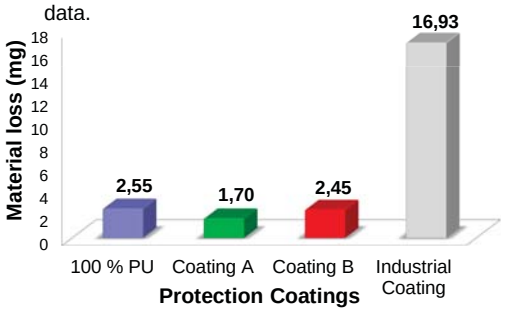
Test facility

The own built test facility provides realistic test parameters related to temperature, droplet size and blade tip velocity.

Comparison of coatings

•Modified polyurethane composite coatings show promising mechanical properties as potential protective coatings.

•The industrial tape is well known to provide good results in ordinary helicopter tests. However, in the current testing, adhesive failure due to peeling effects occurred initially on all tests. Further testing is still needed for obtaining reliable data.



Further work

This project gives a strong indication that the PU coating reinforced with A particles has promising properties regarding erosion resistance. This could potentially represent big benefits and future profits. Further steps are discussed with both a short and long perspective

• Material properties related to erosion resistance should be studied for optimization of new coatings.

• Evaluate the correlation with industrial helicopter tests.

• Look into opportunities regarding large-scale testing.

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