Leading edge erosion the state of the art research results

Hasager, Charlotte Bay; Mishnaevsky, Leon; Bak, Christian

Publication date: 2019

Document Version
Publisher's PDF, also known as Version of record

Citation (APA):

General rights
Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.
Leading edge erosion at wind turbine blades caused by weather effects dominated by concurrent high-wind, high-rain conditions prevail at several offshore wind farms. Variations between typical land- and offshore sites explain the degradation speed based on the study of rain and wind climate data [1]. Research to define and characterize the degradation processes investigating materials and the roughness of blades have resulted in new knowledge on droplets in rain erosion tester based on high-speed camera and numerical modelling. The degradation results in rougher airfoils that cause changes in the aerodynamic performance, hence loss of production. Detailed investigation on the rough surface in wind tunnel testing demonstrate the interplay between surface roughness and aerodynamic performance. These wind tunnel tests showed how surface roughness affected the aerodynamic performance as a function of varying roughness heights. The roughness of surfaces investigated from detailed observations using X-ray tomography and computational micromechanics simulations. Interestingly, the micro- and nanoscale structures, including the heterogeneities, particles and voids in the protective coatings, have critical effect on the crack initiation in the coatings under multiple liquid impact. Based on a systematic finite element simulation on environmental, design, and manufacturing processes, it was revealed what are the desirable coating properties and thicknesses in order to protect leading edges against sharp impacts. This leads to novel coating polymer coating development, relevant for repair of leading edge erosion. Recently it was proposed to limit leading edge erosion by slowing down turbines during few intense rain events, to prolong lifetime, and reduce cost for repair and even increase the annual energy production [2].

**Acknowledgements**

This work was supported by the Innovation Fund Denmark Grand Solutions grant 6154-00018B for the project EROSION, grant 8055-000112A for the project DURABLEIDGE and the EUDP project “Leading Edge Roughness Wind Turbine Blades, grant 64015-0046.

**References**

1. www.rain-erosion.dk