Project: Lifetime Prediction of Leading Edge Protection Systems

Key focus: predicting leading edge protection system's lifetime from rain erosion tests

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Background

Wind turbine blades suffer from rain erosion. Leading edge protection (LEP) coating systems which have good rain erosion test (RET) results in the laboratory do not always correlate with good performance in the field. An improved methodology is required to translate between coating tests and coating lifetimes in different operational environments, as they are affected by rain conditions. A Joint Industry Project named COBRA has published recommendations for designing rain erosion protection systems.

Project description

This research aims to expand on the COBRA methods, by furthering the understanding of damage mechanisms to improve current lifetime prediction models. This will then be used to understand the relationship between the RET and the offshore environment, to ensure testing is representative.

The COBRA methodology was scrutinised for different RET conditions and materials, but was not validated for all LEP materials. The methodology uses outdated testing and LEP systems to develop its key equations and is unrepresentative of current approaches. The offshore environment has been characterised using measurements from ORE Catapult's NOAH platform. An extract of this analysis, Figure 1, shows that precipitation occurs in discrete periods often with a long time period between events. Dynamic mechanical thermal analysis studies have shown that a viscoelastic material recovers in 20 minutes. Current rain erosion testing does not allow this recovery. Therefore, current RETs are causing more brittle failures and the results are unrepresentative of the offshore environment.
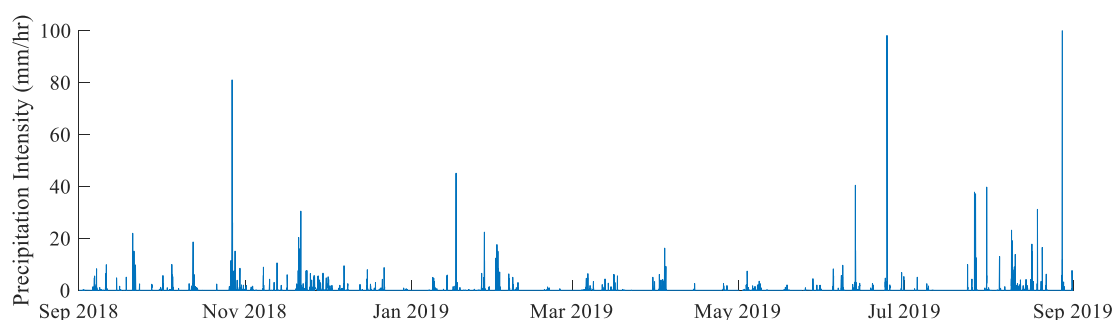

Figure 1: Extract of the offshore characterisation showing discrete periods of precipitation.

Research outcomes/impact

The research aims to develop an improved correlation methodology, which provides the representative RET and lifetime prediction capability required by the wind industry. Enabling a suitable qualification method which helps to inform the design of new materials, ultimately helping to reduce the loss in energy production and inspection and maintenance costs.

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WBRH : Wind Blade Research Hub