Protecting engineering materials from water impact

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Mark Gee, Fellow at the National Physical Laboratory (NPL), discusses new ways to assess and reduce erosion from water impact in an article

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Erosion caused by the impact of water droplets on component surfaces can lead to failures in key technological applications. For example, in steam generating plants, the leading edge of turbine blades suffer major erosion damage from the steam driving the turbines, requiring costly maintenance and repair with consequent loss of generating capacity.

Similarly, erosion caused by the impact of rain drops on wind turbine rotor blades can change the profile of the blades, leading to significant loss in power generation capability. Blades are treated with low energy polymer coatings, but currently these coatings only last about 10 years before the blades need refurbishment.

For both of these applications, new materials solutions are required. In response, NPL has designed and manufactured a rotating arm test system to evaluate the effectiveness of these new materials.

The test system consists of an aerodynamically-shaped rotating arm with samples at either end, a metre apart. The arm is rotated at speeds up to 10,000 rpm in an evacuated chamber, and a jet of water droplets is injected across the samples, causing erosion from the impact with the droplets. The damage is monitored by measuring the progression of mass loss throughout the test and the wear mechanisms are assessed by optical and scanning electron microscopy.

The test system has already been used in several collaborative projects looking at the development of new material systems. In one of these projects, new coatings for steam turbine blade applications were designed and tested, and good progress in extending the durability of the coatings was obtained, with the lifetime of some candidate coatings being ten times that of the uncoated steel.

Further work to determine the relationship between the make-up of new advanced materials and their water droplet erosion performance is now being carried out using high-speed imaging, combined with advanced microstructural characterisation techniques.

More information: Assessing the risk to engineering materials from water impact: www.adjacentopenaccess.org/res … -water-impact/31741/

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