2022 Industrial Technology Institute Research overview

Renewable Energy

Development of Technology to Evaluate Erosion of Wind Turbine Blades

～ Consideration of the mechanism of erosion using test pieces from a rotary testing machine ～

Metals & Physical Properties Division/Analysis & Chemistry Division/Textile & Polymer Division, Materials Technology Department

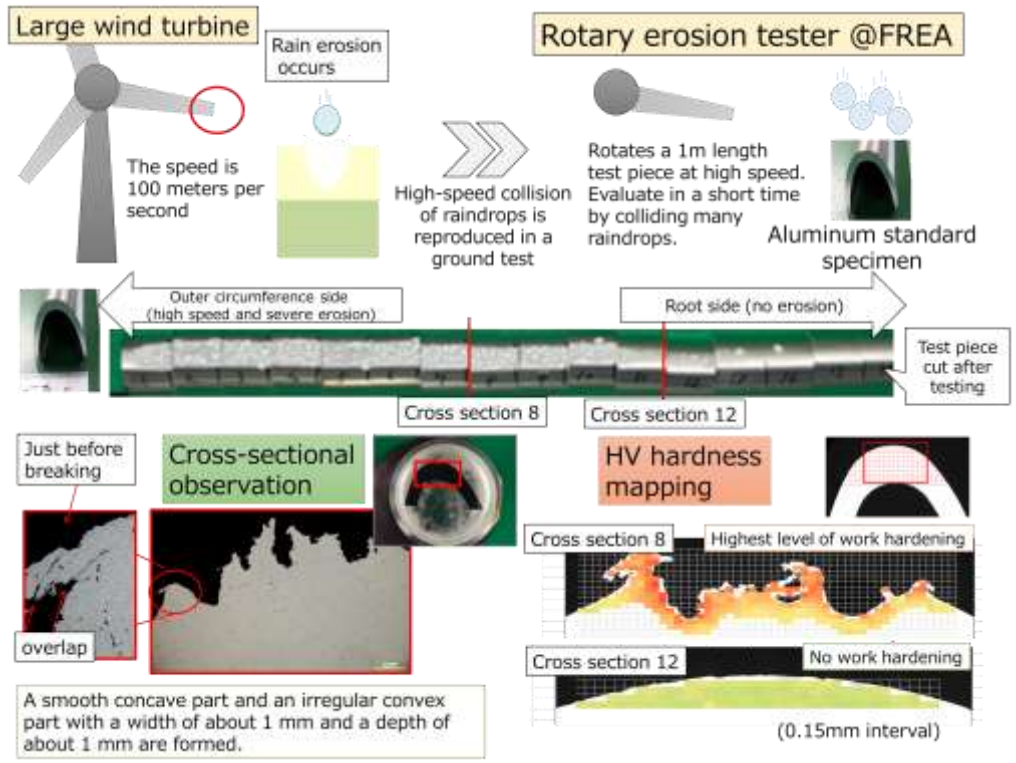

Fig 1 Materials engineering evaluation of standard specimens

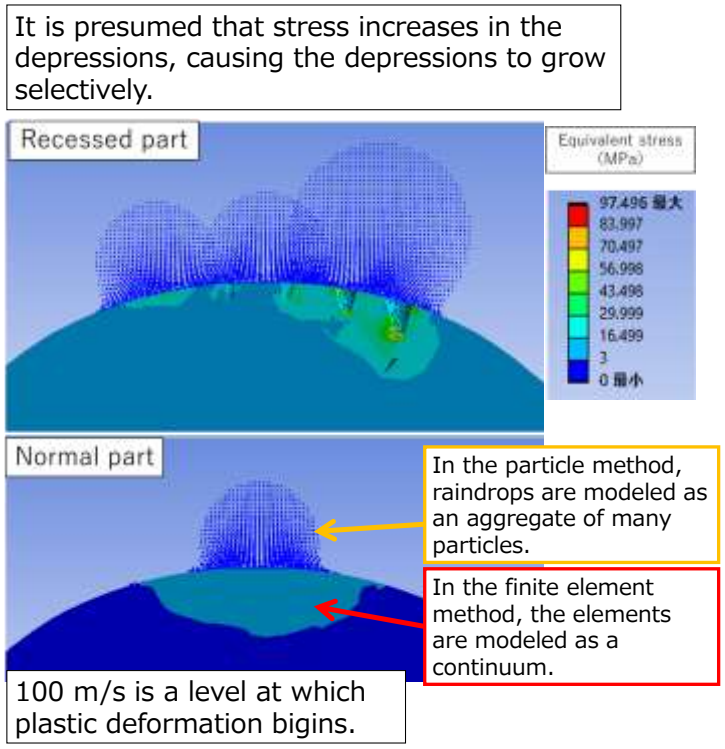

Fig 2 CAE analysis results (Collision speed 100m/s)

Technical Issues to Address

Wind turbine blade components are exposed to sunlight, lightning, and rain, resulting in the occurrence of various defects. Rain erosion has become a significant issue in recent years. This phenomenon occurs when high-speed rotating blades collide with raindrops, causing surface abrasion (erosion). This erosion reduces power output and, in the worst case, can cause the blades to break.

Research Contents

In the first year, we analysed the erosion mechanism through cross-sectional observations, hardness mapping measurements, and computer simulations (CAE) on standard aluminium specimens obtained using a rotary erosion tester installed at AIST (FREA).

Summary

As a CAE method, raindrops are modelled using the “particle method” and blade members are modelled using the “finite element method”. Through the utilisation of “particle method-finite element method coupled analysis,” which calculates by bridging the two methods, we were able to calculate the deformation of the blade members resulting from the collision of raindrops.
Based on these results, it was concluded that rain erosion of metal results from multiple collisions with raindrops, causing "plastic flow" and the formation of indentations. These indentations then lead to bending, fracture, and detachment of convex parts. Next year, we plan to evaluate the coatings and FRP (fibre-reinforced plastic) used in actual blades.

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