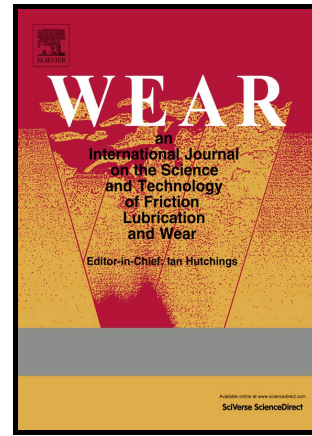


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Effects of sediment erosion in guide vanes of Francis turbine

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Abstract

Guide vanes (GV) in Francis turbines are often reported to have a severe material erosion in case of sediments laden projects. A small clearance gap (CG) between GV wall and facing plate is allowed from the design to pivot GV as a part of flow regulating mechanism. Erosion in GV causes to increase the CG, which induces a leakage flow through the CG due to the inherent pressure difference between GV surfaces. Limited scientific studies on understanding the effects of the leakage flow from the eroded GV on turbine performance have been documented. Presented work aims to characterize the velocity conditions at the runner inlet of Francis turbine due to increase in the CG. Pressure and velocity measurements are done inside a GV cascade producing the similar velocity distribution as that in a reference prototype turbine. With a 2 mm CG, the relative velocity close to shroud of runner inlet is found to increase up to three folds of its nominal value. A vortex filament is found to be developed due to the mixing of the leakage flow with the main flow and is observed to pass into the runner with the flow.

Graphical Abstract

Keywords: Francis turbine; Guide vane; Cascade; PIV; Clearance gap; Leakage flow

Nomenclature

C total flow velocity, m/s

C_m radial component of C, m/s

C_u tangential component of C, m/s

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