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CFD Simulation of Crossflow Mixing in a Rod Bundle with Mixing Blades

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Abstract

A CFD model was developed in this study to simulate the crossflow mixing in a 4x4 square array rod bundle caused by ripped-open blades. The central subchannel and adjacent subchannels of one grid span were modeled using flow symmetry. The lateral velocity pattern within the central subchannel, lateral velocity and the turbulence intensity in the rod gap region were predicted by the CFD method, and the predictions were compared with the measurements. The CFD simulation shows a vortex flow around the fuel rod caused by a pair of blades, which is consistent with the experimental results. The CFD predictions of the lateral velocity on the mixing sections show a near symmetric profile, but the measurements present an asymmetric velocity profile leading to an inversion of lateral velocity. The predicted mixing rate between the central subchannel and the adjacent subchannels reasonably agrees with the measured one. The CFD prediction shows a parabolic distribution of the RMS velocity but the measured one shows a rather flat distribution near the blade that develops to a parabolic distribution far downstream ($L=29D_e$). The predicted average RMS velocity on a mixing section is also slightly lower than the measured one. This study confirmed that the CFD simulation can present the effect of the ripped-open blades on the crossflow mixing in a rod bundle well.