

Unsteady Characteristics Investigation on the Precessing Vortex Breakdown and Energy Separation in a Vortex Tube

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Abstract : In this paper, the phenomenon of vortex breakdown in a vortex tube was analyzed within the scope of unsteady character in swirl flows. A 3-D Unsteady Reynolds-averaged Navier-Stokes (URANS) closed by the Reynolds Stress Model (RSM) was adopted to simulate the large-scale vortex structure in vortex tube, and the numerical model was verified by the steady results. The swirl number was calculated for the vortex tube and the flow field was classed as strong swirl flow. According to the results, a time-dependent spiral flow field gyrates around a central recirculation zone which is precessing around the axis of the tube, and manifests the flow structure is the spiral type (S-type) vortex breakdown. The vortex breakdown is crucial for the formation of the central recirculation zone (CRZ), a further discussion was about the affection on CRZ with the different external conditions of vortex tube, the study on the unsteady characters was expected to hope to design of vortex tube and analyze the energy separation effect.

Keywords : vortex tube, vortex breakdown, central recirculation zone, unsteady, energy separation

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