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Modeling Vortex Cavitation Inception Delay in a Swirl Chamber by Polymer Injection[1] J. MA, Q. ZHANG, C.T. HSIAO, G.L. CHAHINE — Experimental studies have shown tip vortex cavitation can be delayed with injection of drag reducing dilute polymer solutions. We present here numerical simulations conducted to understand the mechanisms responsible for cavitation suppression with local polymer injection. A canonical flow in a linear vortex chamber was simulated by using the NS solver, 3DynaFS-Vis©, equipped with a FENE-P viscoelastic model for the polymer solution and a transport equation to track its concentration. The simulation showed that injection of dilute polymer can delay cavitation inception at a much lower injection flow rate than needed with massive injection of water or a higher viscosity liquid. Injection of polymer increases the pressure along the vortex axis and a much earlier vortex breakdown created by the elasticity of the polymers appears to be responsible for the strong modification of the flow character. This results in a fast reduction of the rotational velocity, increase of the pressure, and delay of cavitation inception. The dependency of polymer effects on the injection flow rate and polymer concentration was also investigated, finding good consistency with experimental observations.

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