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A unified physical model to explain Supercavity closure[1] ROGER ARNDT, Retired, ASHISH KARN, JIARONG HONG, University of Minnesota — An insight into underlying physics behind supercavity closure is an important issue for the operation of underwater vehicles for a number of reasons viz. associated gas flow requirement with each closure regime, effect of cavity closure on the overall cavity behavior and collapse, differences between natural and ventilated supercavity closure etc. There have been several reports on supercavity closure since the 1950s and many empirical relationships governing different closure modes have been proposed by different authors. Yet, there is no universal agreement between results obtained at different experimental facilities. In some cases, contradictory observations have been made. In this talk, systematic investigations conducted into supercavity closure across a wide range of experimental conditions at the Saint Anthony Falls Laboratory (SAFL) are presented. A variety of closure mechanisms were observed including the ones widely reported in the literature, viz. twin vortex, re-entrant jet; new stable closure modes viz. quad vortex and interacting vortex and a host of transition closure modes. A hypothesis on the physical mechanism based on the pressure gradient across the cavity that determines the closure modes is proposed. Using this hypothesis and the control volume analysis at supercavity closure, we explain the observations from SAFL experiments as well as reconcile the observations reported by different researchers. The hypothesis explains the supercavity closure across different experimental facilities, at different blockage ratios and at different flow conditions. Thus, a unified understanding into supercavity closure from the viewpoint of fundamental physics is attempted.

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