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Supersonic Injection of Aerated Liquid Jet. ABHIJIT CHOUDHARI, KHALED SALLAM, Oklahoma State University — A computational study of the exit flow of an aerated two-dimensional jet from an under-expanded supersonic nozzle is presented. The liquid sheet is operating within the annular flow regime and the study is motivated by the application of supersonic nozzles in air-breathing propulsion systems, e.g. scramjet engines, ramjet engines and afterburners. The simulation was conducted using VOF model and SST k-ω turbulence model. The test conditions included: jet exit of 1 mm and mass flow rate of 1.8 kg/s. The results show that air reaches transonic condition at the injector exit due to the Fanno flow effects in the injector passage. The aerated liquid jet is alternately expanded by Prandtl-Meyer expansion fan and compressed by oblique shock waves due to the difference between the back (chamber) pressure and the flow pressure. The process then repeats itself and shock (Mach) diamonds are formed at downstream of injector exit similar to those typical of exhaust plumes of propulsion system. The present results, however, indicate that the flow field of supersonic aerated liquid jet is different from supersonic gas jets due to the effects of water evaporation from the liquid sheet. The contours of the Mach number, static pressure of both cases are compared to the theory of gas dynamics.

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