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EXPERIMENTAL AND NUMERICAL ANALYSIS OF THE FLOW WITHIN A SUPERSONIC EJECTOR

Olivier Lamberts*,§, Philippe Chatelain* and Yann Bartosiewicz*
*Institute of Mechanics, Materials and Civil Engineering (iMMC), Université catholique de Louvain (UCL), Louvain-la-Neuve, 1348, Belgium
§ Correspondence author. Email: olivier.lamberts@uclouvain.be

ABSTRACT Supersonic ejectors constitute interesting devices able of performing compression of a fluid stream. They are used in steam power plants, for propulsion and for refrigeration applications to name but a few. Without any moving part, they are fully passive: the secondary fluid stream to be compressed gains its exergy by entrainment and exchange with a motive (primary) supersonic stream. Unlike free supersonic jets, the primary stream strongly interacts with the confined secondary stream and the resulting flow structure is rather complex. This work aims at offering novel insights into the complex structure of the flow within a supersonic ejector using both advanced post-processing methods of numerical results and schlieren visualizations. Some authors have already examined the flow within a supersonic ejector through schlieren visualizations, but in most cases they used ejectors in which the secondary stream reaches sonic conditions by flowing through a physical throat located at the nozzle exit position (NXP). In the present work, the secondary stream reaches sonic condition within the mixing duct. To the knowledge of the authors, this study is the first one that investigates the quantification and the location of the choking of the secondary stream within the ejector, and their connection with the entrainment. Two very different phenomenologies for the choking of the secondary stream are highlighted, both numerically and experimentally. It is shown that the primary total pressure and the height of the mixing duct are the main parameters that influence the type of choking for a fixed geometry of the primary nozzle. The proposed methodology may serve for the improvement of 1D models of the ejector.