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Numerical simulation of Air/Helium plumes in a semi-confined cavity with one vent

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We present a numerical study (DNS) for plumes originating from intruding a low density fluid into a semi-confined cavity filled initially with air at rest. This study is of significant interest for security engineers studying industrial systems using hydrogen as an energy carrier. In such systems, hydrogen is distributed through pipes, which in case of a technique error, the last will escape through the medium in a plume/jet flow and form when mixed with air a highly dangerous and destructive mixture. Our aim is to understand the mixing of the two fluids and the efficiency of the entrainment along the flow which is poorly estimated except for extreme situations... For security reasons and following the CEA experiments, we consider Helium to be the injected fluid and analysis is done in the sense of dimensionless parameters.

We present some results of our first work devoted for axi-symmetric round plumes. The plume internal and external characteristics have been studied in its first stage evolution just before the impact with the top wall and results are compared to the theory of laminar starting plume (well developed head, conduit, ...). Two different criteria have been studied to define the height of the plume at different instants and a satisfactory error to the order of the mesh size has been found. Long axi-symmetric calculations have been resumed and a well noticed stratification regime has been found confirming the high volume Richardson number's classification when compared to unity.

Auteur principal: M. SAIKALI, Elie (STMF / CEA & LIMSI / CNRS-UPSud)

Co-auteurs: Mme SERGENT, Anne (LIMSI/UPMC); M. TENAUD, Christian (LIMSI); M. BERNARD-MICHEL, Gilles (CEA SACLAY DEN/DANS/DM2S/STMF/LIEFT)

Orateur: M. SAIKALI, Elie (STMF / CEA & LIMSI / CNRS-UPSud)