Large Eddy Simulation of the Vortex End in Reverse-Flow Centrifugal Separators

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The present work is a study of the gas-flow phenomenon known as the ?end of the vortex? (EoV), which spontaneously occurs at the lower end, or under, reverse-flow centrifugal separators such as cyclones or swirl tubes. Different CFD models of swirl tubes have been built to study and analyse this phenomenon in detail. The present numerical work is based on ? and compared with ? previous experimental observations of this phenomenon. The numerical models were built in complete agreement with the geometrical configurations and operating conditions used in these earlier experimental studies. Two different configurations of swirl tubes were analyzed. One configuration was an in principle long tube with variable length in which the dependence on the vessel length of the behaviour of the vortex core in a simple, well-defined geometry was studied. The other configuration was equipped with a wide ?dust collection vessel? at the bottom, the depth of which was varied, to study the behaviour of the vortex core in a widely-used geometry. 3-D LES simulations were carried out using the commercial CFD package Star-CD. The bending of the vortex core to the wall of the vessel and its precessional motion, constituting the phenomenon of the EoV, was seen in both configurations, and the obtained results are in very good agreement, both qualitatively and to an extent quantitatively, with previous experimental results.

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