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Numerical Investigation of Two Turbulence Models for Predicting the Temperature Separation in Conical Vortex Tube

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Abstract : A three-dimensional numerical study is used to analyze the behavior of the flow inside a vortex tube. The vortex tube or Ranque-Hilsch vortex tube is a simple device which is capable of dividing compressed air from the inlet nozzle tangentially into two flow with different temperatures warm and cold. This phenomenon is known from literature by temperature separation. The K ω-SST and K-ε turbulence models are used to predict the turbulent flow behaviour inside the tube. The vortex tube is an Exair 708 slpm (25 scfm) commercial tube. The cold and hot exits areas are 30.2 and 95 mm2 respectively. The vortex nozzle consists of 6 straight slots; the height and the width of each slot are 0.97 mm and 1.41 mm. The total area normal to the flow associated with six nozzles is therefore 8.15 mm 2. The present study focuses on a comparison between two turbulence models K ω-SST, K-ε by using a new configuration of vortex tube (Conical Vortex Tube). The performance curves of the temperature separation versus cold outlet mass fraction were calculated and compared with experimental and numerical study of other researchers.

Keywords : conical vortex tube, temperature separation, cold mass fraction, turbulence
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