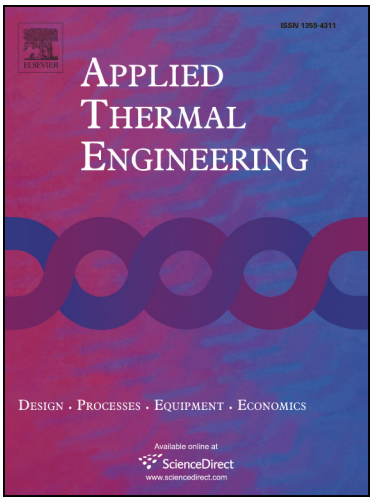

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Optimal Operation of Refrigeration Oriented Supersonic Separators for Natural Gas Dehydration via Heterogeneous Condensation

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Abstract

Refrigerative supersonic separators (3S's) have found extensive applications in natural gas industry, especially for dew point corrections of water vapor and heavier hydrocarbons. Previous studies indicated that even at heavy refrigeration duties and staggering radial acceleration values (>500,000g) generated inside 3S units, the condensed water (or hydrocarbon) droplets should have a minimum diameter of 2 micrometers to provide sufficiently large dehydration efficiencies. To promote the overall condensation rate and facilitate the separation of condensed phase from natural gas streams, certain rates of edible salt particles are assumed in the present article to be injected into the gas flow at the 3S unit entrance. The plenum chamber static vanes are also positioned after the throat location to enjoy the full swirling effect. Our simulation results indicate that by using the optimal structure of the 3S unit for a typical case study, the minimum solid particle injection rate is around 2.4 weight percent to achieve almost complete overall separation efficiency of the condensed water droplets. Moreover, the overall pressure recovery of the entire 3S unit can be boosted up to 83% for such optimal structure.

Keywords: Refrigeration, Supersonic Separator, Swirl, Natural gas dehydration, Heterogeneous condensation, Solid particle injection

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