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

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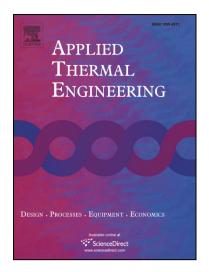
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## **ACCEPTED MANUSCRIPT**

**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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