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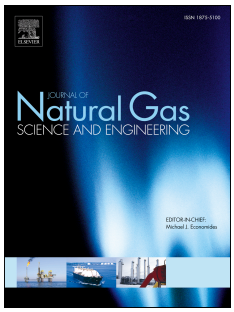

Numerical investigation of water droplets trajectories during natural gas dehydration inside supersonic separator

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Numerical investigation of water droplets trajectories during natural gas dehydration inside supersonic separator

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Abstract

Reliable estimation of the condensed water droplets trajectories inside Supersonic separators (3Ss) during the dehydration process is essential for proper design and safe operation. Most of previous researches ignored the actual sizes of condensed droplets and predicted the particles trajectories for pre-specified diameters. In this article and for the first time, real trajectories are computed by considering the actual particle size distribution (PSD) of the condensed droplets in the presence of swirl, nucleation and growth processes during the dehydration of methane rich natural gas (MRNG) inside Laval nozzle for various diffuser angles. Furthermore, the injection of water droplets to facilitate the condensation process has not been addressed previously.

Our simulation results indicate that even for the most optimal geometry and at extremely large centrifugal accelerations of 500,000g, the condensed particles from MRNG are exceedingly small and can't reach the 3S walls for practical straight tube lengths. Our findings are verified with several previously reported experimental measurements and theoretical investigations results, borrowed from literature. To ensure proper dehumidification, sufficiently large water droplets are assumed to be injected preferably after the throat location. The computed results indicate that by injecting 5 micron diameter particles into MRNG of Khangiran refinery sweet gas stream and increasing its wetness fraction up to 0.12, the dehydration process is successfully achieved in an optimally designed supersonic separator.

Keywords: Supersonic separator, Natural gas, Dehydration, Particles trajectories, Water injection

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