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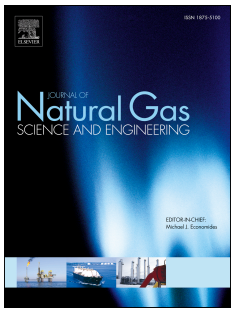

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Analysis of valve-retainer orientation influence on a reciprocating compressor for natural gas vehicle refueling stations

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Abstract

In natural gas vehicle refueling stations, the reciprocating compressor is the key element in defining both the refueling process efficiency and the operating costs of the whole station. Great attention is therefore devoted at increasing both the performance and reliability of the machine. The valve-retainer is a component that plays a key role in determining the compressor performance, by introducing significant pressure losses, which affect the suction and discharge phases. However, the valve-retainer is essential for the proper orientation of the valve during the compressor operation and guarantees a simple and reliable design of the machine. Nevertheless, present design guidelines for the valve-retainer are focused mainly on reliability and maintenance criteria, with scarce regard to the fluid-dynamics behavior of this component.

In order to assess the influence of the valve-retainer on the performance of a reciprocating compressor for refueling natural gas powered vehicles, attention is given in this study to the retainer orientation that determines the flow path of the process gas inside the compressor plenums. No previous work was found dealing with the assessment of the influence of the valve-retainer geometric features on the fluid-dynamic behavior of the plenum.

The present analysis was carried out by taking advantage of a hybrid time-frequency domain numerical model, able to provide a significant increase of the accuracy level and reduced computational costs. The model was also integrated with FEM acoustic and CFD steady-state simulations to characterize the acoustic response of the plenum and the pressure losses, respectively. As a case study, a double acting compressor with two different orientations of the valve-retainer was analyzed by simulating the interaction between the compressor and its plenums. The compressor performance was evaluated in terms of indicated power, specific power, suction and discharge mass flow profiles and pressure oscillations inside the compressor plenums. The robustness and accuracy of the approach allowed one to assess that the influence of the valve-retainer orientation on the compressor performance is indeed negligible. It was observed that a 6% variation

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