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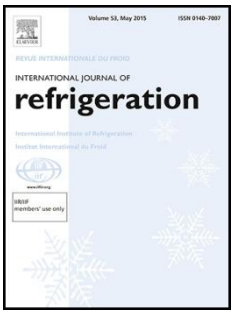

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Author: Dennis Roskosch, Valerius Venzik, Burak Atakan

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Thermodynamic model for reciprocating compressors with the focus on fluid dependent efficiencies

Dennis Roskosch, Valerius Venzik and Burak Atakan

Thermodynamics, IVG, Faculty of Engineering, University of Duisburg-Essen, 47057 Duisburg, Germany

Dennis.Roskosch@Uni-DuE.De

Highlights

- Reciprocating compressor model for fluid replacement in existing compressors
- Efficiency predictions based on only two fitting parameters
- Considering in-cylinder energy and mass balances, heat transfer and valve flow
- Semi-physical correlations for the valve flows
- Model fitting and validation based on numerous fluids
- Good agreement with experiments, for different fluids and compressors

Abstract

Fluids with high global warming potential, which are used in existing refrigeration cycles and heat pumps will have to be replaced soon by less harmful fluids, but the fluid selection is difficult especially due to the unknown compressor performance. In this work a differential compressor model for reciprocating compressors is introduced which predicts volumetric and isentropic efficiencies quickly and can be easily fitted with measured data at only one operation point of an existing compressor. In order to characterize the influence of different fluids two semi-physical correlations for the valve flows are fitted here, and a procedure of transferring them to different compressors is shown. The model is validated on, in total, 63 measured points based on numerous fluids from one semi-hermetic reciprocating compressor which is part of a heat pump cycle. The calculations lead to mean prediction errors of 3.0 % for the isentropic and 2.3 % for the volumetric efficiency.

Keywords

reciprocating compressors, thermodynamic model, semi-physical model, heat pumps, refrigerators.

Nomenclature

A	area, m²
a	crank length, m
COP	coefficient of performance