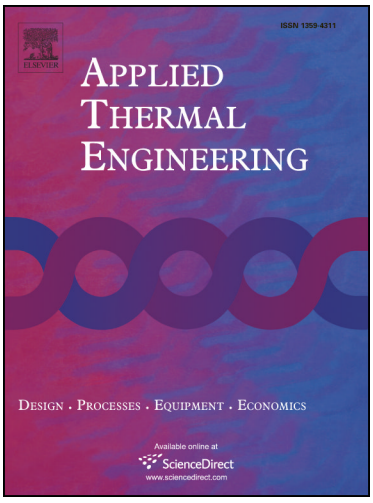

Two-dimensional approach for the numerical simulation of large bore reciprocating compressors thermodynamic cycle

Francesco Balduzzi, Andrea Tanganelli, Giovanni Ferrara, Alberto Babbini

PII: S1359-4311(17)32702-3
DOI: https://doi.org/10.1016/j.applthermaleng.2017.10.041
Reference: ATE 11239

To appear in: *Applied Thermal Engineering*

Received Date: 21 April 2017
Revised Date: 13 September 2017
Accepted Date: 8 October 2017

Please cite this article as: F. Balduzzi, A. Tanganelli, G. Ferrara, A. Babbini, Two-dimensional approach for the numerical simulation of large bore reciprocating compressors thermodynamic cycle, *Applied Thermal Engineering* (2017), doi: https://doi.org/10.1016/j.applthermaleng.2017.10.041

Two-dimensional approach for the numerical simulation of large bore reciprocating compressors thermodynamic cycle

Francesco Balduzzi[1*], Andrea Tanganelli[1], Giovanni Ferrara[1], Alberto Babbini[2]

[1] *Department of Industrial Engineering, University of Florence - Via di Santa Marta 3, 50139, Firenze, Italy - Tel. +39 055 2758773 - Fax +39 055 2758755 - balduzzi@vega.de.unifi.it*

[2] *GE Oil & Gas - Via F. Matteucci 2, 50127, Firenze, Italy - Tel. +39 055 4232587 - Fax +39 055 4232800 - alberto.babbini@ge.com*

[*] *= contact author*

Research highlights

- 2D CFD simulations compared to experimental data on a reciprocating compressor
- Novel method for a 2D numerical model for the analysis of the thermodynamic cycle
- Use of porous simplification for valves and plenums modeling
- Predictability is enhanced with respect to low order models

Abstract

The performance of large reciprocating compressors is strongly dependent on the geometry of gas chambers and valve pockets, both directly influencing the pressure losses along the flow path. Reliable and accurate numerical models are necessary for a proper prediction of the thermodynamic cycle of the compressor, hence of both the efficiency and the absorbed power. In order to account for the effect of the geometrical features, the detail level of the modeling technique needs to be suitable for capturing the most significant phenomena related to the physics involved. To this end, CFD simulations can represent a viable tool for the analysis of the working cycle. Due to the complexity of the geometry and the large extent of the fluid domain, unsteady three-dimensional CFD simulations are very demanding in terms of computational resources, resulting in unreasonably lengthy simulations and specialized hardware requirements.

The present paper describes a two-dimensional CFD modelling strategy aimed at reducing the computational effort by ensuring a compromise between the accuracy of the results and the simulation costs. A simplified geometry is used to allow the reduction of the three-dimensional fluid domain to an equivalent two-dimensional representation. The suitability of using two-dimensional models for the numerical simulation of the thermodynamic cycle of large reciprocating compressors is analyzed and discussed. In the paper, the simulation results of a double-acting large bore cast iron cylinder are compared to experimental measurements. A satisfactory agreement was obtained when comparing the