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A REVIEW OF MODELS FOR PREDICTING INSTANTANEOUS HEAT EXCHANGE BETWEEN THE GAS AND CYLINDER IN RECIPROCATING COMPRESSORS

ABSTRACT: It is an accepted fact that heat transfer between the gas and the metal surfaces delineating the compression space of a reciprocating piston compressor (cylinder wall and cover, and piston) has significant effect upon the compressor performance and the temperature of the valves. This has given rise to a number of theoretical, computational, and, to a lesser extent, experimental studies aimed at explaining and quantifying the relevant mechanisms. However, major part of the research effort has been spent in the field of hermetic refrigeration compressors, which is quite understandable given the vast number of such machines in use. On the other hand, the heat transfer models developed are not necessarily useful for predicting the cylinder heat transfer in small, air-cooled, air compressors used on commercial vehicles for braking and other auxiliary purposes.
Surveyed in the paper are several heat transfer models from the open literature that could be suitable for use within performance prediction software for small air compressors. One promising model was implemented in such a program in order to be compared to the data. Based on the comparison with limited data available to the authors, this simple unsteady model is apparently capable of predicting the cylinder heat transfer with an acceptable accuracy. However, more measurement data are required before a fully qualified statement as to its general utility can be made. The authors hope to obtain these on the test rig for small air compressors in the Engine Laboratory of the Faculty of Engineering of Kragujevac, which is currently being brought into operation.

KEYWORDS: Reciprocating Compressor, Cylinder, Heat Transfer Model.

INTRODUCTION

Within the working cycle of a reciprocating compressor, the work being imparted to the gas enclosed in the cylinder by the moving piston in the compression phase brings about increases in both the gas pressure and temperature. Conversely, in the back-expansion phase of the process, the respective values of the above two gas state variables diminish. Since the time constants of the relevant thermal processes in the gas and the metal parts delineating the compression chamber of the machine are vastly different, there are temporal and spatial temperature differences between them that give rise to heat exchange. Additionally, the gas stream entering the cylinder in the suction phase mixes vigorously with the cylinder gas, giving rise to an intensified heat exchange. It is thus to be expected that these processes influence the machine performance.

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