Efficiency analysis of a Liquid Piston Gas Compressor (LPGC)

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Abstract

A Liquid Piston Gas Compressor (LPGC) is a new concept to be deployed in Compressed Air Energy Storage (CAES) systems in order to to tackle the challenge of unsteady energy supply by renewable energies such as wind and solar. This work aims to understand the thermodynamic and heat transfer characteristics of a LPGC system. In addition, as LPGC is more efficient while working isothermally, further investigation is undertaken on the use of porous materials in the LPGC to increase the rate of heat transfer from the compressed gas to the porous medium in the compression process.

Figure 1 shows the schematic of an LPGC with plates. According to the figure, the hydraulic pump pushes the high-pressure water into the cylinderand the air is compressed at the top of the cylinder.

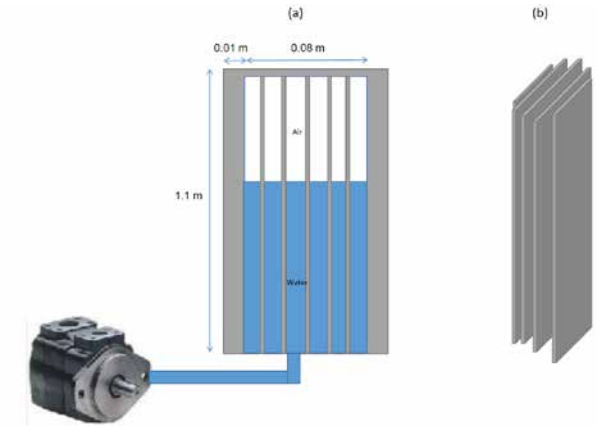

Figure 1: The cross-sectional schematic of (a) compression chamber (b) the arrangement of plates.

As a part of simulation results, figure 2 clarifies that by using plates the final compressed air temperature in the LPGC with plates is significantly lower than that of the LPGC with no plates. Thus, in this case the introduction of plates may be used to create a near-isothermal compression system.

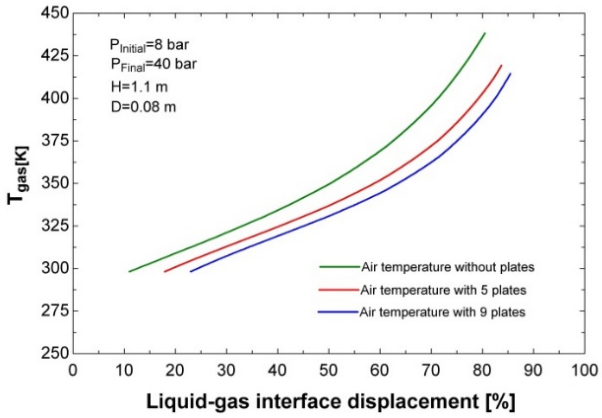

Figure 2. Air temperature as a function of liquid displacement in the LPGC with and without plates.