Proceedings of the International Conference on Fluid Flow and Thermal Science (ICFFTS'20)
Virtual Conference – September 9-10, 2020
Paper No. 126
DOI: 10.11159/icffts20.126

Carbon Dioxide – Based Energy Storage System: a Thermodynamic Approach

Jeanne Lamotte, Sébastien Poncet*
Mechanical engineering department, Université de Sherbrooke
2500 boulevard de l'université, Sherbrooke (QC), J1K 2R1 Canada
*Corresponding author: Sebastien.Poncet@USherbrooke.ca

Extended Abstract

Compressed gas energy storage systems attract progressively the attention of researchers. Coupled to renewable energy sources, they enable to align the electrical energy demand with its production by overcoming their intermittency nature. They may also produce heating and cooling at the same time. They offer a green solution for remote communities but also for provinces where the price of electricity may highly vary during a day. The performances of systems working with air have been extensively evaluated thermodynamically and experimentally for decades and these technologies have already been implemented at a large scale (see the sites of Huntorf and MacIntosh). On the contrary, only few works focused on carbon dioxide as energy transfer medium. With the development of carbon dioxide capture and transport technologies, it appears as a nice way to massively revaluate CO_2 and by the way to limit its emissions and climate change. After an exhaustive literature review on the capture, transport and utilization of carbon dioxide in energy storage systems, a thermodynamic model based on real fluid properties is developed. It evaluates the thermodynamic performances of an innovative cycle proposed recently by Liu et al. (2020). The influences of the turbine inlet pressure and temperature, compressor inlet and outlet pressures, charging/discharging times, the CO_2 mass flowrate and isentropic efficiencies are quantified in details. Some improvements are then proposed to both diminish the price of the system and reduce the throttling losses by integrating transcritical ejectors. The integration of vortex tubes could be also beneficial for cooling and heating production.

***Keywords*:** Thermodynamic modelling, Compressed gas energy storage, Carbon dioxide