EXPERIMENTAL RESULTS OF A CARNOT BATTERY CONSISTING OF AN ORC AND A HIGH TEMPERATURE LATENT HEAT THERMAL STORAGE

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ABSTRACT

ORC systems have extensively been investigated over the years. However, there is limited research in trying to understand the dynamic behaviour of ORC systems and reduce the effects of waste heat fluctuations on ORC system operation. A possible solution to this is the implementation of thermal energy storage (TES) systems to smooth the thermal power fluctuations entering the ORC system. At Ghent University Campus Kortrijk a latent heat thermal energy storage (LHTES) system is commissioned and integrated in a test-rig, consisting of a 250 kWe heater and a 11 kWe ORC, interconnected via a thermal oil circuit. This test-rig is used to demonstrate the advantage of a combined LHTES-ORC system enabling stable ORC operation under fluctuating waste heat conditions. Furthermore, it demonstrates the opportunities of the so called Carnot batteries in overcoming the mismatch between the energy supply and the power demand when generating electricity from renewable energy sources. Based on the experimental characterization of the LHTES and the ORC system a performant control procedure is developed to enable stable ORC operation on the thermal energy retrieved from the LHTES system. With this set-up it is demonstrated that excess (renewable) electricity can effectively be stored as thermal energy at high temperatures (220°C) and afterwards can be recovered by means of a waste heat to power cycle in the form of an ORC. When the LHTES is fully charged, an ORC operation of 1.5h at full capacity can be achieved.