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THERMAL PERFORMANCE OF AN OIL-ROCK HEAT STORAGE SYSTEM

BY

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Abstract

Experiments to evaluate the thermal performance of an oil-rock thermal energy storage system by direct heating from the base of the storage tank are presented. The oil-rock TES system consisted of a combination of sunflower oil and granite rocks. Results on thermal performance of an oil only TES system are also presented. Charging rates of the two TES systems using the thermosyphon principle were determined. An electrical heater was used to simulate solar radiation. In this case, AC power was used to test for the performance of the system in the laboratory and after testing its performance, it will be used with the solar concentrating systems for application. The performance parameters evaluated were: temperature distribution along the vertical height of the storage tank, thermal stratification, charging energy efficiency, energy stored, heat retention capacity, total exergy stored and exergy factors. The results indicate that not only the value of total energy stored and thermal stratification are important for thermal performance of a TES system but also the amount of total exergy stored should be considered. A high ratio of total exergy stored to total energy stored (Exergy factor) can be suggested as a good measure of thermal performance of the storage material. Charging a heat storage from the bottom resulted into loss of thermal stratification phenomenon all over the experiment. Results of charging the storage systems by thermosyphon principle indicated that the oil only TES charges for a shorter period than an oil-rock TES system. The boiler reached a temperature of 230°C in 82 minutes for oil-only TES and 98 minutes for oil-rock TES system and the corresponding maximum top temperatures attained were approximately 207°C and 222°C respectively. Generally, for both charging cases, the performance of the two TES systems was comparable. However, in terms of heat retention, the oil-rock TES retained more heat which makes it a more preferred TES medium.