

Feasibility Study and Experimental Investigation of Heat and Mass Transfer in Dry and Moistur-ised Sand for Energy Savings

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Abstract

Air-conditioning load and ventilation in buildings contribute more than 60% of the total energy consumption in United Arab Emirates (UAE), where the unavoidable extreme temperatures hit the region, especially during summer months. Literature survey indicates that at a depth of approximately 10 meters, the soil reaches stability and it is no longer fluctuating drastically under the influence of external ambient temperatures. This relatively shallow location allows the use of soil's practical location as a possible source for sustainable energy recovery. The aim of this investigation is to explore the feasibility of using soil as a heat sink and experimentally analyse the soil heat transfer with variations in moisture saturations and heat flux rates in a testing rig. For this purpose, an axial to radial experimental analysis on Abu Dhabi soil is carried out on a lab scale test rig. This paper provides an insight into modular design of the experimental setup using spiral and U-shape heat exchangers. Experimental validation results are presented which deliver a heat profile in the sand, measured in time and depth for various heat flux rates. Moreover, thermal conductivity of the sand is estimated from experimentation and compared with literature. The results indicate presence of considerable potential for energy savings in the region.