

Experimental Investigation on The Effect of Divergent Tower Solar Chimney on The Theoretical Power Potential

ABSTRACT

Solar chimney power plant is a sustainable alternative for electricity generation using solar as the source of energy. In general, the main body of a solar chimney plant requires a tall structure which is costly and challenging to construct. Thus, it is important to increase the performance of the solar chimney power plant and have a better energy-cost ratio. This study aims to experimentally investigate the influence of divergent solar chimney as opposed to a cylindrical chimney on solar chimney performance. Three divergent scaled-down solar chimney model at 1-meter, 1.5-meter and 2-meter were fabricated and tested for its performance at various simulated heat loads. The test results were compared with similar heights cylindrical solar chimney. The experiments show that divergent solar chimney increases the theoretical power generation potential and improves the stack effect and have higher outlet velocity compared to a cylindrical solar chimney. The power potential of the divergent chimney is increased up to 18 times with the maximum theoretical power obtain at 0.183W on the 2-meter divergent chimney. Higher temperature was recorded on the 2-meter divergent chimney outlet at 341.3k compared to 330.4k on the cylindrical chimney indicates better stack effect. The highest average velocities in the divergent and cylindrical chimneys were recorded under the electric heat load of 2 kW at 0.994 m/s and 0.820 m/s respectively in the 1-meter configuration. It is also observed that the air velocity in a shorter divergent chimney is higher than taller divergent chimney models while better compared to all cylindrical height. This study finds that a shorter divergent solar chimney produces greater energy compared to a higher cylindrical solar chimney. Therefore, it is possible to reduce the overall cost of solar chimney by reducing the height of the main structure without sacrificing the performance of the solar chimney