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Comparative Study of Vertical and Horizontal Triplex Tube Latent Heat Storage Units

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Abstract : This study investigates the impact of the eccentricity of the central tube on the thermal and fluid characteristics of a triplex tube used in latent heat energy storage technologies. Two triplex tube orientations are considered in the proposed study: vertical and horizontal. The energy storage material, which is a phase change material (PCM), is placed in the space between the inside and outside tubes. During the thermal energy storage period, a heat transfer fluid (HTF) flows inside the two tubes, transmitting the heat to the PCM through two heat exchange surfaces instead of one heat exchange surface as it is the case for double tube heat storage systems. A CFD model is developed and validated against experimental data available in the literature. The mesh independency study is carried out to select the appropriate mesh. In addition, different time steps are examined to determine a time step ensuring accuracy of the numerical results and reduction in the computational time. The numerical model is then used to conduct numerical investigations of the thermal behavior and thermal performance of the storage unit. The effects of eccentricity of the central tube and HTF mass flow rate on thermal characteristics and performance indicators are examined for two flow arrangements: co-current and counter current flows. The results are given in terms of isotherm plots, streamlines, melting time and thermal energy storage efficiency.

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