## Abstract

The present study provides an analytical and numerical investigation of the energy and [exergy analysis](https://www.sciencedirect.com/topics/engineering/exergy-analysis) of a v-corrugated [solar air heater](https://www.sciencedirect.com/topics/engineering/solar-air-heater) (VCSAH) integrated with twisted tape insert (TTI). The TTI is placed in the air passages formed by the absorber and [backplates](https://www.sciencedirect.com/topics/engineering/backplate" \o "Learn more about backplates from ScienceDirect's AI-generated Topic Pages). The effect of design parameters such as twisted tape ratio (Y) and the number of channels (N) on the thermo-hydraulic performance is examined for a wide range of [Reynolds number](https://www.sciencedirect.com/topics/engineering/reynolds-number) (Re) under realistic weather conditions data. The results reveal that as the Y decreases, the thermo-hydraulic efficiency of VCSAH-TTI is first rises to a specific value of Re to reach the peak value, and then drops down. The optimal number of channels that provides maximum thermo-hydraulic efficiency is N = 5 when the TTI is implemented. The maximum thermal and thermo-hydraulic efficiencies of VCSAH-TTI observed are 17.5 and 17%, respectively, compared to the VCSAH without TTI. Besides, the thermal efficiency is directly proportional to the number of channels. At Re = 10,000, the thermal efficiency is found to be 69.3% and 76.7% for N = 4 and N = 14, respectively. The accumulated useful heat gain of the proposed design is 17% higher than VCSAH without TTI.