

Reversal flow in an inclined heated channel inside a closed cavity: application to integrated collector storage solar water heaters (ICSSWH)

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ABSTRACT

The storage tank of an integrated collector storage solar water heater (ICSSWH) is represented by a rectangular glass cavity partially heated on the upper wall. In order to improve the thermal stratification within the cavity that characterizes the storage performance, a rectangular plate is placed parallel to the heated wall and will be called ‘stratification plate’ in the following. However, under certain conditions, a reversal flow may appear and this phenomenon tends to reduce the thermal storage volume. Both numerical and experimental studies have been carried out to study the natural convection phenomenon inside the cavity with a focus on the reversal flow. A parametrical study on heat transfer and fluid flow inside the cavity has been done with CFD simulations. The influences of the position of the heating zone and the stratification plate have been analysed both on the thermal stratification aspect and on the velocity ones with profiles showing the presence of the reversal flow for certain configurations. The numerical study has led to the design of a new experimental bench. This bench provides the possibilities of testing different configurations by varying parameters including the channel width, the position of the heated area, and the injected power. The experimental set-up is instrumented for measurement of temperature by thermocouples and velocity by Particle Imaging Velocimetry.