Heat transfer and mixing enhancement by using multiple freely oscillating flexible vortex generators

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Résumé en anglais	In this paper, we discuss the effect of self-sustained passive oscillations of multiple flexible vortex generators (FVG) in a two-dimensional laminar flow, on heat transfer and mixing. The FVG are located on two opposite channel walls in an alternating positions, inclined in the upstream direction with an angle of 30° with respect to the wall. The FVG oscillate freely without any external force except that provided by the flow itself. Five cases are studied and they differ by the number of alternating flaps and by the presence or absence of two co-planar flaps upstream. The Reynolds number is held constant with a value of 2000 based on the hydraulic diameter of the channel. The simulations are performed by considering a two way strongly-coupled fluid structure interaction approach. The effect of increasing the system degree of freedom, by increasing the number of flaps, resulting in a larger displacement oscillation, on heat transfer and mixing is numerically investigated. The mixing process is quantified by solving the passive scalar transport equation and calculating a mixing index. The results show that mixing is enhanced for larger flaps displacement achieving up to 99% in mixing homogeneity. Moreover, the high amplitude oscillations when compared to the results of an empty channel, show a great ability to reduce the thickness of the thermal boundary layer and to enhance heat transfer resulting in up to 275% increase in the global Nusselt number, 317% increase in the local Nusselt number and 34% increase in the thermal performance factor.
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