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Heat transfer and mixing enhancement by free elastic flaps oscillation

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Auteur	Ali, Samer [1], Habchi, Charbel [2], Menanteau, Sébastien [3], Lemenand, Thierry [4], Harion, Jean-Luc [5]
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Résumé en anglais	An original concept is proposed to enhance heat transfer and mixing quality performances by using flexible vortex generators (FVGs) for a static mixer configuration. The role of free elastic flaps oscillations on the mixing process and heat transfer in a two-dimensional laminar flow is numerically investigated. The computational domain consists of four distant FVGs mounted on two opposite walls. Two cases are studied depending on the Reynolds numbers (based on the bulk velocity and the channel height) set to 1000 and 1850. FVGs efficiencies are compared to the corresponding cases with rigid vortex generators (RVGs). In the flexible cases, flaps oscillations increase the velocity gradients and generate an unsteady laminar flow with complex coherent vortices detaching from the tip of the flaps. The mixing efficiency is quantified by the transport of a passive scalar through the channel. It is shown that oscillations in the elastic cases enhance the mixture quality up to 98% relative to that in the rigid cases. The heat transfer enhancement is also investigated showing up to a 96% increase in the Colburn factor, 56% increase in thermal performance factor and 134% increase in the overall heat transfer. As the FVGs oscillate freely without any additional external force other than that exerted by the flow itself, the implementation of such a technique shows a great potential for the performance enhancement of multifunctional heat exchangers/reactors.
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