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Evolution of Entropy Generation on Mixing Process Using a Novel Chaotic Micromixer

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Abstract – This study aims to compare numerically the laminar steady flow of shear-thinning non-Newtonian fluids in novel chaotic micromixer. The process is verified for non-Newtonian flow in a complex geometry that is heated with a constant flux. The selected geometry produce secondary flow structures that greatly improve fluid dynamic performance. To measure this performance, the Poincaré map method is used for various cases of fluid power-law index in different geometries. In addition, thermal mixing behavior is studied for shear-thinning fluids in the chosen geometry with two different inlet temperatures. In different cases of fluid power-law indexes, the novel geometry resulted in an 82% increase in thermal mixing degree relative to the thermal mixing degree observed in the C-shaped and serpentine channels. The second law of thermodynamics is examined in terms of entropy generation caused by thermal and hydrodynamic processes, as a function of low rates of generalized Reynolds number and power-law index, while taking into consideration the effects of chaotic advection. As a result, the new configuration showed a significant improvement in the degree of mixing compared to other geometries considered, while also minimizing friction and thermal irreversibilities.

Keywords – Entropy Generation, Non-Newtonian Fluid, Behavior Thermal Mixing, Chaotic Micromixer.