

عنوان مقاله:

Flow Control in a Cavity with Tiny-Obstacles on the Walls for Mixing Enhancement Part I: Flow Physics

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خلاصه مقاله:

This paper seeks to make a study on flow control in two-dimensional square cavities having obstacles on their walls. The goal of using these passive controllers is to enhance mixing in an enclosed space. Lattice Boltzmann method is used to simulate the problem. Results are presented for various Reynolds numbers, $400 \leq Re \leq 4000$ and different arrangements of tiny-obstacles with different heights. To give a perspective on the physics of this problem, time evolution of the flow is studied at $Re = 1000$. Then, the flow structure is studied for different Reynolds numbers. Findings show that the interaction of the main vortex with the tiny-obstacles inserted on the wall cavity changes the flow pattern at higher Reynolds numbers totally which is of high importance for mixing, such that the main primary vortex turns into a scooplike vortex along the upper wall. Also, merging the two bottom corner vortices forms a main secondary vortex which fills the cavity. Results show that obstacles heights and the gap between the upper wall and the upper obstacle are key parameters from flow control and mixing viewpoint. Also, the number of tiny-obstacles can be considered as another tool in this regard. The spaces between the obstacles don't have much influence on the flow behavior. Obstacles with $\delta \leq 2\%$ don't change the flow field and can't be considered as a flow control tool

کلمات کلیدی:

Flow control, Mixing enhancement, driven cavity, Lid, Tiny, obstacle, Scooplike vortex, Lattice Boltzmann method

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