Numerical investigation of the two-dimensional vortex in viscous media

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A distinctive feature of two-dimensional turbulence is the presence of an inverse kinetic energy cascade and a direct enstrophy cascade. The existence of the inverse cascade means that in the presence of an external force, the scale of characteristic structures (vortices) increases due to nonlinearity. However, if we consider a laboratory system of limited size, it turns out that the growth of such structures is limited by the size of this system. Despite the fact that the vortices generated in this way constantly change their shape and size, on average they are isotropic [1]. Modeling is the reasonable way to investigate such a process.
Numerical modeling was carried out with a weakly compressible fluid using McCormack finite-difference method. Flow has been considered in a two-dimensional square cell with non-slip boundary conditions. The flow was developed under the action of a force constant in time, but periodic in the directions Ox and Oy. The work shows how the flow pattern differs from the magnitude of the external force and viscosity of the fluid itself. We consider forces with different phases along axes and how they influence on the flow characteristics. For example, large phase can cause to the stabilization of the flow.

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