

**WEAKLY NONHOMOGENEOUS
VISCOUS AND VISCOPLASTIC FLOWS:
STABILITY AND MIXING**

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It is known that the method based on superposition of low perturbations (either initial or continuously acting) belonging to the certain kind on the parameters of chosen process is one of most being used ones in stability analysis. An asymptotic decay or lack of increase of perturbations by some measure testifies to stable development of the main process (the latter may be rest). An exact or approximate numerico-analytical investigation of even linearized initial-boundary value problem in terms of perturbations is connected with considerable obstacles. They may appear for the simple main processes (such as 1D or steady) too. These obstacles are caused by necessity of accounting of 3D and insteady variation picture, coupled fields with different nature, etc.

Often it is sufficient to know only integral characteristics of the non-perturbed flow to represent the decay or growth estimates. The present report deals with namely such sufficient estimates or energetic ones. They are constructed on the basis of variational inequalities in some chosen functional space (for example, L^p). A choice of the functional space determines the measures of parameters deviation. Moreover, these measures may differ for the initial parameters and current ones. An energetic analysis of perturbation development, conducted in general form, is used for first step of mixing analysis.

A stability and beginning of mixing in weakly nonhomogeneous viscous and viscoplastic (Bingham) media with respect to low perturbations are investigated [1-4]. It is shown that an increase or decay of kinematic perturbations linearly depend on the initial variations of density and viscosity. If an initial gradient of viscosity is missing everywhere in solid then the derived estimates are more strong than if an initial viscosity depends on coordinates. An unlimited growth of these variations is interpreted as mixing beginning on macrolevel.

The concrete examples illustrating the general result are adduced. These classical flows are following:

- a) the Couette' flow between two parallel planes;
- b) the Poiseuille' flows between two parallel planes and inside circular tube;
- c) the Couette-Taylor' flow between coaxial cylinders;
- d) an insteady one-dimensional motion of viscous layer including oscillations.

In case d), for example, if a product of oscillation frequency and layer thickness squared divided by kinematical viscosity of fluid is less than π^3 then low initial perturbations are restricted when $t > 0$.

[1] Georgievskii D.V. (1998) Stability of Viscoplastic Solids Deformation Processes. Moscow, Editorial URSS. 176 p. (in Russian)

[2] Georgievskii D.V., Klimov D.M. (2000) Energy analysis of kinematical evolution of perturbations in weakly nonhomogeneous viscous liquids. *Izvestiya of Russian Acad. Sci. Mechanics of Fluids and Gases*. No. 2. P. 56-67. (in Russian)

[3] Georgievskii D.V., Klimov D.M., Petrov A.G. (2002) On inertialess deformation of weakly nonhomogeneous viscous medium. *Vestnik of Moscow State Univ. Ser. 1. Mathematics. Mechanics*. No. 2. P. 37-41. (in Russian)

[4] Georgievskii D.V., Klimov D.M., Petrov A.G. (2003) The problems on inertialess flow of weakly nonhomogeneous viscoplastic media. *Izvestiya of Russian Acad. Sci. Mechanics of Fluids and Gases*. No. 3. P. 17-25. (in Russian)