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Instability and Electroconvection at a Electrodialysis Membrane
ELENA SHAPAR, EUGENY DEMEKHIN, VLADIMIR LAPCHENKO, Russian Academy of Sciences — Electrolyte layer covered electrodialysis membrane under constant drop of potensial is considered. Self-similar solution of one-dimensional problem for second kind elecroosmosis (overlimitiny current) is found. Using special decomposition method analytical asymptotic solution of the problem is obtained; limiting current for the self-similar solution

$$j_* = 4/\sqrt{\pi} \approx 2.25.$$

Hydrodinamic instability of this solution with respect to linear 2D-perturbations is studied for the full system of equations. In contract to the works of Rubinstein is found that the region of instability is finite with respect to the wavenumber α, growth rate $\lambda(\alpha)$ has maximum at some $\alpha = \alpha_m$ and 1D-solution is stable for sufficiently short perturbations. Direct numerical simulation of the full system of equations with a special non-uniform finite-differential grid shows that filtering mechanism of the linear stability singles out from the initial white-noise perturbations the maximum growth rate mode with $\alpha = \alpha_m$. Secondary instability leads to chaostic flow.

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