approach only the waves of two kind are available with the amplitudes (37). By $c^H = 1 \quad (k_i = 0)$ when film flow velocity is zero, it is got $\mathrm{Re}_{ms} = 0$ and there is only one wave. Parametric resonance in a system as shown by (37) takes place under fulfillment of the condition $A \cdot D = 0$, or $\mathrm{Re}_m(8k + i\,\mathrm{Re}) = 2kA$, and further it follows:

$$k^* = 2\frac{(8\pi + i\,\mathrm{Re}_k)^{0,5}}{\pi Ga^2} \cdot \qquad (38)$$

$$\cdot\left\{1 \pm \left[1 + \pi Ga^2\left(\frac{4Be - 1 + \mathrm{Re}_k/(4\pi)}{16\sqrt{2}\pi}\mathrm{Re}_k - \frac{2\pi/Oh^2}{8\pi + i\,\mathrm{Re}_k}\right)\right]^{0,5}\right\},$$

where Ga, Be, Oh - Galileo, Batchelor and Ohnesorge numbers determined by physical properties of media and film thickness (independent of flow regime), $\mathrm{Re}_k = 2\pi\,\mathrm{Re}/k^*$ - Reynolds number defined by the length of corresponding resonance perturbation. Correlation (38) allows establishing the relation between resonant values k^* and corresponding Reynolds number Re_k, as well as the other defining criteria of the system. Then the relation $\mathrm{Re} = k^*\,\mathrm{Re}_k/(2\pi)$ can be established as well.

The formula (38) can be substantially simplified in many important cases, e.g. in MHD-granulation the following estimations are valid: $\mathrm{Re}_k \gg 1$, $Ga^2 \gg 1$, $Be \ll 1$, $Oh^2 \ll 1$. This yields:

$$k^* = \frac{1}{\pi Ga}\left(\frac{2}{Ga}\sqrt{8\pi + i\,\mathrm{Re}_k} \pm \sqrt{\frac{8\pi + i\,\mathrm{Re}_k}{16\sqrt{2}\pi}\mathrm{Re}_k^2 - \frac{8\pi^2}{Oh^2}}\right),$$

The Eigen oscillations with account of (34) are

$$\zeta = \zeta_0 \exp\left[-2(8k + i\,\mathrm{Re})\frac{k}{A}t\right], \qquad (39)$$

where $\zeta_0 = \zeta(0)$. Therefore $\omega_* = -\frac{2k}{A}(8k + i\,\mathrm{Re}) \cdot$ Consider Eigen oscillations for real values k and ζ_0, then after estimation of the terms and accounting the assumptions made and the relation $arctg\left(\frac{\mathrm{Re}}{\sqrt{\mathrm{Re}^2 + 16k^2}}\right) \approx \frac{\mathrm{Re}}{\sqrt{\mathrm{Re}^2 + 16k^2}}$ it is available to come at

$$\left(32k^2 - \mathrm{Re}^2\right)\left[2\sqrt{2}k + \mathrm{Re}\left(\frac{1}{Fr^2} + \frac{8k^2}{We}\right)\right] +$$

$$+6\sqrt{2}k^3\,\mathrm{Re}\sqrt{\frac{k}{\pi}}\frac{32k^2 - \mathrm{Re}^2 + 6k\,\mathrm{Re}^2}{\sqrt[4]{16k^2 + \mathrm{Re}^2}} > 0 \qquad (40)$$

based on condition $re(\omega_*) > 0$. The condition (40) answers increase of Eigen fluctuations of system in time (development of film instability). At big enough k condition (40) is not satisfied, i.e., starting from some value of k all subsequent fluctuations of smaller length become fading in time. At $\mathrm{Re} \gg k$ is possible to get the following approximate formula:

$$re(\omega_*) = \frac{2k\,\mathrm{Re}^2\left[\sqrt{2}\left(Ga^2 + 8k^2/Oh^2\right) - 8k\,\mathrm{Re}\right]}{2\left(Ga^2 + 8k^2/Oh^2\right)^2 + 8\sqrt{2}k\,\mathrm{Re}\left(Ga^2 + 8k^2/Oh^2\right) + \mathrm{Re}^4}, \qquad (41)$$

where from follows that decrease of perturbations in a film is possible only on condition that is extremely seldom in practice. Film is unstable, but, apparently from (41), the increase rate of perturbations is small at $\mathrm{Re} \gg 1$ that practically means uselessness of suppression of Eigen modes by parametric excitation of film flow disintegration on the set wavelength.

4 Conclusions by the results obtained

The results obtained may be used for analysis of parametric excitation and suppression of films. Horizontal progressive electromagnetic wave excides on a film surface the wave with amplitude $\sim Al \cdot \mathrm{Re}$; parametric resonance in a film flow by action of constant magnetic field is impossible in contrast to the alternating field; viscous forces are important: application of inviscid approach lead to inaccuracy in calculation of a wave amplitude 3-4 decimal orders; parametric resonance is impossible by means of horizontal electromagnetic wave. The perturbation amplitude in case of $\omega \gg k$, $\omega \gg k^2/\mathrm{Re}$ does not depend on the wave number and is determined only by frequency of a field.

References:

[1] Kolesnichenko A.F., Kazachkov I.V., Vodyanyuk V.O., Lysak N.V. *Capillary MHD flows with free surfaces*, Kiev: Nauk. Dumka, 1988, 176 p. (In Russian).

[2] Kazachkov I.V. *Parametric wave excitation and suppression on interfaces of continua*/ DSc. thesis, Kiev, In-t Electrodyn.,1989, 464 p.

[3] Kazachkov I.V. Electromagnetic excitation of parametric oscillations in a liquid metal films spreading out in non-conductive media.- Preprint of Inst. Electrodyn. Ukr. Acad. Sci.- Kiev.- 1986.- N454.- 52pp. (in Russian).

[4] Tranter C.J. Integral transforms in mathematical physics, London: Methuen IX, 1951.

[5] Filatov A.N. The methods of averaging for differential and integrodifferential equations.- Tashkent: Fan.- 1971.- 279 pp. (In Russian).