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The experiment result analysis of turbulent mixing at moderate Reynolds numbers in a gravity field of the Earth.

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Kucherenko's group explored the turbulent mixing of different density gases [1] in "OSA" – facility experiments in 2001. Explored gases were placed in a multifunctional shock tube and were separated by a "spectre-membrane". There was a grid from micro conductors. A fluid soap film was superimposed on this grid. The specter-membrane was destroyed into small-scale fragments by the external force. The contact boundary of gases was accelerated by means of a compression wave, which was formed in the shock tube. The zone of the gravitational turbulent mixing appeared at the contact boundary. Acceleration of the contact boundary was about $g \approx 40000$ m/s^2. The constant of gravity turbulent mixing (α_b=0.04) was found as a results of these experiments.

The same experiments were carried out in the gravity field of the Earth also [2]. Turbulent mixing zone appeared in the field with g=9.81 m/s^2 when a membrane was destroyed. Estimated value of constant α_b=0.078 approximately twice exceeded the values determined in experiments with a compression wave.

We suggested the interpretation of the apparent difference of the turbulent mixing constant. All experimental data, both in the shock tube and in the field of gravity, are described by uniform dependence in variables $\overline{Re} = \left(S^{3/2} g^{1/2}\right)/\tilde{\nu}$ and $\varphi\left(\overline{Re}\right) = \frac{3L_b}{2A}\left(\frac{\tilde{\nu}^2}{g}\right)^{1/3}$. It allows us to surmise that a self-similar growth rate of the turbulent zone depends on turbulent Reynolds numbers. There is shown, that α_b decreases when turbulent Reynolds number increases, and dependence of turbulent zone width passes to a standard $L=\alpha A g t^2$. Opposite, the value α_b increases at moderate values of $Re_t=10^2 - 10^3$ and the dependence of turbulent zone width becomes nonlinear and self-similar law of turbulent zone growth does not carry out.

References

1. Yu.A. Kucherenko et al. 2001. "Experimental investigation into the evolution of turbulent mixing of gases by using the multifunctional shock tube". Proceedings of the IWPCTM 8, Pasadena, USA.
2. Yu.A. Kucherenko et al. 2001, "Experimental investigation into the self-similar mode of mixing of different density gases in the earth's gravitational field". Proceedings of the VI Zababakhin Scientific Talks, Snezhinsk, Russia.