On neutral stability of shock waves in liquid-vapor system

Konyukhov A V[@], Levashov P R and Likhachev A P

Joint Institute for High Temperatures of the Russian Academy of Sciences, Izhorskaya 13 Bldg 2, Moscow 125412, Russia

[@] konyukhov_av@mail.ru

The criterion [1] of neutral stability of shock waves in media with arbitrary thermodynamic properties when applied to liquid-vapor system under conditions of phase equilibrium can be reformulated in terms of the dependence of saturated vapour pressure on temperature $p^s(T)$ and heat capacity at constant volume $c_v = e_T|_v$:

$$p - p_0 > \frac{T p_T^s}{1 + c_v/(v p_T^s)}.$$

Thus for strong shocks ($p >> p_0$) with post-shock temperature T and specific volume v, the condition of the neutral stability is

$$\frac{c_v}{R} > \vartheta\left(\vartheta - 1\right)\frac{p_r v_r}{T_r} Z_c,$$

where $v_r = v/v_c, T_r = T/T_c, p_r = p/p_c$ are the reduced variables, $Z_c = p_c v_c/(RT_c)$ is critical compressibility factor, $\vartheta = T(\ln p^s)_T$. The inequlity is fullfilled for near-critical two-phase states of various substances, thermodynamic properties of which obey the law of corresponding states at different values of the acentric factor. The neutrally stable shock waves in the near critical region correspond to the segment of the Hugoniot with positive slope in (p-v) plane. This type of Hugoniots is characteristic for two-phase region. The calculations of the evolution of a two-dimensional periodic perturbation of such a shock waves, show weak attenuation of secondary waves.

[1] Kontorovich V M 1958 *Soviet Phys. JETP* **6** 1525–1526