Experimental study of shock-wave properties of emulsion matrix at various values of filler concentration

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The study considers an emulsion being an aqueous solution of ammonium nitrate with mineral oil and an emulsifier. The emulsion matrix density was $\rho_0 = 1.35$ g/cc. The samples porosity was controlled by adding glass microspheres with an average diameter of 70 μm to the matrix.

The authors studied three types of emulsion matrix samples featuring various filler concentrations, the latter being 1, 3 or 4% by mass. The samples density was 1.25, 1.07 and 1.025 g/cc accordingly. The mass velocity profiles were recorded with VISAR laser Doppler interferometer.

The experimental data, when processed, resulted in a Hugoniot of the emulsion matrix, the maximal pressure being 35.2 GPa. This Hugoniot was well approximated with the generalized Hugoniot for liquid media. The Hugoniots of the porous samples were determined up to such pressure values, which, when exceeded, initiated a chemical reaction in the medium. The relative position of the Hugoniots featuring different filler concentration was typical for porous media. In particular, in the vicinity of 3% there occurred a change in the curvature of the relationship between shock-wave velocity and mass velocity.

At low pressure, the structure of compression pulses for porous samples had typical blurring of the shock-wave front while the wave was propagating through the sample. For instance, if the sample thickness changed from 4 to 8 mm, the material with 4% filler concentration had a shock-wave front that became more than three times wider than before, reaching several microseconds.