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ON COMPRESSIBILITY AND GRINDING OF SAND PARTICLES UNDER COMPRESSION TO 570 MPA

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Gerdyukov et al. studied experimentally [1] the shock compressibility of sand and propagation of plane and spherical waves in sand. In addition, the compressibility and degree of grinding of sand under static compression were determined. These results are cited in this paper.

The bulk density of dry sand ρ_0 was 1.49 g/cm^3. In our experiments, we used "Instron" equipment to compress the sand in a steel casing with inner diameter of 15.0 mm. The weight of sand samples was chosen so that the initial height-to-diameter ratio was 2, 1, and 0.5. Complete "Instron" diagrams of compression at a loading rate of 1 mm/min were recorded. The limiting pressure stress on a punch was 100 kN. The compression diagram was constructed with allowance for a certain compliance of the loading system. The sand particle size was determined prior to and after the experiments using sieve analysis.

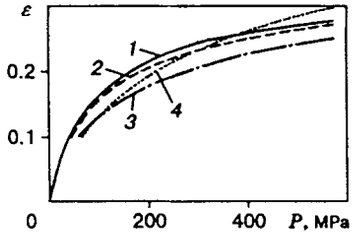

Fig. 1

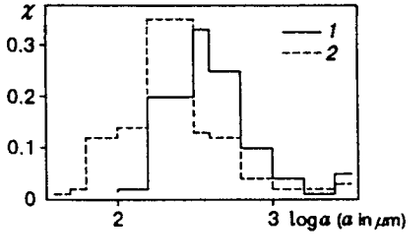

Fig. 2

It was found that within the experiment accuracy the initial geometry of the sample does not influence the shape of the compression diagram. The diagram is presented in Fig. 1 (curve 1) as a curve of relative compression ε versus the applied pressure P. For comparison, the results on the shock compressibility of dry sand from [1–3] are also given here (curves 2–4). The above value of ρ_0 was used to move from shock adiabats in the form of relations between the wave and mass velocities $D = c_0 + \lambda u$ to compression diagrams $\varepsilon(P)$. The coefficients c_0 and λ taken from [1–3] were, respectively, 4.06, 5.00, and 5.60 km/sec and 2.43, 2.40, and 1.70.

Figure 2 shows the results of determination of the particle size of the sand prior to and after the experiments (curves 1 and 2). The histograms relate the particle sizes a to their relative mass portions χ. The mean particle size $\bar{a} = 1/\sqrt[3]{\sum(\chi_i/\bar{a}_i^3)}$ for the initial and postloading states is estimated as 0.31 and 0.12 mm, respectively.

The above results supplement the pattern of sand behavior under compression. It is shown that for pressures of up to 570 MPa the results on the static compressibility of sand agree closely with those of [1–3]. Grinding of sand particles is observed even under such, not very intense compression. This should probably be taken into account in constructing more precise models for describing sand grounds as heterogeneous media.

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