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ON THE THEORETICAL GROUNDS FOR STUDYING THE ELASTIC PROPERTIES OF TWO-PHASE MEDIA BY LABORATORY TESTING OF THE ROCK SAMPLES

S.S. Kevorkyants

Geoelectromagnetic Research Centre of the Institute of Physics of the Earth, Russian Academy of Sciences (GEMRC IPE RAS), Troitsk, Moscow Region, Russia

Abstract. The work addresses theoretical substantiation of studying the elastic properties of two-phase media on the core samples of rocks shaped as truncated cylinders. For this purpose, the direct problem is solved for the elastic field propagation in a two-phase truncated cylinder consisting of a solid skeleton and a pore fluid. This problem reduces to the system of Biot equations with appropriate boundary and initial conditions. The cylinder is excited by the elastic pulse parallel to the axis of the cylinder and uniformly distributed over one of its faces. The vectors of displacement of the solid and liquid phases caused by this excitation are the potential functions expressed in terms of the gradients of scalar potentials; and the Biot equations are converted into a system of two telegraph-type partial differential equations of the second order with the a pulse function of external pressure in the right-hand side. The system of telegraph equations is converted from time to frequency domain and solved for the Fourier transforms of the desired functions, which are then converted to the time domain. The system of Biot equations is solved using a combination of the finite difference and variable separation methods. The problem reduces to a system of linear algebraic equations with symmetric block-diagonal matrix with three diagonals, which is solved by the matrix sweep technique. The work is original in both the formulation of the problem (specifying the boundary and excitation conditions) and the approach suggested for its solution.

Keywords: elastic waves, two phase medium, Biot equations, finite differences and variable separation techniques.