Constitutive equation in the theory of fluid-saturated porous media(*)

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THE DEVELOPMENT of the theory of multi-component media shows that balance equations as well as the constitutive one in majority of cases were presented in the Eulerian description. However, for porous media in which the fundamental constituent is a solid, it is fully substantiated that the material description should be preferred. This fact is not trivial because, contrary to the one-component continua, in the constitutive equations of multi-phase media formulated for particle under consideration, the influence of other particles may occur. Such a situation takes in fact place in all these interaction relations which contains arguments depending on relative velocities (flow rules, supply of momentum etc.).

In the present paper these facts are discussed in detail. The aim of the paper is to demonstrate a consistent theory, and hence a closed system of equations, in an unified Lagrangean description, efficient for discussion and boundary-value formulation. We take into consideration all fundamental features of the porous fluid-saturated body like: large deformations, change of porosity and permeability, nonlinear properties of the skeleton, separation of phases. A closed system of equations is derived. The material description of interface drag forces leads to a specific structure of field equations and permeability conditions. Boundary conditions in terms of large deformations are discussed.

In order to give an efficient approach to solve a complex, nonlinear boundary-value problem, a virtual work principle is presented.

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