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Mathematical models for filtration from a reservoir into a porous medium via homogenization.

In the present talk we investigate the filtration from a water reservoir into a poroelastic medium. For the description of filtration in poroelastic media via homogenization there are three levels of approximation: the Darcy system of filtration, the Terzaghi- Biot system of poroelasticity, and the system of poroelastic filtration [1]. Therefore, the main problem here is the boundary conditions on the common boundary for the solutions of homogenized equations.

P. Polubarinova-Kochina [2] uses the Darcy system of filtration in the porous medium and simply postulates the hydrostatics in the reservoir and the continuity of the pressure on the common boundary “reservoir-porous medium”. There are some particular results obtained by W. Jager and A. Mikelic [3] for special geometry of pore space (disconnected solid skeleton) and only for 2-D domains.

We study the complete problem in 3-D for the arbitrary geometry of corresponding pore spaces.

For the basic model at the microscopic level there is a flow from a reservoir into the porous medium and maybe backwards, and its can be calculated. The same property remains valid for the homogenized model of poroelastic filtration. But for Darcy's system of filtration, or for the Terzaghi- Biot system of poroelasticity, the motion in the reservoir is automatically approximated by hydraulics, the limiting pressure on the common boundary takes the value of the hydraulic pressure at the common boundary (the pressure is continuous!), and there is no information about the flow from the reservoir into the porous media and back.

[1] Meirmanov, A: mathematical models for poroelastic flows. Atlantis Press, Paris (to appear)
[2] Polubarinova-Kochina, P. Ya.: Theory of ground water movement.
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[3] Jager, W., Mikelic A.: On the flow conditions at the boundary between a porous medium and an impervious solid. In "Progress in PDE: the Metz surveys 3". Pitman reseach Notes in Mathematics, N 314, Longman Scintific and Technical, London (1994).