DESCRIPTION FOR THE GENERAL PUBLIC

The porous materials are from many years a subject of investigations and analysis because of their interesting properties related with heat transport, filtration, absorptivity, stiffness and lightness. The porous structures are very popular in the nature, e.g. sand, pumice, spongy bones and snow. There are also widely produced: metal foams, dry ski slopes or filter cartridges. The porous medium consists of the skeleton and the pores, through which the fluid can flow. Main parameters of the porous medium are the porosity and the permeability. The porosity expresses the volume of the pores in the whole volume of the medium. The permeability characterizes the ability of the medium to pass the fluid. The higher permeability the easier fluid can flow through the porous medium.

The most known filtration law is the law of French civil engineer – Henry Darcy (1803-1858). According to the Darcy's law the velocity of the fluid is proportional to the permeability of the medium and the pressure gradient and it is inversely proportional to the viscosity of the fluid. Also other filtration laws are used. One of such laws is the Brinkman filtration law. In is applied when the porosity of the medium is very high (close to one) and when the porous medium is bounded by the solid or the free fluid region. Example of such case exists on the artificial ski slope. The slope is a porous material with the high porosity. The porous layer is bounded by the slope wall and on the other hand side by the free fluid layer or moving skis. Another example is the wind blowing over the forest. In this case the forest can be treated as the porous medium with the high porosity. The forest is bounded by the ground on the one hand and on the second hand by the free flowing fluid – the air. The fluid flows also in the forest.

There are two approaches in solving such problems in the literature. The first approch is based on the Beavers-Joseph experiment (1967) and the second model of filtration flow is based on the Brinkman equation. In the first approach the slip constant in the Beavers-Joseph boundary condition is to determine. In the second model the effective viscosity in the Brinkman equation is to identify. The effective viscosity is a property of the considered porous medium and characterizes the ability of the medium to transfer the shear stresses.. In case of the forest the shear stresses caused by the wind can induce its destruction. In case of the artificial ski slope the shear stresses are caused by the movement of the skis on the porous material layer.

The purpose of the proposed project is analysis of viscous, incompressible fluid flow in boundary layer of the porous medium at the high porosity. The slip constant on boundary of the considered region in the Bevers-Joseph boundary condition and the effective viscosity in the Brinkman filtration equation are to determine by means of numerical simulations of imaginary physical experiments. The calculations will be conducted both for the Newtonian fluid and for the generalized Newtonian fluid. Investigations of the multilayer model of the boundary of the porous medium are also planned. The numerical simulations will be conducted using modern versions of the Trefftz-type methods which do not require finite element mesh generation.