NUMERICAL SIMULATION FOR MODEL DEEP FILTRATION IN POROUS MEDIUM

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Abstract. In this paper we present a numerical simulation for the deep filtration model, it means the filtration with blocking pores of deep pores bed. There are two kinds of particles: "big" and "small" suspended in a fluid passing through a porous filter. "Big" particles are trapped while passing through narrow channels of the filter whereas "small" particles can pass through a pore structure. A steady state of the model is reached when the filter cannot trap additional particles.

Introduction

Deep filtration is a process used to separate solid particles suspended in a fluid. A dilute suspension is injected into a filter made of porous material. Particles, while following through the filter, may be trapped inside by various mechanisms. In some cases the trapped particles may be recovered later by "cleaning" the filter.

We consider the model for deep filtration with the pores completely blocked. On the surface of the filtrating bed layer the cake almost does not appear and the solid "big" particles are retained inside the pore blocking it completely and preventing other particles from passing.

Model for deep filtration with the pores completely blocked

In this model we consider the liquid flow through mechanic filter in two-dimensional system. Filters, which we use to numerical simulation, consist of two kind of channels ("narrow" and "wide") assigned randomly to the filter structure. In numerical simulation we assume the model of a square lattice, rotated by 45° to the flow axis, of width Y = 100 and length X = 50, which is an idealized network model of the filter pore space (Fig. 1). Fluid containing suspended particles is injected on the left side of the filter (x = 0) and exits the right side (x = X). There are two kinds of particles: "big" (of a radius R) and "small" (of a radius r) suspended in a fluid. Particles of a big radius R are either trapped inside "narrow" channels (blocking it completely and preventing other particles from passing) or move along "wide" pores. Particles of a small radius r can pass freely through not blocked pores.

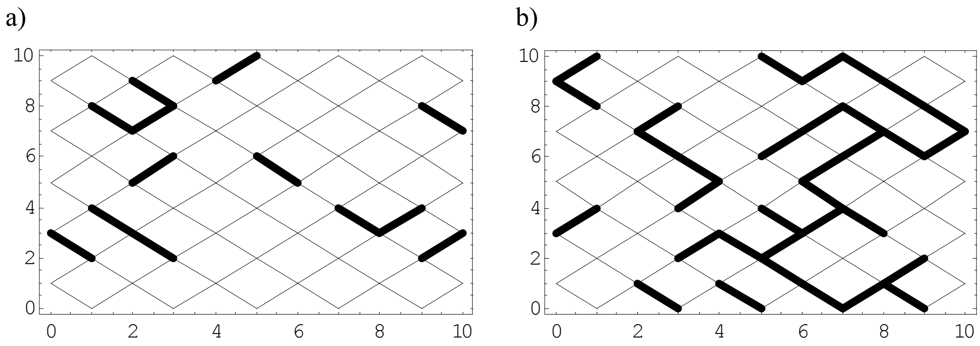

Fig. 1. Examples of the schema of filters, where the probability of assigning the wide channel equals: a) $p = 0.1$, b) $p = 0.4$

A general principle of move of the particles is defined in the following way. Particles are injected from the left side of a filter and then always move in the right direction choosing one of two available channels. They are moving either until they leave the filter or then they are trapped inside.

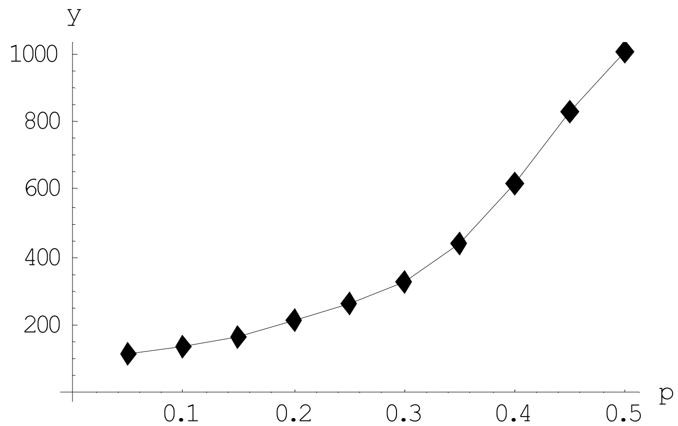

Fig. 2. The relationship between the number of the particles of the radius R, which have been trapped inside and the probability p, where p is the probability of assigning the wide channel of the filter

Numerical simulations show that the efficiency of the filter increases together with the probability p, where p is the probability of assigning the wide channel of the filter. Time, after which the filter is completely blocked and cannot trap additional particles, is prolonged (Fig. 4). The number "big" particles (of a radius R), which the filter is able to trap, increases (Fig. 2).

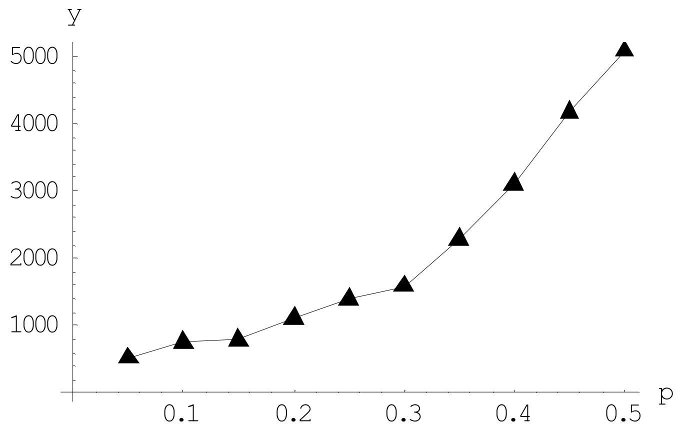

Fig. 3. The relationship between the number of all particles, which either have passed through the filter or have been trapped inside and *p*, where *p* is the probability of assigning the wide channel of the filter

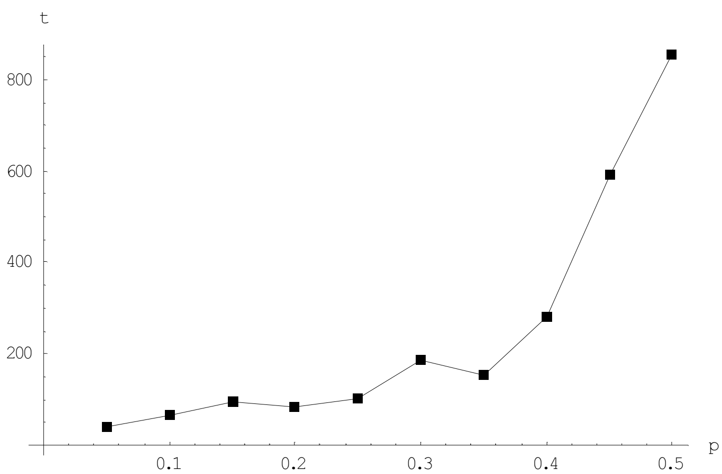

Fig. 4. The relationship between the time of the filter complete blocking and *p*, where *p* is the probability of assigning the wide channel of the filter

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