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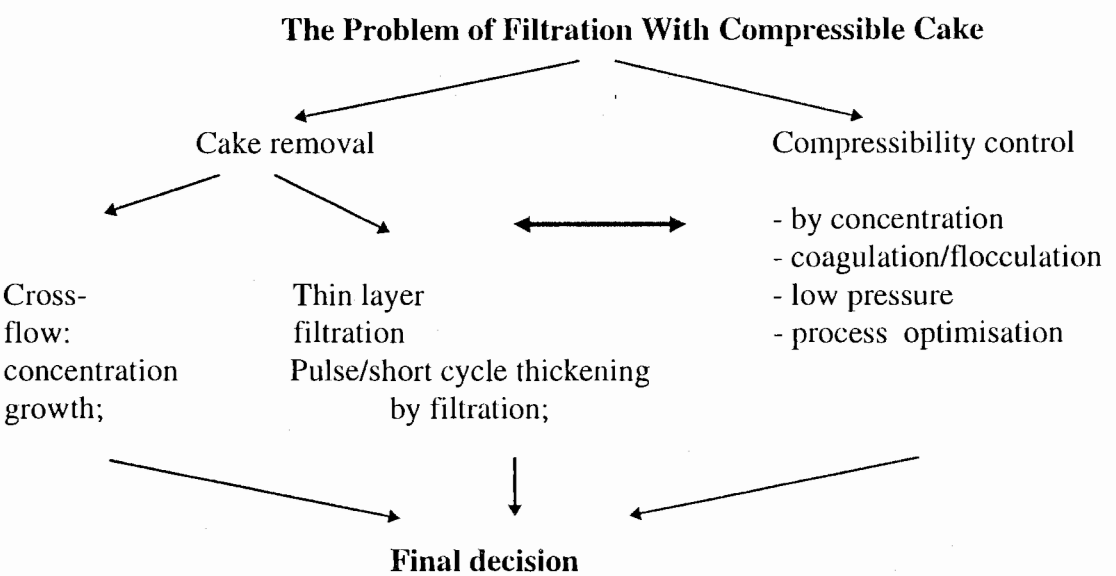
OUTLOOK OF MICROFILTRATION FOR SLURRY FORMING COMPRESSIBLE CAKES

Alexander Yelshin, Visiting Professor, Dept. Engenharia Biologica, Universidade do Minho, 4709 Braga, Portugal

Microfiltration widely used for liquid purification from colloidal and biological materials as well as for slurry thickening. Experts indicated the problem of cake compressibility in different areas of industrial application the microfiltration with cake build-up or cross-flow filtration with boundary deposit layer on the filtering surface.

The compressible cake phenomena under pressure drop and frictional drag acting on the cake particles can be devided as the following: 1). Particles rearrangement in the cake under the stress; 2). Matrix compression in a gel likeness cakes; 3). Complex case when both effects take place in the cake, for instance in biofilm. In the first case the main factors of cake compressibility are as following: decreasing porosity and pore size due to cake structure collapse and increase the pore tortuosity associated with porosity. In the second case the deformation of the matrix leads to increasing a tortuosity. In the third, the most complicated case, we have simultaneously decreasing the porosity and pore size as well as increasing the tortuosity. This phenomenon belongs to separation or thickening solutions contained macromolecules and particles and microbial cells.

Outlook of the microfiltration processes for slurries forming compressible cakes shows that the filtration problem can be formulated as the scheme:



Cake removal. A verity of proposed methods and filter constructions announced in publications and patents but two basic performances are in majority of methods.

Cross-flow filtration. The practice demonstrates that it is impossible to solve the problem by tangential velocity increasing, only. At the same time the concentration increasing during filtration can change the rheological properties of a slurry.

Thin cake layer filtration. This method gives the possibility to receive more concentrated suspension but even this process depends on cake compressibility. Hence, the most actual way to improve the filtration with compressible cake is the compressibility control.

Control slurry concentration. The cake properties of colloidal systems are changeable with varying the slurry concentration. Analysis shows that some types of suspensions have for constant pressure filtration an extrimal dependence of specific cake resistance on slurry concentration and the extremum can belong to minimal specific cake resistance. A numerous suspension demonstrates decreasing cake resistance with the concentration increasing. These phenomena related the follows effects: particles aggregation in suspension, the cake structure arrangement changing. It means by concentration control we can control cake compressibility. For slurry with minimum at the functional dependence the optimal region of the concentration can be determined.

Coagulation/flocculation. The cake from coagulated particles has more tough structure and in the defined region of filtration pressure may give more high process output. For the cake with flocculated particles the output increasing related with increasing the cake porosity and average pore size. Some amount of particles adds in slurry for bring up the cake stability against compression. They create in the cake skeleton preventing the structure collapse.

Low pressure. In many cases' optimizations of applied pressure can give a good result even for high compressible cakes.

Initial conditions and filter medium. The role of initial conditions was shown by experiments. In the filtration process beginning particles directly interact with filter medium. The effect of filter medium surface structure influences on properties of the cake formed nearby filter surface. During filtration this primary layer loaded the largest stress force instead the cake layers that formed later. So, the primary cake layer compression determined further output value of processes. We must to point out that this effect – interaction of cake with the filter medium in the first stage of filtration investigated insufficiently. It is related with unsteady state of process conditions which usually unnameable to control in the experiment. For initial stage of compressible cake formation a method of non-equilibrium thermodynamics can be suggested for application.

The complexity of the compressibility phenomena in cakes or boundary deposit layers in the microfiltration related with small cake thickness, colloidal or gel likeness nature and unlimited variety of possible physico-chemical factors variation. Nevertheless, the further research should be direct towards understanding the following affects: 1). Relationships between porosity, pore size and pore tortuosity; 2). Primary layer structure and behaviours modelling; 3). Cake structure formation modelling depends on slurry concentration; 4). Investigation behaviours of cake structure with filter add from the point of view composite material mechanics; 5). Global optimization approaches developing for choose and control the main cake properties.

The problem discussed exceeds the bounds of microfiltration and it successful evaluation would be useful for biotechnology, biofouling, environment protection technology.