S3.5.2 MODELING A PRESSURE FILTRATION PROCESS FOR CAKE FILTER FORMATION WITH GEODICT

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Cake filtration describes a type of surface filtration. Solid particles, which are entrained in liquid, deposit on a filter medium and form a filter cake with an increasing thickness as a function of filtration time. In the simplest case, the resistance of the cake increases proportionally with its thickness. In many industrial applications, such as in the pharmaceutical, crop science and health care fields, the separated solid phase is the valuable product which should be recovered. The filtration process requires normally additional steps, first followed by washing and then dehumidifying (drainage).

As a standard test for liquid-solid filtration experiments, the measurement of filter resistance in a small pressure filter, as described in VDI guideline 2762, is being widely used in both academic and industrial laboratories. The gained results are later used as the basis for selection/dimensioning of an appropriate liquid-solid separation apparatus such as pressure Nutsche, filter press, etc. for industrial production scales.

For the present study, the following test case is considered. A suspension of NaCl solution with spherical glass particles having a size distribution of 10 to 100 µm is assumed to be filled into the cylindrical pressure vessel of the above-mentioned tester. The cap is closed and with the aid of compressed air, the filtration is carried out under constant pressure. The filter cake is formed and the filtrate flows down into a cup located on a scale to record its amount as a function of time. When the filtration is finished, the filter cap is opened to gently pour the washing liquid (assumed as water) on the filter cake surface. Afterwards, the filtration under constant pressure is started again to remove the remaining salt solution from the filter cake (product cleaning). When the washing process is finished and the filter cake is cleaned, the compressed air with constant pressure, which can be higher than the filtration air pressure, is blown through the filter cake for a certain time to reduce the humidity of the filter cake.

These three mentioned steps, namely filtration, washing and dehumidification are modeled with the help of GeoDict, a software package developed by Math2Market GmbH. First, the filter element is modeled as a porous layer with a fixed thickness and permeability. All particles are deposited on the surface, no depth filtration takes place and the simulation directly starts with the cake formation. The filtration is stopped when a filter cake with a height of 5 mm with saturation of S=1 is achieved. As the collision model, the sieving model is selected. SatuDict module (from GeoDict), which uses the pore morphology method to determine the distribution of the two phases inside the porous media, is applied for modeling the washing and dehumidification (drainage)

processes. The method calculates the stationary distribution of wetting and non-wetting phases for a given capillary pressure [1].

[1] GeoDict User Guide 2015, Material property predictors, Math2Market GmbH.