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Experimental Study of Filter Cake Cracking During Deliquoring

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Shrinkage cracking during the deliquoring of compressible filter cakes by means of differential gas pressure is an undesired phenomenon of great practical importance for the pharmaceutical industry amongst others. Cracks are detrimental to the deliquoring process as they can lead to a channelling effect whereby the gas flows preferentially through the network of cracks rather than displacing the interstitial liquid, reducing the effectiveness of the deliquoring process. This has economic consequences of increased gas consumption, as well as higher residual moisture content, which would lead to an increased energy input in the later thermal drying stages.

The precise mechanism of crack formation is not fully understood at present. Crack formation is usually preceded by shrinkage of the filter cake, the driving potential for this shrinkage being the action of the capillary forces on particles forming the cake. When the stresses generated by the capillary forces exceed the tensile strength of the filter cake, the formation and propagation of cracks can be observed [1]. The tensile strength can be significantly reduced by local cake inhomogeneities.

In this contribution we will present the results of an experimental parametric study on cake cracking. The cracking probability was investigated for a model system of calcium carbonate-water on a laboratory-scale pressure filtration rig. The effects of the following parameters on crack formation were studied in detail: particle size distribution, filtration and deliquoring pressure, cake height, concentration of slurry and filter medium. The results will be presented in the form of graphs and correlations allowing the estimation of both the probability and severity (expressed by an increase in cake permeability) of cracking. For selected cases the crack network structure will be characterised by digital image analysis and three-dimensional techniques such as x-ray microtomography.

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