

SOFTWARE FOR IMPROVING THE EFFICIENCY OF TEST FILTRATION TASKS

A. Häkkinen¹, M. Huhtanen¹, B. Ekberg², and J. Kallas³

¹ *Lappeenranta University of Technology, Department of Chemical Technology, P.O. Box 20, FIN-53851, Lappeenranta, Finland, E-mail: Antti.Hakkinen@lut.fi*

² *Larox Corporation, P.O. Box 29, FIN-53101, Lappeenranta, Finland*

³ *Tallinn University of Technology, Laboratory of Inorganic Materials, Ehitajate tee 5, 19086, Tallinn, Estonia*

Abstract

Selection, design and sizing of filtration equipment for a new application always require some tests to be performed. Theoretical filtration models can be used in some cases for estimating the performance of different filters based on experimental results but prediction of filtration characteristics of unknown suspensions on a completely theoretical basis is still fairly unreliable. In addition to this, the interactions between the different stages of the overall filtration cycle, such as cake compression, washing and air drying, are difficult to predict and those therefore need to be determined experimentally.

The pilot scale experiments performed in the real process environment are typically very expensive and those often require test equipment that is not always easily available. Experiments may also be performed in a test laboratory by using samples collected from the target process. The problem here is that the sample amount is often fairly small and the properties of many samples are influenced by aging during transportation and during the test work. It would be important for these reasons to be able to perform the required experiments as quickly as possible with as small amount sample suspension as possible.

This paper introduces a software that has been developed for improving the efficiency and quality of the typical test filtration tasks and also for simplifying and rationalizing the interpretation on the test results. The software consists of two different modules. The first module creates the optimal experimental designs according to the initial information given by the user. The test designs are created by applying the basic principles of factorial designs in such a way that the variations in the investigated ranges of the desired process variables are taken into account in a systematical manner. Utilization of different kinds of factorial designs also means that the amount of experiments needed for achieving the required accuracy can be minimized. The second module of the software analyses the experimental results by utilizing the standard multivariate data analysis techniques. The meaningful information from a given table of experimental data is extracted and used for creating regression models that quantify the relationships between the studied process variables. These models can be further applied for predicting new values, for visualizing the relationships between the different variables, or for optimizing the variable combinations in order to reach the predefined process objectives.

The current software is capable of creating the experimental designs for five different kinds of filters and the suitability of the applied techniques for each filter type has also been verified by performing a large amount of experiments. Some of the experimental results are presented in this paper for illustrating the procedure that has been developed and also for showing the quality of the final results obtained by the applied methods.

Keywords: Cake filtration, Design of experiments, Modelling, Optimization