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## THE MODELLING AND SIMULATION OF SOLID-LIQUID FILTRATION PROCESSES

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### INTRODUCTION

Since the introduction of the personal computer in the late 1970's, and the development of the workstation and parallel processors in the 1980's, the opportunities to produce powerful and realistic simulations of separation processes have grown enormously. The software advances made by separations technologists during this fifteen year period are perhaps difficult for the non-expert to follow in detail, however, the results of their labours are readily observed. The most effective software is a well chosen mix of interactive algorithms, expert system and input information by the engineer which maintains the ability to provide valuable information, rapidly, whilst giving advice or education in a congenial fashion so that any psychological barriers to computer use are avoided.

In both the academic and industrial environs, computer simulations are today routinely used for plant design, research and troubleshooting duties. The processing power of modern hardware has grown to the extent that an engineer can now correctly select and simulate processes such as multi-component distillation and batch or continuous reactions with a reasonable degree of confidence. It is unfortunate, therefore, that one of the oldest and most frequently used unit operations, namely filtration, still relies almost entirely on extensive experimentation and the use of heuristics to produce the desired information. For these systems it would be rare practice indeed to use fundamental theoretical relationships for either the selection, design, sizing or optimisation of equipment. The result is that filters, and to varying extents other solid/liquid separation devices, are specified as something of an afterthought in a largely ad-hoc manner.

### THE DEVELOPMENT OF COMPUTER SIMULATIONS

The inherent costs of laboratory and pilot scale tests have for many years provided the necessary stimuli for accurately modelling the performance of solid/liquid separation equipment. Following some early, relatively simplistic efforts, work appears to have begun in earnest in the early 1950's when technologists attempted to develop equipment selection charts. Further development of these charts, and the widespread introduction of the personal computer, led in 1991 to the development of the first commercially available computer software capable of equipment selection<sup>1</sup>. During a parallel period attempts were made to model the operation of devices such as rotary vacuum filters through hand calculations, spreadsheets and expert systems. It is only in very recent years, however, that significant progress has been made toward modelling a wider range of solid/liquid filtration devices such as belt filters and diaphragm filter presses<sup>2-5</sup>.

### STATE OF THE ART SIMULATIONS

The more sophisticated computer based filtration simulations currently available (in academia only!) include routines which can interpret many aspects of the filter cycle. Through semi-empirical relations, cake formation models account for the compressibility effects induced by pumping suspensions into filters at either constant pressure, constant rate or a combination of operational modes such as variable pressure/variable rate. The subsequent post-treatment processes such as cake compression, washing and gas-dewatering can be modelled and simulated using academically tested, and industrially proven, techniques. The result is the combination of models in a suite of menu driven computer software capable of producing a range of performance criteria for the filter cycle from a basic knowledge of the process requirements and suspension properties.

## CONCLUDING REMARKS

Despite some recent advances, the computer simulation of filtration processes is still in its infancy and has some considerable way to go before simulations can rival those available for other separation processes. The paper to be presented will attempt to convey the methodologies behind the simulation of filtration processes and emphasis how the various aspects of the filter cycle have been successfully modelled thus far. Results from the simulations of a number of filter types will be shown to highlight the potential wealth of data available to an engineer needing to specify filters and guarantee performance.

## REFERENCES

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