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ACARP MATTERS

OVERCOMING THE CHALLENGES OF PASTE THICKENERS IN COAL PREPARATION

Bulga Thickener

Paste

The use of paste thickeners in coal preparation plants to dewater tailings produces significantly higher concentration of solids than conventional thickeners, which makes disposal easier.

However, varying coal tailings types – with diverse mineralogical composition, particle size distribution, swelling characteristics, settling velocity and flocculant and coagulant interactions – significantly affect the dynamics of the sedimentation process and cause pumping problems. The challenge is to keep underflow (effluent) solids concentration as close as possible to the design limit.

Paste thickeners are relatively new to the Australian coal industry and their inconsistent performance has limited their uptake across the industry, with Bulga and Clermont currently the only coal preparation plants to utilise the technology.

A project undertaken by the University of New South Wales in cooperation with GBL Process is set to turn this performance around. Researchers have developed a dynamic model that describes the process of paste thickening and relates the solids concentration to key measurements, including bed level, feed solids concentration and feed flow; and operational variables, such as underflow rate. The model was validated using data from Bulga's preparation plant. The researchers were then able to design a model predictive control (MPC) algorithm which controls the underflow solids concentration of the paste thickeners, thereby improving the overall performance of the thickeners.

Project Leader Jie Bao (UNSW) and Goetz Bickert (GBL Process) said the team had achieved most of the project objectives.

"The dynamic mathematical model that predicts the behaviour of the thickener has been successfully developed. By estimating the varying coal type parameters online, this model adapts to different coal types. A model based control algorithm has also been developed to determine quantitatively the optimal control action based on the model prediction," he said.

"The rake torque and clarometer settling time were considered in the early stage of this project for blackbox modelling from previous Bulga plant data. They are not included in the final model due to the lack of the clarometer settling time data and reliable measurement of rake torque.

"The model also includes a Kalman filter which was not in the original proposal. The Kalman filter is used to estimate, in real-time, the unknown compressibility parameter of the feed (varying with the coal types) and the solids concentrations at different heights inside the thickener. They are very important to determine the optimal control action of the underflow pump. The development and implementation of the Kalman filter is novel in the mineral processing industry but it has been used in other process control scenarios, such as in control of nuclear reactors."

ACARP Project Monitor Wayne Bower said there was some reservation in the industry about the consistency of paste thickener outputs and the impact on the co-disposal dumps in pit.

"It has been looked at for many new operations recently built, but there is still a general lack of confidence in paste thickeners' abilities to produce consistent performance and results across multiple operating scenarios. That said, when the thickeners are performing well they produce excellent paste results and are a far better option than other existing co-disposal options in place across our industry.

"This research aims to alleviate the variability of the paste thickener performance which is one of its biggest draw backs.

"There is more research needed on operating thickeners for it to be proven. Jie and the team have been talking with us about a trial on our operating thickener, but we need to do a rake drive upgrade before this could be considered."

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