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Mass flow-based controls with solids measurements reduce sludge handling costs

Extended abstract. The Tampere Water Viinikanlahti wastewater treatment plant in Tampere, Finland has commissioned what is believed to be the world's first multi-variable predictive controller (MPC) of a centrifuge sludge dewatering operation based on multiple online measurements of solids content. The online measurements replace manual testing that was considered too slow or not timely enough for optimum real time control. The objective was to avoid wasting energy and chemicals and save on dry cake disposal costs. The centrifuge mass flow-based control is part of a strategy by the Viinikanlahti plant to equip the treatment plant with total solids measurement to control and optimize other unit operations based on mass flow values rather than volumetric values. These include total solids-based primary clarifier sludge pump scheduling and anaerobic digester input solids optimization.

In the centrifuge operation the dry cake solids and the recycled centrate suspended solids are functions of several variables which interact with each other. It is therefore an application for multi-variable process control (MPC) which has been implemented in a small control system. The online measurements involved in the centrifuge control are feed solids, dry cake solids as it falls to the conveyor and centrate suspended solids. Polymer flow and centrifuge torque are also inputs. The responses of controlled and manipulated variables determined online are input to a control matrix which makes the best control decisions to achieve the desired results.

The objectives of the control are to produce a dry cake with solids content as high as possible to reduce transportation costs by truck, to minimize recirculated centrate dissolved solids that would increase polymer and dewatering costs, and to minimize polymer consumption. The paper presents the results of the control implementation which include a 50% reduction in centrate solids and a 1% to 2% increase in dry cake solids. The impact of these changes on chemical consumption is being evaluated and the results to date will be presented. The operators have confidence in the control and use it continuously. They have more time for other controls and tasks. One operator takes care of the entire plant during evening and night shifts and weekends. Also, to reduce costs the plant staff is making plans to reduce manual testing frequency.

With solids measurement after the primary clarifiers the pumping sequence from the clarifiers is now controlled to minimum solids content. The primary sludge consistency has been increased and the water load substantially decreased, thus avoiding excess water being pumped to sludge thickening and excess pumping energy as was the case with time-based control. With another total solids measurement after thickening, the optimized solids level to the anaerobic digester is expected to reduce the heating demand, reduce foam generation and increase biogas production. The results of these controls are presented.

Keywords: wastewater, centrifuge, dewatering, optimization, MPC

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