Marcin Janik
Silesian University of Technology
Faculty of Energy and Environmental Engineering
Institute of Water and Wastewater Engineering

Influence of disintegrating mixing on flow conditions of thickened wastewater treatment surplus sludge

Disintegration processes of thickened surplus sludge significantly change their physicochemical properties. Fragmentation and size reduction of sludge particles result in a change of rheological parameters and fluidisation.

The dissertation describes changes of rheological properties of thickened surplus sludge subjected to mechanical disintegration in turbine stirred vessel of standard geometry. Specially constructed test stand allowed defining power consumption of the stirring process. Torque measurement made also possible evaluating the cavitation effect in mixing. Rheological properties of sludge were characterized by a nonlinear relationship of Ostwald-de Waele model whose parameters were determined by viscometric measurements.

Studies were performed in two series of research adopting different rheological measurement methodology. In the first stage sludges from five sewage treatment plants were investigated, each at three levels of input values of dry matter content, speed and time of mixing. There were significant differences in rheological parameters between sludges from selected plants. At the second stage of research tixotrophy of sludges were also taken into consideration. Methodology for this part of research allowed testing only two levels of input variable values.

It was determined that the dry matter content in sludge essentially affects the shape of the flow curve. Less important for rheological properties of sludge are disintegration time and stirrer speed. Time of measurement in rheometer was also significant for test results.
Statistical analysis showed the influence of sludge origin on its rheological properties, suggesting the need for individual approach to the analysis of sludge disintegration feasibility for various sewage treatment plants.

Disintegration of sludge results in reduction of mixing power consumption and change in its physical properties. The results of testing Ostwald-de Waele model parameters, as well as estimating changes of mixing power consumption and grinding of sludge after disintegration indicate substantial improvement in rheological properties of disintegrated sludge.