

Monitoring for “rat-holing” during extraction of sludge from waste water lagoons using the OnLine Rheometer



The onset of water entrainment into the sludge stream was identified by using Rheology Solutions OnLine Rheometer during extraction of wastewater sludge from a lagoon

A genuine process monitoring and control rheometer which can be operated in-line or on-line and measure the viscoelastic properties in a flow environment and in real-time has the potential to improve product quality and reduce processing costs.

THE PROBLEM

Extraction of wastewater sludge held in lagoons under a cover of water is a key operation in waste water treatment plants. Typically, the sludge is pumped out from the bottom of the lagoon and conveyed for further processing. However, during the pumping process water can enter the extracted stream and dilute the sludge. This phenomenon is called “rat-holing”. Figure 1 shows an image of rat-holing observed in a laboratory experiment.

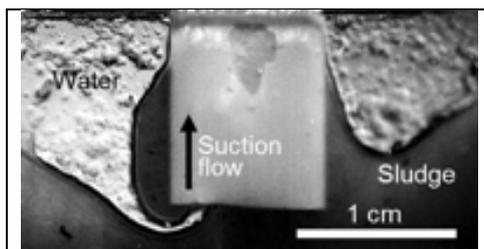


Figure 1. Image showing the rat holing process. Water (light sections) breaks into the suction flow stream (arrow) and dilutes the extracted sludge (dark sections).

Due to rat-holing, the water content of the extracted stream can exceed the limits permitted by design. When this happens, downstream operations must be adjusted to account for the extra water and these adjustments add to the cost of operations.

A suitable method for monitoring for rat-holing is therefore needed during sludge extraction.

THE OPPORTUNITY

The rheology of sludge is a sensitive function of solids content and decreases drastically when the solids concentration is reduced due to dilution with water. Figure 2 shows how the viscosity changes with the change in % Total Solids in a typical waste water sludge. The OLR measures the rheology of the extracted sludge stream. Therefore, the OLR can help operators monitor for rat-holing.

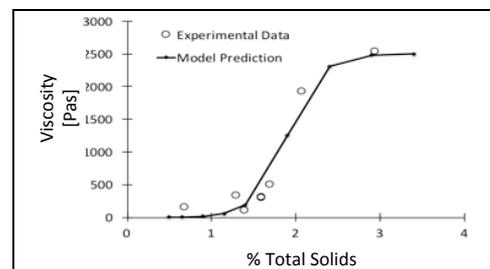


Figure 2. Change in Viscosity measured at 70 Hz with change in %Total Solids.

Extraction of accumulated sludge from storage lagoons is a key operation of waste water treatment plants. It is desirable that sludge flows continuously without entraining the surrounding water. The complicated rheology of sludge makes this difficult. A method for monitoring for water entrainment is needed

VALIDATION

A recent trial showed that the OLR can clearly identify the onset of the rat-holing process. When the OLR performance was compared with an inline solids meter, which is a popular instrument used in waste water treatment plants, it was found that the OLR identified the phenomenon at least 2 hours earlier than an inline solids meter.

These results are shown in Figure 3.

POTENTIAL IMPACT

The early warning could prevent extra water from being pumped into the downstream process. This could simplify processes that follow.

In addition, the measurements of the OLR could be related to the solids content through the calibration curve shown in Figure 2. This allowed an inline assessment of the solids content of the sludge stream from the OLR readings. These readings, are also shown in Figure 3.

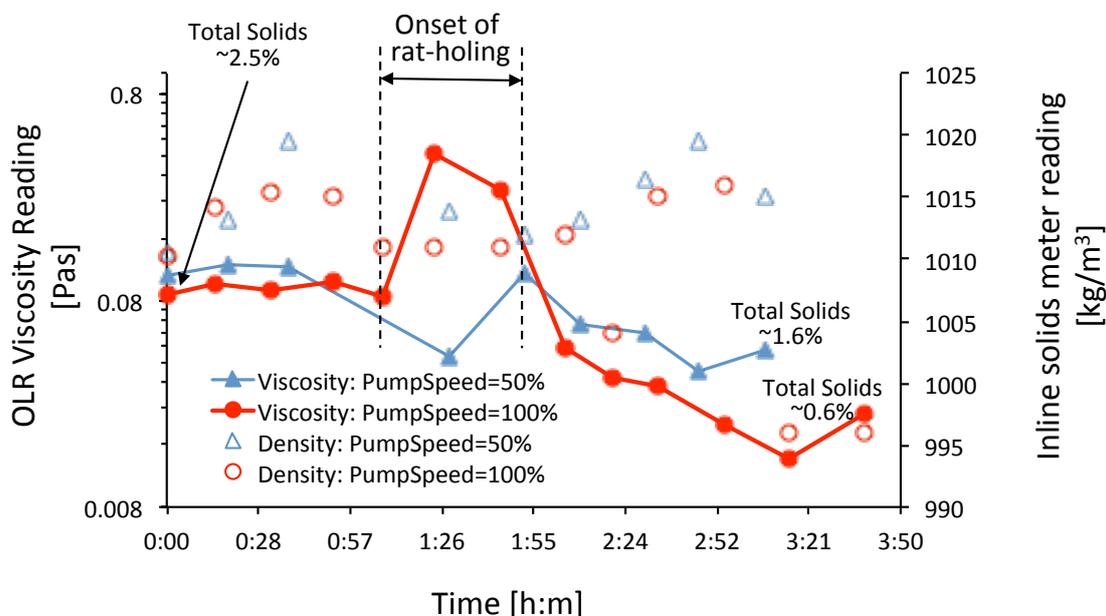


Figure 3. OLR readings (left axis, log scale) shown in filled symbols and lines. Inline solids meter reading (right axis, linear scales) shown by unfilled symbols. The two colours represent different rates of extraction given by %Pump Speed available. Rat-holing sets in in the marked region and is signified by a rapid decrease of viscosity immediately afterwards. Inline solids meter readings decrease marginally almost two hours after OLR readings. The viscosity readings decrease by almost an order of magnitude while the readings of the Inline solids meter decreases by approximately 4%.

the **OLR** *keeps your process in line*



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