

Bench-Scale Dewaterability Assessments: Methods for Determining an Optimal Polymer Demand

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Municipal Solids Dewatering

Dewatering at municipal water resource recovery facilities (WRRFs) is an operationally challenging, and costly endeavor due to the costs associated with chemical conditioning of the solids to improve their dewaterability [1], and hauling of the material for beneficial use or disposal. Operational goals for a utility include significant reduction in solids volume, and the associated dewatering costs. Therefore, it is important to recover as much water as possible. However, solids characteristics and process changes throughout a WRRF can impact the ability to effectively dewater. To improve the ability to recover water with minimal chemical addition, it is important to understand the many factors that can contribute to solids dewaterability. The information contained in this Fact Sheet refers specifically to **determination of optimal polymer dose (OPD) for dewatering** of solids generated at municipal WRRFs.

Determining Optimal Polymer Dose Using Bench Scale Techniques

Determining Optimal Polymer Requirements

Determining polymer demand on the bench-scale is typically done utilizing water release rate as an indicator of polymer conditioning. The theory is that at increasing doses of polymer the solids are destabilized and water is released, thus increasing the rate that water can escape the solids. Typical methods used are the Time to Filter (TTF) test or the measurement of the capillary suction time (CST) for conditioned solids.

From the perspective of a utility, the easiest of these methods is to measure the CST, which has been used many times in research to determine an OPD [2]–[5].

Depending on the full-scale dewatering equipment used, biosolids can experience high shear forces during dewatering. Increasing shear increases polymer requirements [6]. When utilizing CST to quantify an OPD, it is important to account for the effect of shear on the measured polymer requirements. This can be done by using a mixer that displays mixing speed and torque during conditioning (Figure 1), and determining a mixing speed and time that yields a minimum CST.

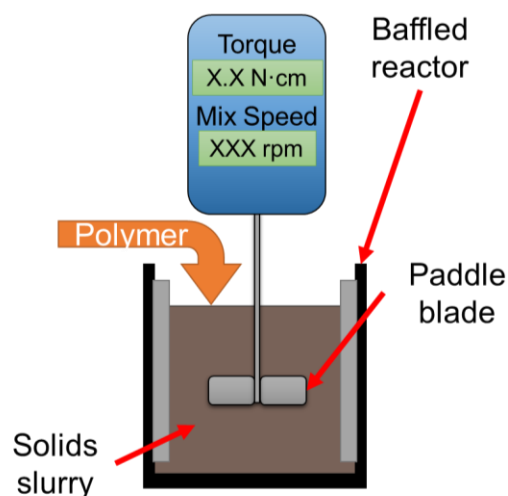


Figure 1. Example of conditioning using lab mixing.

After conditioning the solids, the CST of the conditioned slurry is measured. A CST apparatus allows the user to empirically assess the impact a dose of polymer has on the rate at which water is released from the biosolids. A conditioned solids sample is placed into the CST apparatus, and the water is pulled via capillary suction through chromatography paper. The CST is measured as the time it takes the water to travel the distance between electrodes located in the frame plates (Figure 2). A minimum CST for a given polymer dose is defined as the OPD.

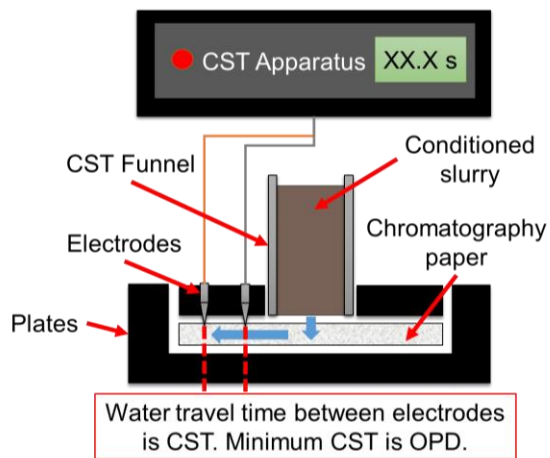


Figure 2. Using CST to determine OPD.

Another way to quantify an OPD is by measuring charge demand of conditioned solids. Typical equipment used to quantify charge is a streaming current detector, or an electrophoretic mobility device. A streaming current detector utilizes a piston that moves with a known amplitude. The piston motion causes charged ions in solution to move opposite the motion of the piston, and this motion is measured as current. Cationic polymer is added until the charged ions are neutralized. The OPD is the point of polymer addition when no charge is measured (Figure 3). An electrophoretic mobility device measures charged particle flow. An electric field is applied to a conditioned slurry which creates a flow of charged particles. Polymer is added until the charge is neutralized thus reducing the flow. The OPD is defined as the point where little or no charged particle flow is observed (Figure 4). The theory behind using charge demand to determine an OPD is that the anionic charged surfaces of floc particles and

EPS in solution are neutralized with cationic polymer. A neutral charge indicates the OPD [7], [8].

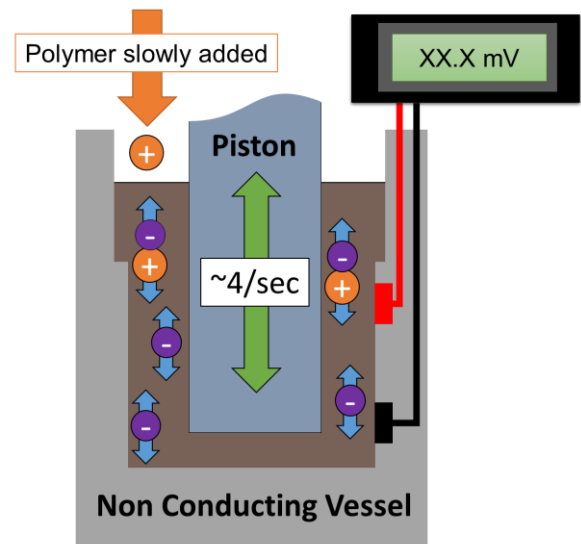


Figure 3. Schematic of a streaming current detector in operation.

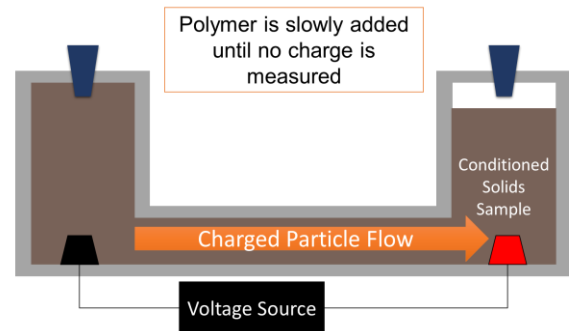


Figure 4. Schematic of an electrophoretic mobility device in operation.

While these methods to determine OPD are useful for optimizing process, they do not reveal to the user the effect of conditioning on cake solids. Additional methods are required to assess the impacts of chemical conditioning on the final cake solids (see WEF Fact Sheet: *Bench Scale Dewaterability Assessments: How Can We Determine Process Impacts on Cake Solids?*). It should be noted that only a select few methods are discussed in this Fact Sheet, and other methods for determining OPD exist. Some of these methods, particularly charge demand to determine an OPD, may be inaccessible to an average utility due to the learning curve and equipment required for operation of these tests.

Summary

Dewatering is a complex process that utilities are expected to effectively manage on a daily basis. The ability to determine an OPD for a given solids characteristics utilizing bench-scale methods is a valuable tool, and can inform WRRF process optimization and capital planning efforts.

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Further Reading

- WEF Fact Sheet: *Factors Affecting Municipal Biosolids Dewaterability*
- WEF Fact Sheet: *Bench Scale Dewaterability Assessments: How Can We Determine Process Impacts on Cake Solids?*

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