FACT SHEET

Bench Scale Dewaterability Assessments: How Can We Determine Process Impacts on Cake Solids?

By: Isaac Avila and John T. Novak

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 remove 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 remove 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 describes ***methods for assessing dewaterability*** of solids generated at municipal WRRFs.

Methods to Anticipate Cake Solids

The following three methods offer simple, reliable ways to screen the impact of process changes or chemical utilization in solids dewatering. There are several methods that can be used to assess the impacts of process changes on cake solids. For example, simply squeezing cake solids and visually assessing the moisture content can give an operator an indication of how well a dewatering process is operating. However, for utilities looking to anticipate the impacts a specific process change would have on cake solids, more quantitative methods are required.

In this fact sheet three methods that have been used to quantify process change impacts on cake solids are discussed. Other methods have been used and some of these may be preferable for specific dewatering processes.

Drying Rate Method

The drying rate test does not require conditioning prior to analysis, and it is used to determine a cake solids content of a solids sample. An optimal polymer demand (OPD) is typically determined using separate methods such as capillary suction time (CST) or charge demand (see Fact Sheet: *Bench-Scale Dewaterability Assessments: Methods for Determining an Optimal Polymer Demand*). For the drying rate method, samples are dried slowly at temperatures of 85 ˚F – 95 ˚F in a climate controlled environment for up to two days, and the drying rate and moisture content are measured (Figure 1-A). This procedure is performed slowly so the water that can be removed through mechanical dewatering processes can be distinguished from more tightly bound water [2]. When the drying rate versus moisture content is graphed on an arithmetic scale, the linear portion of the graph (Figure 1-B) is representative of the free water content of the solids (as defined by [2]). Point A is the inflection point where water evaporation rate switches from free water to bound water. The final cake solids is derived using the equation in Figure 1-B, where DS(A) = dried solids content at point A. The derived cake solids results are reported to represent cake solids achievable in a highly optimized full-scale centrifuge [3].

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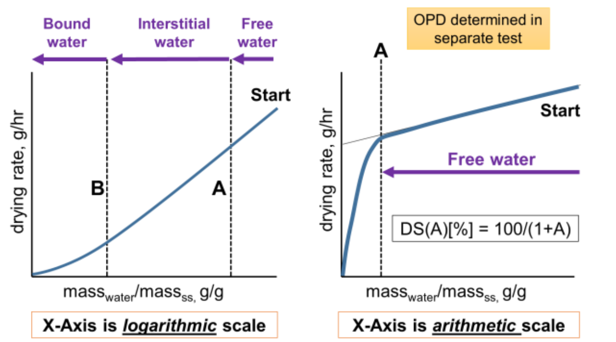

Figure 1. (A) Typical drying rate curve. (B) Drying rate curve graphed on arithmetic scale. Figure adapted from graphs presented in Kopp & Dichtl, 2001.

Modified Centrifuge Technique

The modified centrifuge technique (MCT) combines polymer conditioning and dewatering using modified centrifuge cups at a controlled centrifugation speed. Per the method, polymer must be used to form flocs before dewatering. Typically, a CST apparatus is used to determine an OPD, then the OPD conditioned sample is allowed to free drain, and the sample is then dewatered in the modified centrifuge cups (Figure 2). The cake solids produced from the controlled centrifugation can be measured using standard methods, and have been reported to be representative of the cake solids achievable from full-scale belt filter press dewatering equipment [4], [5].

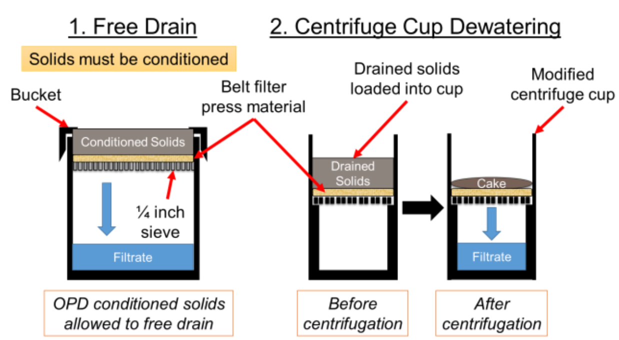

Figure 2. Typical steps performed during MCT do produce cake solids (See Ngwenya et al., 2017 for detailed methodology).

Press Method

The Press Method utilizes a steel pneumatic press to produce cake solids by squeezing conditioned solids at a set pressure and time. Prior to dewatering with the pneumatic press, polymer is added to form flocs, and the solids allowed to free drain through the lower steel frame plate. The steel frame plates are lined with filter screen mesh material that allow the filtrate to pass through. The press is assembled and then the solids are dewatered for a set time at ~25 psi leaving behind a cake (Figure 3) [6]. As with the MCT, the cake solids can be analyzed using standard methods. An optimal polymer dose is determined through analysis of polymer versus cake solids graphs.

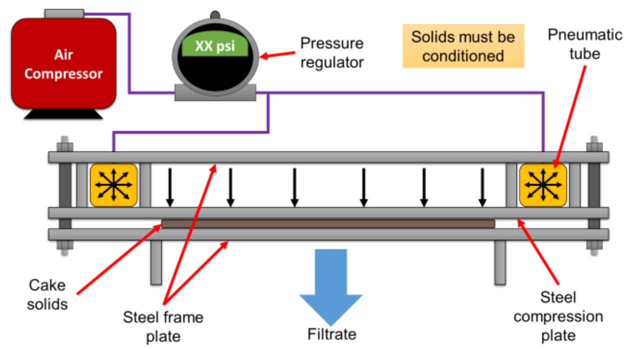

Figure 3. Schematic of pneumatic press used to produce dewatered cake - Image adapted from Benisch & Neethling, 2014.

Summary

Dewatering is a complex process that utilities are expected to effectively manage on a daily basis. The simple, quick methods described in this fact sheet have been used to determine the impacts process or chemical changes have on cake solids moisture content. For a utility, this information is valuable because it leads to better process optimization, and has application in capital planning efforts.

Authors

Isaac Avila

Prof. John T. Novak

Reviewers

Ed Fritz, P.E.

Rashi Gupta, P.E.

James Hanson, P.E.

David Oerke, P.E., BCEE

Dr. Richard Tsang, PhD, P.E., BCEE

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[2] J. Kopp and N. Dichtl, "Influence of Free Water Content on Sewage Sludge Dewatering," *Chem. Water Wastewater Treat. VI*, vol. 6, pp. 347–356, 2001.

[3] J. Kopp, H. Yoshida, and G. Forstner, "Impact of Hydrolysis and Bio-P Removal Processes on Biosolids Dewaterability and Polymer Consumption in the Dewatering Process," in *WEFTEC 2016*, 2016, pp. 1645–1656.

[4] M. Higgins, C. Bott, P. Schauer, and S. Beightol, "Does Bio-P Impact Dewatering after Anaerobic Digestion? Yes, and not in a good way!," *Proc. Water Environ. Fed. Residuals Biosolids 2014*, vol. 2, pp. 1–11, 2014.

[5] Z. Ngwenya, M. J. Higgins, S. Beightol, and S. N. Murthy, "A Laboratory Based Method for Predicting Dewaterability," in *WEF Residuals and Biosolids Conference*, 2017, pp. 566–582.

[6] M. Benisch and J. Neethling, "Optimizing Dewatering-Introducing a new Dewaterability Testing Procedure," 2015.

Further Reading

- WEF Fact Sheet: *Factors Affecting Municipal Biosolids Dewaterability*
- WEF Fact Sheet: *Bench Scale Dewaterability Assessments: Methods for Determining an Optimal Polymer Demand*
- WEF Fact Sheet: *Thickening and Dewatering*
- WEF Fact Sheet: *Bench Scale vs Pilot Scale Dewatering Testing*
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Contact

Water Environment Federation
601 Wythe Street
Alexandria, VA 22314
703-684-2400
biosolids@wef.org

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