Design Review Committee Briefing #12

Subject: Sidestream Treatment Technology Alternatives

Date: December 19, 2018

The Issue

The sidestream treatment process serves as means for reducing phosphorus and nitrogen as well as preventing struvite buildup in key processes of a wastewater treatment plant (WWTP). Struvite is a nuisance by-product of the solids digestion process that forms through chemical reactions of magnesium, ammonium, and phosphate to produce hardened crystals that can block pipes, damage pumps and other dewatering processes. Sidestream treatment is a common approach to controlling struvite formation. It also has the ability, with some technology options, to harvest phosphorus and nitrogen to create a fertilizer product that can be sold. The configuration and performance of the sidestream treatment process is integral in achieving the required effluent discharge requirements for the Nampa WWTP. An introduction to the selection of the sidestream treatment process is described in this briefing.

Background and Analysis

Sidestream treatment limits the operational challenges related to struvite accumulation (e.g. blocked pipes and mechanical equipment failures), reduces the overall nutrient loading to the secondary treatment system thereby reducing the system size, and provides an opportunity to produce a revenue-generating product. This is a rapidly evolving technology and the various approaches presented below are closely tied to specific technology providers. The technologies currently being evaluated as part of the preliminary design are as follows:

- **Alternative 1 - Centrate Precipitation with Harvesting**: Alternative 1 involves installing a sidestream treatment reactor to treat centrate, which is the liquid removed through the solids dewatering process. This is a nutrient-rich stream that comprises approximately 20 to 30 percent of the overall nutrient load for the Nampa WWTP. Alternative 1 generates struvite from the centrate and harvests it for sale through a third-party contract, which is negotiated in conjunction with the equipment process selection. This alternative produces a higher quality (and higher valued) product than other options presented.
- **Alternative 2 - Direct Chemical Addition**: Alternative 2 involves installing an expanded ferric chloride dosing system. Ferric chloride is dosed to the process at the primary digesters. This precipitates phosphorus out of the stream where it can be isolated and disposed of by hauling it to the landfill. However, this approach does not provide a means to recover a product. This alternative involves construction of chemical storage tanks, mixers, and hauling infrastructure.
- **Alternative 3 - Centrate and WAS Precipitation with Harvesting:** Alternative 3 builds upon Alternative 1. In addition to installing a sidestream treatment reactor similar to Alternative 1, a WASSTRIP tank is built on the waste activated sludge (WAS) system between the final clarifiers and the WAS thickening equipment. This facilitates phosphorus precipitation earlier in the system and reduces the amount of struvite buildup in the system. As in Alternative 1, a higher quality product that can be harvested and sold through a third-party contract is produced, although in this alternative it is produced in higher quantities.
- **Alternative 4 - Digested Sludge Precipitation with Harvesting:** Alternative 4 is the installation of sidestream treatment between the primary anaerobic digesters and the sludge dewatering process. This approach reduces the risk of struvite accumulation on the sludge dewatering equipment (i.e. centrifuges). However, because the struvite is recovered from the digested sludge the struvite product created is lower quality than Alternative 1 and 3 and, therefore, has a lower potential value.

- **Alternative 5 - Digested Sludge Precipitation without Harvesting:** Alternative 5 is a very similar setup to Alternative 4. The only difference is that the struvite product is not harvested and instead, the precipitant is sequestered in the biosolids, which are then sent to a landfill. This approach reduces the costs of having to process the product to a marketable quality but does result in a loss of financial benefit from the sale of the product.

Potential Consequences

There are several key factors, which are described below, that will influence the overall evaluation of the sidestream treatment process.

- **Capital vs. Operating Cost** – Alternatives 1, 3, 4, and 5 require the design and construction of a struvite reactor, which increases their associated capital costs. Conversely, Alternative 2 has limited capital costs but requires more significant on-going operational costs. Balancing the capital and operating costs, along with the potential variability in these costs, will be key in the evaluation of the various alternatives.
- **Value of Recovered Product** – Alternatives 1, 3, and 4 all provide an opportunity to recover a product that could be marketed and sold. The value of this product varies between the options and the duration of a guaranteed price for the product can also vary. Alternatives 2 and 5 do not include product recovery, although this could be added to Alternative 5 in the future if desired. Understanding the value of the recovered product from the economic and public perception perspectives will impact the overall evaluation.
- **Manufacturer/Technology Experience** - Given the rapidly evolving market for struvite recovery there are limited installations within the United States. Selecting approaches with a more robust installation list and business model could limit risk of design and operational challenges but could require additional investment.
- **Operational Challenges** – Struvite can pose significant operational challenges at WWTPs due to the time and effort involved to replace pipes and mechanical equipment impacted by its precipitation. Limiting the accumulation of struvite in more unit processes (i.e. moving the struvite precipitation upstream in the solids handling process) may be beneficial.

Recommendation

This briefing is intended to be informational to the Committee as the preliminary design process advances. During Design Review Committee Meeting #4 we will gather and discuss the DRC's input and/or concerns on the four potential consequences noted above for consideration.

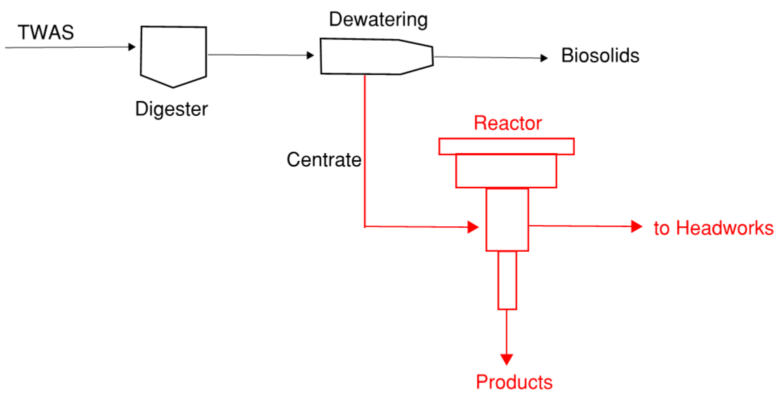

Figure 1. Alternative 1 Process Flow Diagram

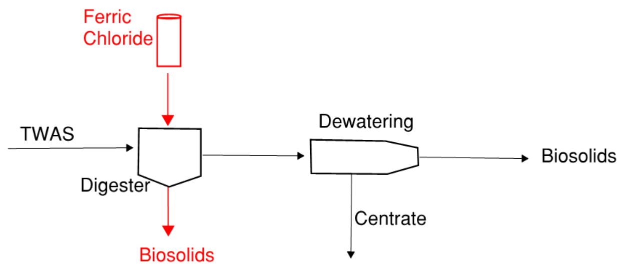

Figure 2. Alternative 2 Process Flow Diagram

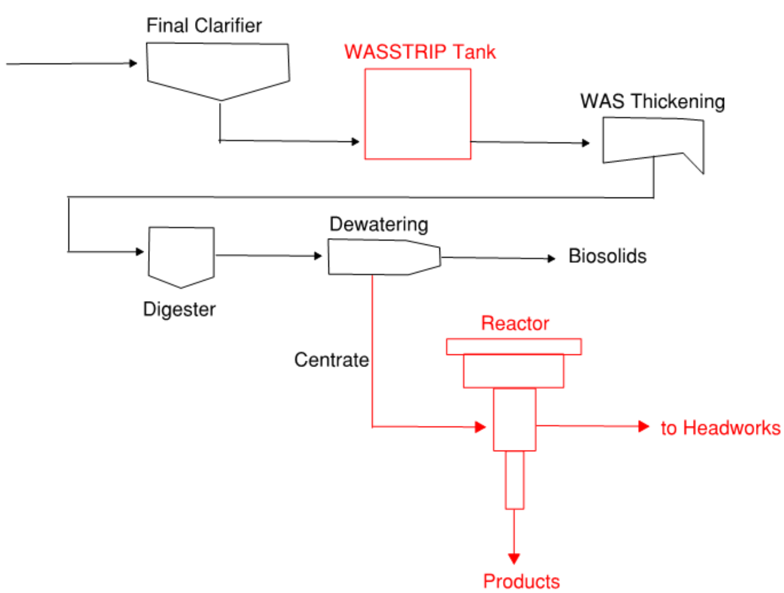

Figure 3. Alternative 3 Process Flow Diagram

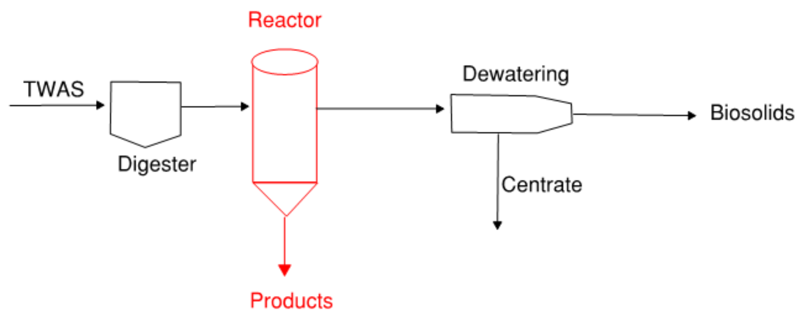

Figure 4. Alternative 4 Process Flow Diagram

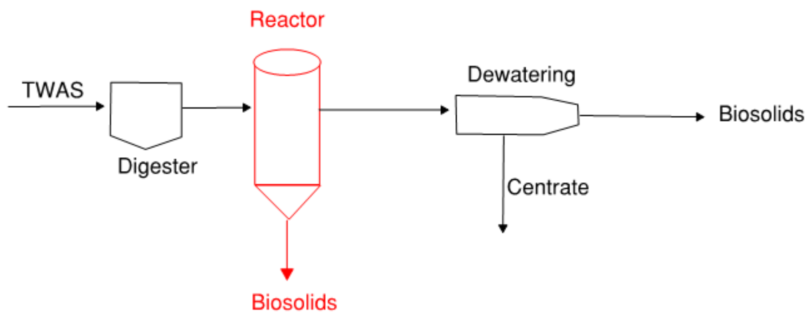

Figure 5. Alternative 5 Process Flow Diagram