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INNOVATIVE BIOSOLIDS TECHNOLOGIES
A Snapshot of the ATAD Process

If someone were to pitch a process that would produce Class A biosolids, with a low energy requirement, automated controls, a soil-like end product, and low odors, most wastewater professionals would shrug their shoulders because they have heard it all before. In fact, the Autothermal Thermophilic Aerobic Digestion process, or ATAD, has existed in various forms for the past three decades. The system was envisioned as a way for treatment plants to meet the stringent Class A biosolids regulations, using aerobic digestion, which most plants are familiar with. The heart of the system is an accelerated aerobic digestion process for solids destruction that reduces the total mass of organic solids that must be disposed. Previous versions of the process have been known to have problems with operations, product dewatering, and odors caused by the process, but the newer generation has eliminated most, if not all, of these concerns. The technology is classified by the US EPA as "Established" – it is being widely used, with more than 25 installations across the country.

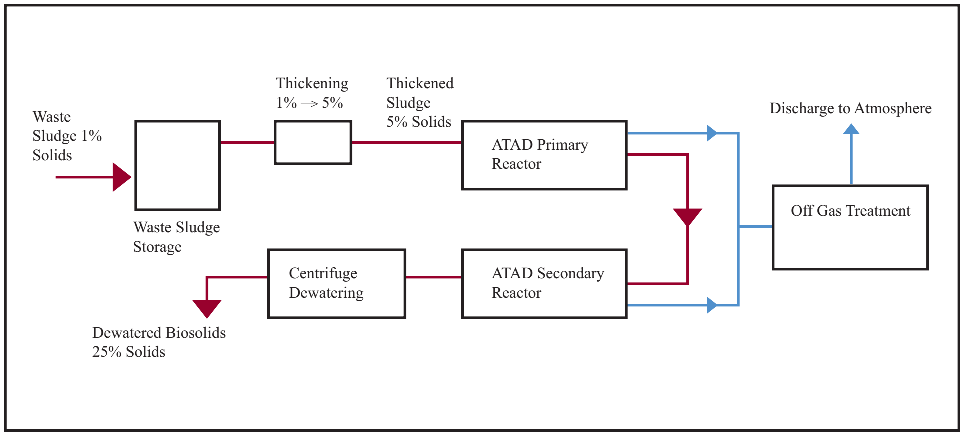

Figure 1. ATAD Process Flow Diagram

Process Description

The ATAD process is depicted in Figure 1. The process is composed of an enclosed reactor where conditions are maintained such that the autothermal thermophilic bacteria are promoted without an external heat source. The autothermal portion describes the fact that during the biological breakdown of the influent organic matter, the biomass resident in the digester creates its own heat. Thermophilic relates to the fact that the bacteria thrive at higher temperatures, in the range of 150°F to 165°F. Higher temperatures mean that solids destruction occurs faster, and more completely. It is this solids destruction that generates the heat for the process. Much like a backyard compost pile, the breakdown of sludge releases heat, but the ATAD breaks more organic matter down, so more heat is generated. The elevated temperatures also inactivate or destroy many of the pathogenic bacteria, which, combined with the volatile organics destruction, means the process can readily achieve Class A status based on time and temperature.

The temperature must be carefully controlled, so that conditions are warm enough to keep the target bacteria population "happy", but not elevated enough to shut down digestion. This is controlled through pre-thickening of the sludge to be treated, metered feeding of the waste stream, and precise control of the aeration and off-gas airstreams. To balance the feed and withdraw cycles, most systems include two reactors, one a higher temperature first stage digester where most of the solids destruction takes place, and a second reactor where the material is allowed to cool slightly, separating ammonia and other odorous gasses from the sludge.

Pre-thickening the sludge coming into the process, and the ability to control the rate at which it enters the reactor, are two important process considerations. Where available tankage exists, a waste activated sludge storage tank upstream of the ATAD is helpful so that normal wasting from the wastewater treatment process can continue. From the waste storage, decreasing the volume of sludge to be treated is as simple as running a thickening process to boost the solids content from the typical ½ to 1 percent common to waste activated sludge up to 5 percent needed for the ATAD. This decrease in volume also decreases the amount of heat lost by the system when the reactor is fed. A smaller volume of cold sludge going into the warm tank means more heat going into the biomass, rather than into the water. This serves to both lessen the volume of the reactor and to decrease the time needed for the temperature to rise and enable breakdown of organic matter.

Precise control of the aeration and mixing in the reactors is controlled through the use of sensors in the tanks. These sensors, which monitor dissolved oxygen, oxidation reduction potential, temperature, and other variables, depending on the manufacturer, trigger the programmable logic controller (PLC) that commands the air supply blowers and the mixing units within the tank. This results in the optimal amount of air being added to the system to satisfy the biological oxygen demand and keep the temperature fluctuations to a minimum. Compared to the first generation systems that required multiple manual inputs, the modern PLC driven systems are more reliable and provide a finer degree of control. This PLC is also a part of a larger control system that logs the temperature of the reactor, the feed and isolation intervals, and the discharge points, all of which are critical for the monitoring requirements for a Class A biosolids product. Heat exchangers, cycling plant effluent on one side and the reactor contents on the other, are used to bleed heat off from the system when necessary.

In the second reactor, which has a hydraulic residence time above 10 days, temperatures are maintained around 95°F to encourage denitrification and promote the release of ammonia. This off-gas is blended with the exhaust gasses from the primary reactor, and then treated through either a mechanical scrubber or a passive biofilter. The advantage of the scrubber is the smaller footprint, while the biofilter requires little or no chemical addition. Since odors were one of the principle concerns of the first generation systems, a well designed off-gas control system is critical to the overall performance of the ATAD system.

Benefits

The benefits of the ATAD process over conventional aerobic digestion are the decreased time and volume required for complete digestion. This can also translate into additional energy savings. Compared to anaerobic digestion, the residence times and external heating requirements can be substantially less. In terms of general system advantages, the biggest advantage is probably the volume reduction through the process. The pre-thickening of sludge, elevated temperatures, efficient aeration, more complete organics destruction, and off-gassing of volatile compounds all reduce the mass and volume of solids at each step. Refer to Figure 2, which shows that typical volatile solids reduction of 50 percent or greater is common. Additionally, a high solids end product can be achieved using a centrifuge, but results have been mixed using belt presses.

Summary

Experience has shown that the ATAD process succeeds in generating a consistently pathogen free, stable material with significant nutrient components. The final product, due to a high solids content, low odor, and grainy, soil-like texture, is very well accepted by the public for use in landscaping and other give-away programs. The volume reductions and energy requirements are of interest to wastewater professionals, and public acceptance makes everyone's jobs easier.

Written by Howard Butler, Staff Engineer with CET Engineering Services.

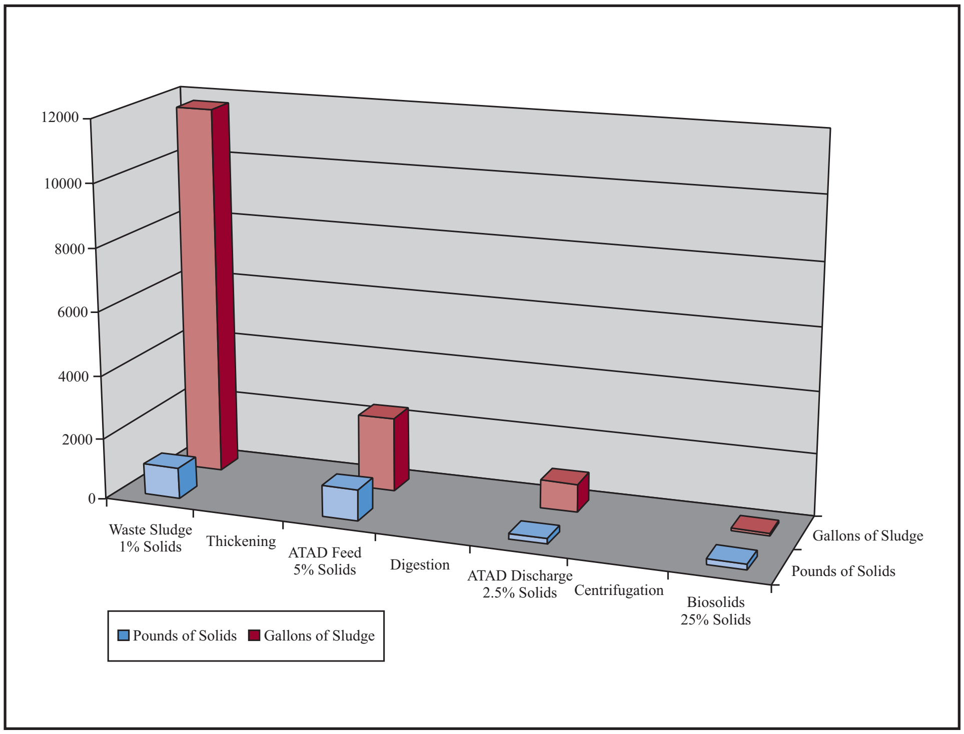

Figure 2. Typical Volume and Mass Reductions through ATAD Process

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