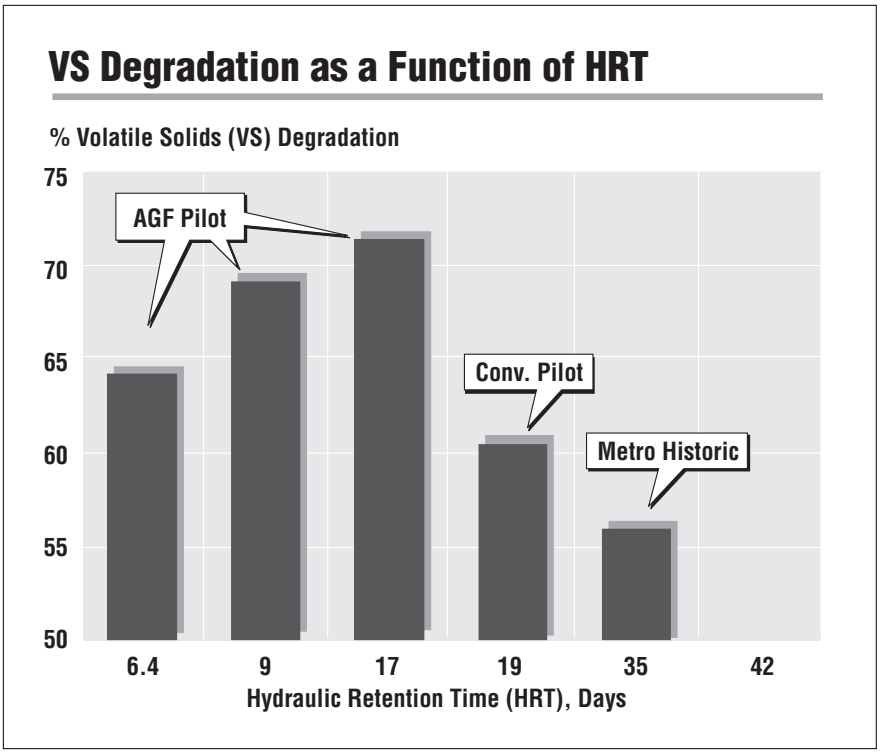
AGF—Anoxic Gas Flotation

Technology Description

Anoxic gas flotation (AGF) is an enhancement to conventional anaerobic digestion. It uses the "activated sludge" concept of returning thickened digested sludge for further treatment. The process of capturing and returning thickened digested solids to the anaerobic reactor increases the solids content in the digester. But more importantly, this process allows the solids retention time (SRT) to be increased without increasing the hydraulic retention time (HRT). The net effect is that the long SRTs required for substantial sludge destruction can be attained with smaller digesters. For example, in a conventional digester, a 25 day SRT can only be attained with a digester volume that provides a 25-day HRT. With the "activated sludge" modification, 25 day SRTs or more may be achievable with HRTs as low as 6 to 9 days.

Various means are available to thicken digested sludge, such as gravity thickening and centrifuges. However, they have had limited success with attaining significant sludge destruction because of the fragile nature of the anaerobic bacteria. What makes AGF unique is the use of anoxic gas or methane flotation to thicken the digested sludge for return to the digester. The methane environment maintains the digested sludge microorganisms in an anaerobic state and thus does not disrupt the digestion process. Similar in concept to dissolved air flotation (DAF), the anoxic gas flotation process first mixes digested sludge with polymer and a pressurized liquid recycle stream that is supersaturated with methane. Upon entering the lower pressure of the flotation tank, the methane will form tiny bubbles which cause the sludge to float to the surface and thicken.



The liquid effluent produced under the floated thickened sludge is returned to the liquid treatment processes. Removal of this liquid portion serves to reduce the build-up of digestion products, such as ammonia and sulfide, which can be inhibitory or toxic. Thus, wasting the liquid portion helps to reduce toxic and inhibitory conditions often associated with high solids digesters.

Demonstration Project

Western Environmental Engineers entered into an agreement with the King County Applied Wastewater Technology (AWT) Program in 1995 to demonstrate the AGF process at the King County East Section Reclamation Plant. This demonstration project was the first pilot-scale test of the AGF process using municipal wastewater sludge.

Western Environmental Engineers constructed a 2,000-liter pilot-scale AGF digester for the demonstration project. Another 2,000-liter digester was constructed and operated conventionally to compare the results of the AGF digester. Both pilot-scale digesters were located within a semi-trailer. The demonstration project ran from July 1995 to June 1996. Co-thickened primary and secondary sludge at 6% solids was fed to both digesters in a fill-and-draw mode. The AGF digester was operated at HRTs of 6.4, 9, and 17 days with associated solids retention times (SRTs) of 19, 29, and 58 days. The conventional digester was operated at a 19 day HRT/SRT throughout the testing period. Both digesters were operated at 97°F.

Demonstration Project Results

The AGF pilot plant operation demonstrated that enhanced solids destruction can be attained at very short HRTs. Even at the lowest HRT of 6.4 days, the AGF digester attained higher volatile solids destruction (60%) than the conventional digester operating at a 19 day HRT (55%). Operating at a 19 day HRT, the AGF digester reduced 70% of the volatile solids (VS) compared with 55% for the conventional digester, a 27% increase in VS destruction. With the increased volatile solids reduction came a commensurate increase in methane gas production and a reduction in biosolids that ultimately would be dewatered, hauled and applied.

All digested biosolids from the AGF pilot digester were monitored for heavy metals and pathogens. Every sample met the requirements for a Class B "exceptional quality" biosolids.

Potential Benefits

The demonstration project showed that the AGF process can attain similar or greater solids destruction than conventional digestion systems with one-half to one-third of their digester volume. Certainly the greatest benefit to King County is the potential to increase the capacity of the existing digesters by two to three times. The additional benefits of more gas production and less biosolids to dewater, haul and apply make this an even more attractive technology. King County is currently evaluating the potential to demonstrate this technology at full-scale and continuous flow conditions.

Funding

Demonstration funding included the King County Applied Wastewater (AWT) Program for $130,000 and the US Dept. of Energy for $65,000.

Contacts

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The AGF Process