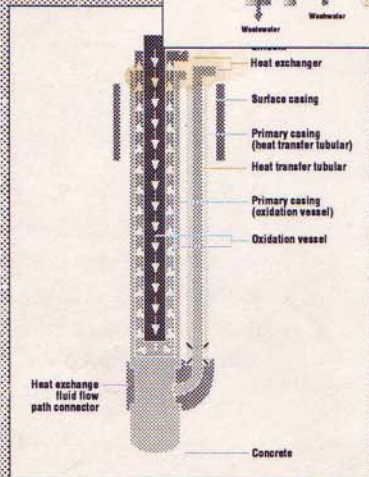
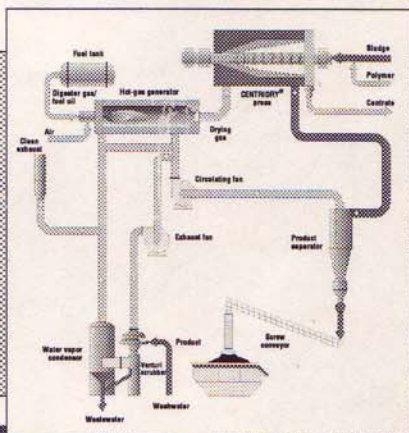
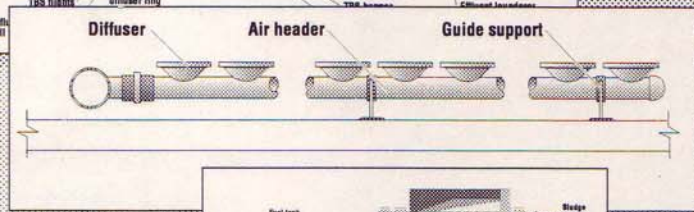
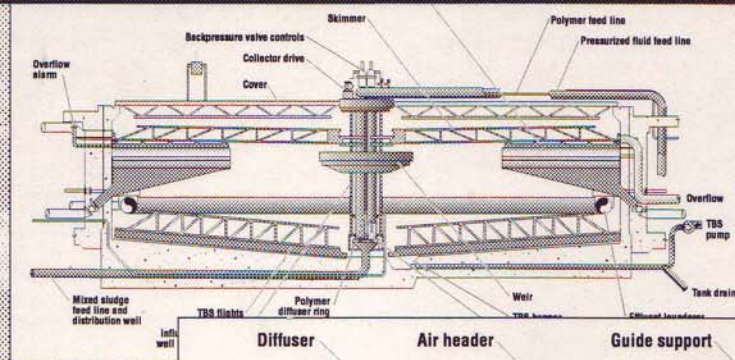


WASTEWATER PRACTICES

"Technology and Teamwork Bringing Results"



WASTEWATER PRACTICES: TECHNOLOGY AND TEAMWORK BRINGING RESULTS

Introduction

The regional wastewater treatment plants at West Point and Renton have protected the fresh waters of the Lake Washington Basin and salt waters of Puget Sound for over 30 years. The systems serve citizens and businesses of Seattle and suburban cities from Mill Creek to Auburn and from West Seattle to the Pine Lake Plateau. Managed by the King County Department of Natural Resources, we face the challenges of providing environmental and public health protection as the population increases, regulations change and technology improves, while our customers and stakeholders expect containment of sewer rates. The visions of the Wastewater Treatment Division (WTD) meet these changing pressures by applying innovative technology and working collaboratively with our partners. To these ends we share with you the following approaches to technology and teamwork:

- The WTD and the SEIU, Local 6, have in partnership developed collaborative labor-management relationships and practices which promote mutual trust, mutual respect, open communication and problem-solving, foster active participation in decision-making and encourage responsibility in running the business. We have joined with the Union to implement Job Progression and Gainsharing and to mutually resolve issues through a Joint Labor Management Committee. The output has been significant cost saving to the rate payer, more rapid assimilation of improvements, and higher skilled co-workers.
- We are building new relationships with our stakeholders, King County senior management and the Metropolitan King County Council to respond to neighborhood, community and regional needs ranging from water reuse opportunities to odor control.
- WTD operates and maintains facilities utilizing leading technology to improve reliability and to save operating dollars. Examples currently in place include an anaerobic selector and high purity oxygen secondary treatment, lower energy consumption aeration equipment, co-thickening of primary and secondary solids, utilization of heat pumps for process heating, and automation of processes and control systems.
- The plants produce limited quantities of tertiary treated Class A reuse water suitable for displacement of some potable water use, and provide secondary treated effluent for industrial process water.
- The plant solids streams produce biosolids for soil improvement to grow forest and field crops. Biogas production is being used directly in cogeneration facilities and being scrubbed for sale as pipeline quality natural gas. Development work is underway to improve conversion rates and assess alternative utilization through fuel cells and drying of biosolids.
- Significant resources are being applied to develop alternative biosolids processing technology to potentially reduce the plant footprints, contain capital investments, reduce operating costs and improve product quality. These technologies include: Pulse Power, Vertad, microGas, Centridry and Anoxic Gas Flotation.

Applying technology and teamwork brings improved quality, provides cost competitive treatment, contains future capital investment and provides for highly trained and retained employees. The new approaches open up flexibility by policy makers to meet regional and community needs in such areas as water supply, siting of facilities and prioritizing rate-payer dollars for competing needs. King County Department of Natural Resources Wastewater Treatment Division welcomes you to share our evaluation, development and implementation of team work and new technology.

APPLIED WASTEWATER TECHNOLOGIES PROGRAM (AWTP)

Spring 1997 Status Report

The Applied Wastewater Technologies Program (AWTP) was developed in 1991 as part of the West Point Treatment Plant Settlement Agreement. This agreement, which resolved litigation related to permits for the secondary treatment upgrade, established this \$5 million research program to identify and evaluate technologies which offer the potential to further reduce environmental impacts at the wastewater treatment plant. Several specific environmental impact areas identified in the agreement include:

- Minimization of space requirements (the "footprint") for treatment facilities at the West Point site. The agreement encourages King County (formerly Metro) to implement alternative solids handling processes which will allow removal of existing digestion facilities by the year 2005.
- Further reduction of environmental impacts, including truck traffic, odors and air emissions.

While much of the focus of the AWTP has been on new technologies that address solids handling and treatment, other key impact areas are not being ignored. In addition, although the program is primarily designed to address impact issues at the West Point site, the AWTP is demonstrating new technologies and refinements in wastewater treatment operation that have positive implications for the other major King County treatment plant at Renton as well.

Current AWTP Program Activities

The AWTP commissioned an extensive technology review of solids handling and treatment technologies which was completed by Montgomery Engineers. Following completion of the review, a series of workshops with the AWTP Citizens' Advisory committee, Citizens' Water Quality Advisory Committee and others were conducted to present the technical information. The workshops were successful in narrowing the list of solids processing technologies for potential application at West Point and prioritizing environmental impact areas for further consideration. The AWTP has since completed separate research projects addressing solids handling, odor and air emissions control using biofilters, dewatering technologies, the impacts of food waste on the wastewater system, and the control of truck noise and emissions. Specific improvements to King County's biosolids haul trucks have been made based on the results of AWTP research.

The AWTP is funding a series of demonstration tests of innovative treatment processes in 1996 and 1997. These focus on the following areas:

- **Anoxic Gas Flotation (AGF)** is an innovative anaerobic digestion enhancement involving the recycle of biomass to the digester to increase process efficiency. The AGF process shows potential to reduce the number of digesters, increase gas production/revenues, decrease the volume of biosolids produced, and thus, decrease truck traffic. An 11 month pilot demonstration project was conducted in 1995-1996 at the King County East Section Reclamation Plant. A final report is due out in June 1997. The AWTP is evaluating the potential of funding a full-scale prototype. AWTP Budget: \$130,000. Co-funding: \$65,000 grant from U.S. Dept. of Energy. Patent: Dennis Burke, Cyclus Envirosystems, Olympia, WA. For more information, contact Stan Hummel, King County Project Manager, (206) 684-1844.
- **Vertad—Deep Shaft Digestion** is a novel aerobic (biological) sludge digestion process in a 400 foot deep underground shaft. If successful, the process would reduce the above ground space requirements associated with digestion facilities. The high temperatures created in the process may produce Class A biosolids. A four month demonstration project will be conducted at the East Section

AGF—ANOXIC GAS FLOTATION

Anaerobic Digestion Enhancement

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.

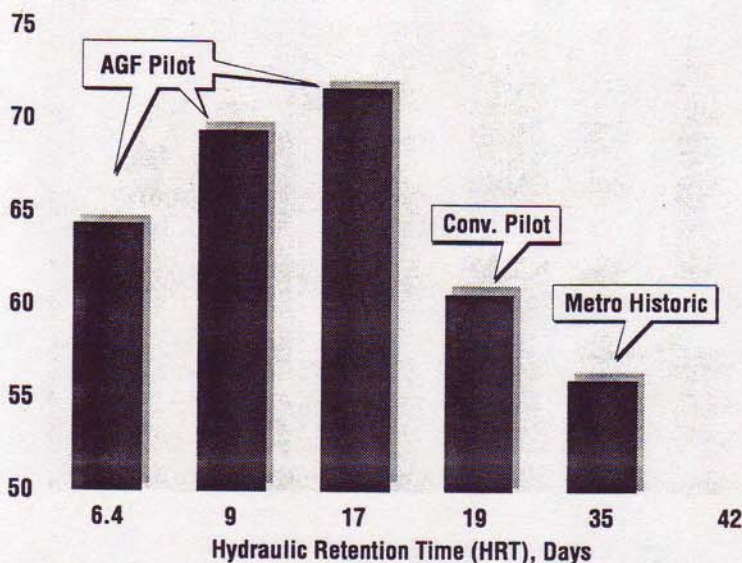
Demonstration Project

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.

VS Degradation as a Function of HRT

% Volatile Solids (VS) Degradation



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

For more information about the AGF or "Activat8" process and AWT project, contact Stan Hummel, Project Manager, King County AWT Program, (206) 684-1844, or Dennis Burke, President, Cyclus Envirosystems, Inc. (formerly Western Environmental Engineers), 6007 Hill Road NE, Olympia, WA 98516, (360) 923-3000.

The AGF Process

