The Sustainable and Resilient Wastewater Utility

By Chad Newton, P.E., Gray & Osborne, Inc.

Wind turbine installation at the Atlantic County Utilities Authority (NJ) Wastewater Treatment Facility
PHOTO CREDIT: MORTENSON CONSTRUCTION/LEE VERNON STUDIOS

Sustainability is simply the ability to continue anything indefinitely. Sustainability can be evaluated in three dimensions: environmental, social and financial, also known as the "triple bottom line." Resiliency, a related concept, refers to the ability to absorb adverse shocks without crisis. The Brundtland Commission of the United Nations in 1987 defined sustainable development as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs." Which are the most significant unsustainable practices in our society, and what can utilities do to increase their sustainability and resiliency? We face drastic changes in the next few decades, which will place new stresses on utilities. Successful utilities will incorporate a sustainability ethic into all decisions.

GLOBAL CLIMATE CHANGE

The earth's atmosphere had a carbon dioxide (CO2) concentration of around 280 parts per million throughout the pre-industrial era. Currently the concentration is 385 ppm and rising due to widespread fossil fuel burning (coal, oil and natural gas, also known as methane). In the 1980s scientific consensus developed that the greenhouse effect of CO2 would result in a warmer global average temperature. Observed trends over the past three decades have only confirmed the initial hypothesis. James Hansen of NASA wrote: "If humanity wishes to preserve a planet similar to that on which civilization developed and to which life on Earth is adapted, paleoclimate evidence and ongoing climate change suggest that CO2 will need to be reduced from its current 385 ppm to at most 350 ppm." To do otherwise is environmentally unsustainable for the complex webs of the biosphere. Reducing and reversing global climate change will require transformation of our systems. The Water Environment Federation (WEF) has issued a resolution urging wastewater utilities to become community leaders for mitigating climate change.

OIL DEPLETION

Fossil fuels have powered the industrial revolution in an accelerating fashion since World War II. Global oil consumption increased from 7 million barrels per year in 1945 to 85 million barrels in 2005, due to ever expanding fleets of cars, trucks and ships. The International Energy Agency has announced that peak production of conventional crude oil occurred in 2006. With conventional oil fields (the "cheap oil") being depleted throughout the world, exploration has shifted to expensive supplies such as deepwater off-shore and tar sands. Since 2006 the effect has been high oil prices marked by extreme volatility. Gasoline at $4.00/gallon, as we have seen recently, is financially unsustainable for many households and businesses. Cheap energy has allowed many unsustainable practices to flourish, but what is unsustainable will, by definition, come to an end eventually.

HABITAT AND BIODIVERSITY LOSS

Expanding and intensifying human activities have shrunk and degraded natural habitat, resulting in biodiversity loss and extinctions of entire species. The International Union for Conservation of Nature (IUCN) estimates that 900 species have gone extinct in the modern era and extinctions continue at more than 100 times the natural rate. Just as significant, pollution degrades the natural habitat for the remaining species, reducing ecosystem services and biodiversity as only the hardiest species thrive. In our region, wild salmon populations have dropped precipitously for reasons

Solar Array at the Hill Canyon Wastewater Treatment Plant, Camarillo, California. The Array provides about 15% of the facility's energy needs.
PHOTO CREDIT: PETER BENNETT/GREEN STOCK PHOTOS

including stream pollution and stream temperature increases. Continued habitat degradation and species extinction are simply environmentally unsustainable.

SOCIAL SUSTAINABILITY

Can our social structures be continued indefinitely? The "baby boom" generation is edging towards retirement, and lifelong skills and institutional knowledge could travel with them. Social sustainability requires a proactive process to transfer that knowledge to the next generation. Cost of living is a social and financial sustainability issue. It is mathematically unsustainable for the cost of any essential service, such as medical care or utilities, to grow at a faster rate than wages. Eventually the poor are shut out and forced to go "off-grid."

HOW CAN WASTEWATER UTILITIES IMPROVE THEIR OWN SUSTAINABILITY AND RESILIENCY?

In the face of these broad threats from unsustainable systems, how can utilities respond?

Water and wastewater utilities may be affected by climate change in a few different ways:

- If unchecked, climate change will have a significant effect on water resources. In the Pacific Northwest, climate models have predicted warmer and wetter winters leading to reduced mountain snowpack. To maintain resiliency, communities that rely on snowpack for water supply can identify other resources or reduce consumption.
- Climate change will lead to rising sea levels. Resilient utilities with coastal facilities can prepare by developing flooding defenses and protecting drinking water aquifers from saltwater intrusion.
- Climate change mitigation requires reduction of fossil fuel combustion. Utilities that rely on electricity produced by fossil fuels may face increased costs as carbon taxes or credits are imposed.

The primary component of the carbon footprint for wastewater systems is electricity consumption. Utilities consume a lot of electricity, 30 to 60 percent of a typical municipal government's total. Even facilities supplied with renewable electricity sources, such as hydropower, will face pressure for conservation as renewable supplies are stretched thinner. Many electric utilities offer financial incentives for energy conservation projects. WEF MOP 32, Energy Conservation in Water and Wastewater Facilities is a great resource. Beyond conservation, utilities can look to their facilities for electrical production with a goal of net-zero energy:

- Anaerobic digestion produces methane, which can be burnt for facility heat or electricity, or refined into natural gas. Gas microturbine technology is becoming available in smaller sizes for cost-efficient electricity production from methane.

Continued on page 20

Opportunities for energy recovery abound throughout water distribution and wastewater collection and treatment systems, particularly in areas with significant topography.

Continued from previous page

- Energy can be recovered from water flowing downhill via micro-hydropower turbines. Opportunities for energy recovery abound throughout water distribution and wastewater collection and treatment systems, particularly in areas with significant topography. If you pay to pump water up a hill, why not make money when it flows back down the hill?
- Thermal energy can also be recovered from wastewater, as a heat source for heat pumps and district energy systems, such as at the Olympic Village in Vancouver.
- Facility sites can be evaluated for renewable energy potential. Utilities may be able to offset their electric bills through on-site solar, such as several sites in California including Camarillo, or wind power installations, such as at the Atlantic County Utilities Authority (New Jersey).

In the face of oil depletion, resilient utilities will reduce their reliance on gasoline-powered maintenance equipment and diesel-powered standby generators, and provide employees with transportation choices. How would $10/gallon diesel affect your sewer inspection program? What if diesel deliveries became unreliable? Utilities can increase their resiliency by increasing on-site fuel storage, but better yet by switching to electric-powered equipment and vehicles.

Despite valiant efforts, wastewater effluent discharge s can degrade the natural environment and reduce biodiversity. Endocrine disrupting chemicals and pharmaceuticals ("micropollutants") may pass through conventional treatment facilities at concentrations that cause harm to aquatic organisms. Accumulation of persistent toxic chemicals throughout the natural environment is unsustainable. Research is ongoing into the fate of micropollutants through treatment processes and their effect in the aquatic environment. If it is determined that concentrations must be reduced to protect the environment, the benefit of additional treatment processes should be weighed against (significantly) increased electricity consumption and the social effects of increased utility rates. Source control and commercial phase-out may be more sustainable approaches to biodiversity protection.

Utilities can increase their social sustainability through pro-active mentorship programs, which transfer skills and institutional knowledge from retiring workers to younger staff. Resiliency can be improved through cross-training, so that multiple people are trained to do any task.

Sustainable utilities need to balance capital and operations costs against the social and financial sustainability of their ratepayers. In the face of oil depletion, utilities may have increasing pressure to minimize rate increases simultaneous with increased expenses and pressure to improve environmental performance. To respond to these pressures, sustainable utilities must strive to minimize required inputs (of energy and money) while maximizing internal resources (electric generation potential, microorganisms and knowledgeable staff) to provide the best available service to customers and protection to the natural environment. Sustainability can be most simply defined as the ability to continue doing what you're doing forever.

You may contact Chad Newton at cnewton@g-o.com

Adaptive Implementation Puts the Yakima Basin on a Sustainable Track

By Ryan Anderson, City of Yakima Wastewater Division and Thomas E. Coleman, P.E., consulting engineer for the City of Yakima

Aerial view of the Yakima floodplain COURTESY OF TOM ELLIOT OF THE YAKAMA NATION WILDLIFE PROGRAM

Most wastewater treatment facilities face a similar challenge of balancing competing demands between replacing aging infrastructure, maintaining plant capacity and meeting increasingly stringent effluent limits. Facility managers and engineers at the City of Yakima's Regional Wastewater Treatment Facility (YRWWTF) realize that a proactive approach to this challenge is the only practical path forward for an organization whose goal is to protect the environment and protect its ratepayers from excessively high rate increases.

The Yakima River is impaired for pH, dissolved oxygen (DO) and temperature. These impairments are not caused by any one source of pollution or pollutants in the basin, but by the collective influence of nutrient loading, habitat degradation and stream flow impairments. The Washington Department of Ecology's (Ecology) approach to such impairments has typically involved setting very low nutrient and temperature limits for NPDES permit holders through the process of determining Total Maximum Daily Loads (TMDL). Loading limits are then assigned to the individual dischargers in what has been called a "standard implementation" of the TMDL. Standard implementation (SI) can work well if there is a high degree of certainty that if loads are reduced by X% that water quality standards will be met.

However, in a basin such as the Yakima where water quality impairments are the result of multiple stressors, are dominated by non-point source contributions, and result from broad source categories with diverse stakeholder interests there is a very high level of uncertainty that a standard implementation will result in the necessary water quality improvements.

Requiring NPDES permit holders to achieve very low phosphorus or nitrogen limits could cost tens of millions of dollars with little certainty that these limits would improve pH, DO and temperatures in the river. At the same time, SI TMDLs do not consider the global impacts of increasing reliance on energy, steel, concrete and chemical resources used to comply with locally applied permit limits. Recognizing this unique water quality challenge, Yakima Basin stakeholders are working with Ecology's Central Regional Office to develop an adaptive implementation (AI) approach. As Ecology learns more about the Yakima River's needs, they are supporting the conclusion that an SI TMDL may not be the most effective course of action to restore the local or global environment.

The guiding principle of adaptive implementation is that high levels of uncertainty can be most effectively addressed through a "learning while doing" approach. Under this AI approach, a water quality implementation plan would be prepared and initial control actions taken. Then there would be an ongoing assessment of the efficacy and

Continued on page 22

The guiding principle of adaptive implementation is that high levels of uncertainty can be most effectively addressed through a "learning while doing" approach.

costs of the actions, and revisions then made to the implementation plan, based on new analyses.

An AI approach can help direct investments into projects that cost effectively lower nutrient loading at point sources and nonpoint sources. At the same time, the process would identify floodplain, riparian zone and other ecosystem improvements necessary to improve water quality. The success of the AI process in achieving water quality improvement goals depends on the formation of a strong collaborative partnership of the stakeholders. The partnership must be committed to long-term monitoring and evaluation of water quality improvement measures to ensure that effective steps towards

Continued from previous page

meeting multiple environmental objectives associated with cleaner water are being implemented.

Recently, the South Central Washington Resource Conservation and Development Council (RC & D) formed a new committee called the Yakima Basin Clean Water Partnership (YBCWP). RC&D broadly represents stakeholders in the Basin. Its member sponsors include cities, conservation districts and the Yakama Nation. The YBCWP was formed to address 303(d) listings sustainably and will serve as the forum for identifying the important first steps in this process.

The City of Yakima is one of the RC&D sponsors and a strongly committed supporter of the water quality partnership. Proactive steps which the City plans to implement at the YRWWTF over the next two years consistent with the AI approach include biological phosphorus removal and struvite recovery, anaerobic pretreatment of industrial wastewater, and floodplain restoration of city-owned property next to the river.

The floodplain restoration project will restore several ecological functions important to salmon recovery and water quality in the Gap to Gap reach of the Yakima River. The first phase of the project will restore functioning spring-brook habitat connected to the Yakima River. Spring-brooks return hyphorheic and other groundwater flow to the river and create year-round thermal refuge for juvenile salmon. The second phase of the project will involve continued establishment of native vegetation and creation of side channels. Some side channels may be in connectivity with surface flow and some will only be watered at their downstream points. Side channels, and their biological and chemical complexity, provide more habitat for juvenile Chinook and coho salmon as well as steelhead trout. They also serve as flow paths for surface and hyporheic flow, at various scales, that cause nitrogen and phosphorus attenuation. Side channels are important thermal buffers in river systems.

The third phase of the floodplain restoration project may occur if levies in the Gap to Gap reach are set back. This will allow for a better balance of material transport and storage, continued development of side channel and spring-brook features beneficial to salmon and water quality, and will also cause the river to migrate away from the YRWWTF through channel avulsion. The city would then discharge treated wastewater to its restored floodplain channels in order to ensure that the ecological features of its restoration project are maintained. As the efficacy of floodplain restoration is demonstrated, an ecosystem marketplace may be used to encourage even more restoration of ecological infrastructure.

You may contact Ryan Anderson at rcanders@ci.yakima.wa.us

Aerial photo of Corvallis wastewater reclamation plant

Corvallis Nutrient Recovery from Wastewater

By Dan Hanthorn, Operations Manager, City of Corvallis

Since 1997, the City of Corvallis wastewater reclamation plant has accepted a total of 200 million gallons of leachate from the nearby Coffin Butte regional landfill site. The current leachate contribution to the plant averages 75,000 gallons per day. The original Corvallis 4.6 mgd dry-weather-flow treatment plant was constructed in 1955. It was upgraded in 1964 to 6.4 mgd with trickling filters, and upgraded again in 1978 to 9.7 mgd with the addition of the activated sludge process. In 2000, a separate 85 mgd combined sewer overflow treatment facility and new digester complex were built. The plant discharges to the Willamette River.

Leachate from Coffin Butte is very high strength, having an ammonia concentration greater than 1,200 mg/L ammonia. The leachate also contains a host of additional contaminants and is comparable to the highest strength examples of the material from landfills around the world, i.e. Tehran, Iran and Hong Kong, China.

The volume of leachate is restricted to 0.5 – 1.0% of daily plant flow due to high levels of 1) ammonia; 2) true color (6,300 platinum-cobalt units – very, very black!); 3) magnesium (enhanced struvite formation potential); 4) zinc (allowable local-limit head works loading); and 5) process control issues (low temperature ammonia toxicity and warm weather nitrification D.O. requirements).

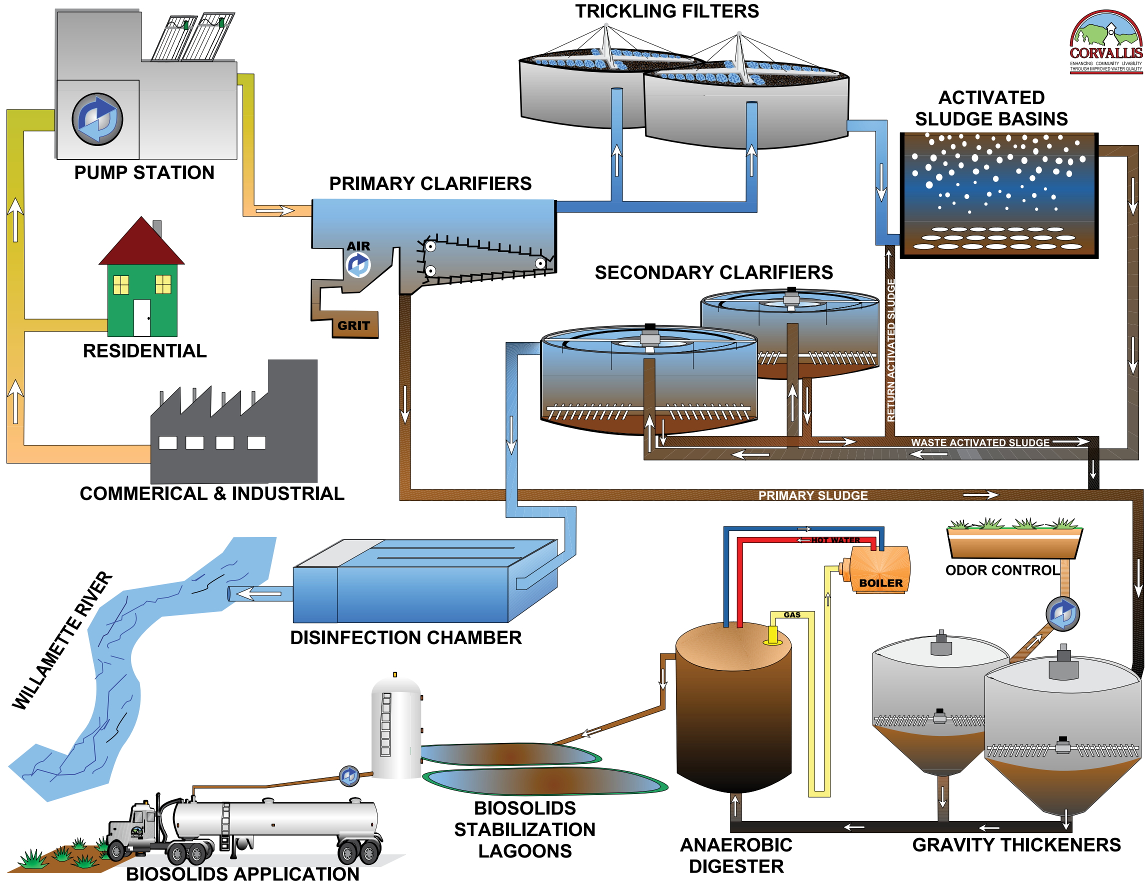
Leachate tipped at Corvallis represents 65% of the leachate generated at the landfill. The balance is transported by tanker truck up to 450 miles to alternate treatment locations. The landfill has been looking for a solution to reduce logistics and stabilize expenses.

Recognizing that the City was competent in treating liquid waste in the way the landfill's core competency is managing solid waste, Coffin Butte was receptive to the City's proposal to provide leachate pretreatment services. Pretreatment of leachate enables the intake of greater volumes of the waste.

Beginning in April 2010, various pretreatment options were explored. Candidate pretreatment processes included: Ozone, Ostara, Liqui-Cell, air stripping, Sharon, AT3, Anammox, BNR, constructed wetlands and others. A Triple Bottom Line (TBL) analysis evaluated capitalization cost, O&M expense, energy and chemical requirements, process footprint, carbon footprint and operational considerations. The shakeout resulted in the selection of a two-step process that combined the Multiform Harvest struvite crystallizer process and Thermoenergy ARP (Ammonia Recovery Process). Both processes yield marketable fertilizer products (struvite pellets and 40% liquid ammonium sulfate) important to local agriculture.

Initial bench top testing concluded the combined process strategy had the potential to: 1) reduce ammonia concentration by up to 90%; 2) significantly reduce color; 3) precipitate greater than 99% of dissolved zinc and copper; and 4) sequester magnesium, mitigating the potential to

Continued on page 24



Corvallis WWRP schematic (does not show nutrient recovery)

CORVALLIS NUTRIENT RECOVERY FROM WASTEWATER

Continued from previous page

form struvite deposits in treatment plant pipes and process structures.

The Multiform Harvest process crystallizes magnesium, ammonia and phosphorus to produce struvite pellets. Magnesium and ammonia occur in abundance in the leachate. The phosphorus necessary to produce struvite as well as additional ammonia is introduced by blending leachate with lagoonate (overflow from the biosolids gravity dewatering lagoon). After blending the lagoonate and leachate, pH is optimized to enhance struvite production and introduced into the Multiform Harvest crystallizer with a 20-minute average detention time. Struvite pellets are harvested regularly and the crystallizer overflow is processed to remove zinc and copper precipitates.

Following struvite crystallization and metal separation the process stream receives further treatment for ammonia recovery and color reduction in the Thermoenergy ARP process. Effectiveness of the ARP process relies on converting ionized ammonium into ammonia. The ammonium/ammonia equilibrium of the waste stream is shifted to favor ammonia by further adjusting pH and increasing the temperature. The ammonia rich stream is then sprayed into a vacuum chamber where the ammonia is flashed out of solution. After a short residence time of 6-15 minutes at a 15-30x recirculation rate the vaporized ammonia is condensed, concentrated and introduced to sulfuric acid to achieve the final fertilizer product, 40% liquid ammonium sulfate.

Through the two-step pretreatment process, very long chain organic molecules that impart a strong color signature to the leachate are broken down. Large molecules in the leachate are also resistant to biological degradation through the wastewater treatment plant's trickling filter/activated sludge secondary treatment process. The smaller, pretreated organic molecules are more accessible to biological treatment organisms and a significantly larger portion of leachate COD is expressed as treatable BOD5.

The pretreated flow is then released to the sanitary sewer for final treatment in the wastewater treatment plant. With removal of most magnesium, in-plant treatment systems are less prone to struvite fouling. The removal of 1,000 pounds/day of ammonia loading (35% reduction) to the wastewater treatment plant improves treatment process performance and reduces costs. Marketing of the two fertilizer products is expected to recover most of the leachate pretreatment system O&M expense.

You may contact Dan Hanthorn at Dan.Hanthorn@ci.corvallis.or.us

Installation of purple pipe

Meridian reclaimed water booster station

The City of Meridian Steps Up to Sustainability

By Mollie Mangerich, Environmental Division Manager, City of Meridian Public Works Department

The City of Meridian, Idaho has assertively stepped up to the challenges and dynamics of incorporating sustainability concepts into a variety of projects. From the construction of an LEED Silver certified City Hall and establishing a state-of-the-art wastewater treatment and reclamation facility, to establishing and staffing an Environmental Division within the Public Works Department —"Sustainability and Environmental Awareness" is a stated priority of city leadership. The Public Works Department has positioned itself strategically to emphasize financial and environmental sustainability in our program and project areas while including our customers in a wide variety of work groups and steering committees to help guide and support the way we manage our community's resources and waste products, and the services we provide.

Environmental sustainability and stewardship are within the City's current Comprehensive Plan, documenting a holistic approach to the protection, sustainable use and innovative approach to managing our natural resources. The Public Works Department has set forth the goal to create a WWTF that is self-sustaining, utilizing closed-looped systems to recycle and/or reuse 80 percent of the waste stream incorporating water reclamation, co-generation and nutrient recycling by 2030. With the City's award of an Energy Efficiency Block Grant, the Public Works Department has begun to:

1. Replace existing blowers at the WWTF with newer more efficient turbo blowers with an estimated energy savings of 250,000 kWh to 300,000 kWh annually (5% of WWTF energy use) with a potential annual costs savings of $48,000.
2. Replace street lights with more efficient LED lighting on main corridors resulting in a reduction of 75,000 kWh and an annual estimated cost reduction of $6,000 with an expected reduction of 31 metric tons in GHG emissions.
3. Install new lighting at the WWTF resulting in a potential yearly electricity savings of 70,000 kWh to 80,000 kWh and an annual cost reduction of approximately $5,000 to $6,000. This project is expected to result in a 29 to 33 metric ton reduction in GHG emissions.

The anticipated low phosphorus limit based on the Boise River TMDL has challenged Wastewater and Engineering staff to find a successful and sustainable strategy to meet pending new requirements while remaining within WWTF capacity and NPDES flow limits. A significant part of this strategy is the development and implementation of a city-wide reclaimed water program. Full implementation of this program will allow the beneficial reuse of 2.3 billion gallons of water by 2020. The city has successfully produced Class A reclaimed water after earning a city-wide permit for the following allowable uses:

- Irrigation
- Car Wash
- Toilet Flushing
- Dust Suppression
- Sewer Flushing
- Fire Suppression

We have prepared for the first commercial use of recycled water in Idaho at a car wash near a new I-84 interchange. Our reclaimed water program relies on partnerships, and the next partnership will be between the Idaho Transportation Department and the City to provide a reclaimed water system to be used for irrigation for the interchange and street landscaping as well as for private development beginning in May 2011.

We face myriad challenges in the production, distribution, treatment and reclamation of our water and reuse of its byproducts. Fortunately, our leadership supports us and has dedicated resources to planning and strategic development of modern and reliable facilities that emphasize financial stewardship and environmental sustainability for our customers.

You may contact Mollie Mangerich at mmangerich@meridiancity.org

Not Just for Milk Anymore: Pasteurization of Reclaimed Water in Ventura, CA

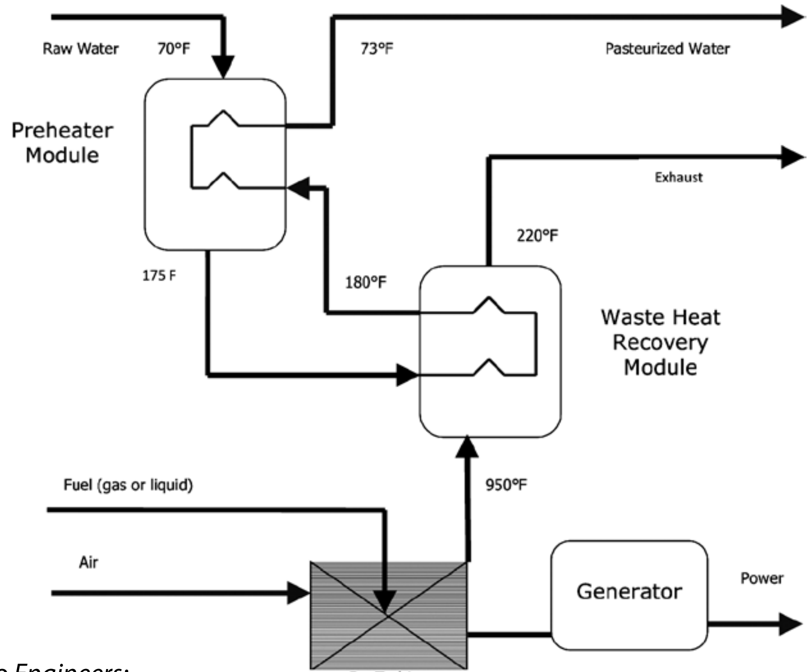


Figure 1. Pasteurization System

By Andrew Salveson, Carollo Engineers; Nitin Goel, Carollo Engineers; and Greg Ryan, Pasteurization Technology Group

Pasteurization has been widely used since the 1860s. Traditionally, this treatment process has been used to disinfect beer, wine and milk, but not water. This simple, cost-effective process has now been independently validated for the water reuse market by Carollo and approved by the California Department of Public Health. The economy of pasteurization is based upon the capture of a waste heat source (e.g., turbine exhaust, solar heat or cooling towers) and the transfer of that heat to the water for disinfection. Depending upon the production of digester gas, a wastewater utility can disinfect greater than 25 percent of their flow without any energy cost.

A nation-wide economic analysis has shown pasteurization to be the lowest-cost disinfection alternative both in terms of energy use and total cost in all but a few locations. In Ventura, California, the pasteurization system has the potential to profit the City (an income of $162,000 per year from operating pasteurization, as opposed to an expense of >$200,000 per year for operating UV disinfection). Because of these potential savings, Ventura is now constructing a pasteurization demonstration reactor (0.5 mgd) for long-term performance demonstration.

PASTEURIZATION OVERVIEW

Pasteurization is the process of heating a liquid to a high temperature under pressure and then cooling it immediately. Carollo Engineers performed the demonstration testing on behalf of the Pasteurization Technology Group (PTG) at the Laguna Subregional Water Reclamation Facility in Santa Rosa, CA.

This validation report was subsequently approved by the California Department of Public Health (CDPH) for reclaimed-water disinfection. The detailed performance testing required for CDPH approval is an exhaustive process that thoroughly documents the pathogen disinfection performance of a disinfection system over a wide range of operating conditions and water quality combinations. To date, only UV, ozone and now pasteurization have been approved based upon such detailed testing. Surprisingly, chlorination has been approved by CDPH but not using the same rigorous testing method as the other technologies.

ENGINEERING OVERVIEW

The patented PTG pasteurization system (Figure 1) uses plate-type (water-to-water) and stack-type (air-to-water) heat exchangers to recover and use waste-heat from other processes. The plate-type heat exchanger, or preheater module, transfers heat from the already disinfected (effluent) wastewater to the influent (feed) wastewater. The stack-type heat exchanger, or waste-heat recovery module, transfers the waste heat from the external heat source to the feed water. The external heat source can be turbine-exhaust heat, burner- (flare-) exhaust heat, hot water, or other forms of heat. Following the waste-heat recovery module, in-line pumps are included to maintain a higher pressure (than the influent) on the effluent side of the system.

It is often intuitively assumed that pasteurization would not be cost-effective to heat wastewater to greater than 160°F, but this is demonstrably wrong. Leveraging the heat-capture capability of its various heat exchangers allows the PTG system to retain more than 96% of the reactor heat within the reactor. This means only a low 3°F to 5°F of energy input is required on a continual basis. The secondary benefit of the capture and maintenance of the heat within the reactor is that effluent temperatures are typically within 3°F of influent temperatures, so external downstream cooling is not needed.

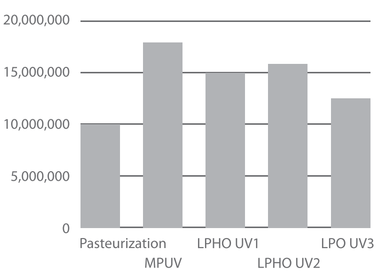


Figure 2. Net present worth for pasteurization and UV systems
UV = ultraviolet
MP = medium-pressure
LPHO = low-pressure, high-output

DESIGN CRITERIA

Pasteurization disinfection performance, as reported in the literature, is dependent on contact time and temperature. Low contact time coupled with high temperature is known as "flash pasteurization" and has proven to be very effective in the food industry.

CDPH specified the required performance criteria using the critical design parameters of temperature and contact time. The data indicated that the critical temperature to achieve 4-log MS2 disinfection was 176.4 F. CDPH rounded up the required temperature value to 180°F. The lowest contact time associated with 4-log MS2 removal was 7.7 seconds. Again, CDPH rounded up the required contact time to 10 seconds.

At Ventura Water Reclamation Facility (VWRF), waste heat could be recovered either from the combustion of digester gas or from the combustion of an imported energy source (natural gas). In terms of design parameters, the contact time and temperature requirements set by CDPH (10 seconds contact time, 180°F minimum temperature) were used for both scenarios. The analysis showed that the cost of importing natural gas and burning it in turbines to generate electrical energy and waste heat was significantly less than the cost of UV disinfection. Substituting digester gas for natural gas further reduced the cost. The natural gas would fuel a single turbine, providing 1.06 MW of power and enough heat to disinfect 14 mgd of water. Less-expensive gas burners would then be used to generate the additional heat needed to treat the remaining portion of the flow 7 mgd for a total capacity of 21 mgd.

ECONOMICS

The VWRF analysis showed a marked cost difference between pasteurization and UV disinfection (to replace the existing chlorination/dechlorination system). The VWRF analysis was based upon an average flow of 12 mgd and a peak flow of 21 mgd. California's tertiary recycled-water standard was used to set the disinfection goals. One full train of redundancy was provided for each process. The net present worth (NPW) is shown below (Figure 2), with pasteurization shown as significantly less expensive. The cost estimated was based, in part, on the following assumptions: an energy cost of \$0.11/kW-hr, a conservative natural gas cost of \$4.50 per million Btu, a labor rate of \$50/hour, a life-cycle of 20 years, and an inflation rate of 4.5%.

You may contact Andrew Salveson at asalveson@carollo.com, Nitin Goel at ngoel@carollo.com and Greg Ryan at gryan@pastechgroup.com

Wastewater Treatment Plants—Big Green Machines

By Janet Gillaspie, Executive Director, Oregon Association of Clean Water Agencies (ACWA)

Wastewater treatment plants are big green machines—using physical and biological processes to turn polluted water into clean, recycled water. The local wastewater treatment plant should be at the core of any community's sustainability program. But more can be done to improve the sustainability aspects of the wastewater treatment plants in the Pacific Northwest. Opportunities to become more sustainable include:

- Renewable power production
- Energy efficiency
- Purchasing and using green cleaners
- Buying electronic devices designed to reduce toxics
- Collecting rechargeable batteries, electronic equipment, cell phones and paints for recycling
- Reducing pesticide use by changing landscaping practices
- Meeting "green" standards for vehicle fleet maintenance
- Substituting treated wastewater for potable water use, where possible

Renewable Power Production: The huge amount of energy it takes to treat sewage should be the first focus for improving sustainability of a wastewater treatment plant. A study completed for the Oregon Association of Clean Water Agencies, the *ACWA Energy Independence Project* (June 2008), concluded that wastewater treatment plants can be energy independent by applying best-in-class energy efficiency techniques, along with deploying available renewable energy sources. Some renewable energy sources like biogas generators or solar P/V installations are cost effective now for Oregon wastewater utilities served by investor-owned utilities. Accepting Fats, Oil & Grease (FOG) or segregated, clean green waste with tipping fees and increasing biogas production can actually generate dollars for wastewater utilities. Technologies such as some solar installations, wind or microturbines will be cost-effective as electricity prices continue to increase. The report includes detailed information on energy efficiency and evaluates seven of the most prominent renewable energy technologies for wastewater plants. The report is posted on the ACWA web site at *www.oracwa.org.* The report was completed for ACWA by Kennedy/Jenks Consultants, and funding was provided, in part, by the Energy Trust of Oregon.

Energy Efficiency: Stay tuned for the Winter issue of the PNCWA newsletter for more details and tips on energy efficiency. The first place to start is an up-to-date energy audit. In Oregon, contact your public power electric utility (PUD, co-operative or municipal owned utility) or check online at *http://www.bpa.gov/energy/n/industrial/facilties.cfm*; for wastewater utilities served by Pacific Power or PGE, find your local service provided at *http://energytrust.org/public-sector/incentives/water-wastewater-treatment-facilities/equipment-upgrades/.* Energy audits for wastewater utilities are provided free and additional incentives are available.

Purchase and use green cleaners: How to sort out the various "green" claims by product manufacturers, especially for cleaning products? Easy—specify the eco-certification programs that have committed to incorporating Oregon''s Priority Persistent Pollutant inventory into their chemical screening and ranking programs. Wastewater utilities should specify that all soaps and cleaners meet one of these standards:

- EPA—*Design for Environment*
- Eco-Logo
- Good Guide with a product score for the environment over 8.5
- Coastwide Laboratories—*Sustainable Earth series*

If outside cleaning services are used, work with the contractor to ensure they are selecting cleaners and soaps that meet these standards. Hand sanitizers are common around treatment plants. Select alcohol based cleaners, NO Triclosan.

Buy electronic devices designed to reduce toxics: A green ranking system has been created by the US Green Electronics Council. The Electronic Product Environmental Assessment Tool (check) ranks electronic devices including computers, laptops and monitors for specific environmental standards. Many electronic devices participate in this program. To reduce toxics in electronic devices, specify "gold" or "silver" for any new electronic purchases. An inventory of registered devices is available at *http://www.epeat.net/Companies.aspx*

Collect rechargeable batteries, electronic equipment, old cell phones and paints for recycling: Rechargeable batteries, old electronic equipment, out-of-date cell phones and unused paint can all be collected and properly recycled for free in Oregon. For many communities where proper recycling procedures are not in place, the toxic metals, flame retardants and other toxics in these waste streams ends up back at the wastewater treatment plant years later as landfill leachate. Here are some good resources:

- Free rechargeable battery recycling at *www.call2recycle.org*
- Electronic recycling programs in Oregon at *www.deq.state.or.us/lq/ecycle*
- Paint recycling in Oregon at *www.paintcare.org*

Reduce pesticide use by changing landscaping practices: Pesticides cause water quality problems throughout the Pacific Northwest. Wastewater utilities can be leaders in their communities by promoting the use of Integrated Pest Management for landscaping around the treatment plant and pump stations, and ensuring that contracted landscaping services meet the Eco-Biz standards (Portland, Oregon only). Round up unwanted and unused pesticides for proper disposal to ensure that worker safety and water quality are not impacted by spills or unintentional improper disposal. See *www.ecobiz.org*

Meet "green" standards for vehicle fleet maintenance: The Eco-Biz program for automotive repair services ensures contracted vehicle fleet services meet specific environmental performance standards (Oregon only). Outside of Oregon, the practice checklist is a useful tool to ensure fleet maintenance practices are top notch. See *www.ecobiz.org*

Substitute treated effluent for potable water, where possible: Reducing potable water use at the treatment plant saves money and improves sustainability. Where possible, substitute recycled treated effluent for outdoor cleaning and other washing where potable water quality standards are not needed.

Summary: Wastewater treatment plants are big, green machines and through thoughtful facility planning and easy-to-achieve revisions to everyday practices, even higher sustainable goals can be met.

The Oregon Association of Clean Water Agencies (ACWA) is a private, not-for-profit professional association of Oregon's wastewater treatment and stormwater management utilities, along with associated professionals. Its 125 members are dedicated to protecting and enhancing Oregon's water quality. You may contact Janet Gillaspie at gillaspie@oracwa.org

Sustainability at Work and at Home

By Larry Littrell, Lake Stevens Sewer District

Larry's organic garden

Larry at work

There is a lot of talk in the industry about sustainability. It seems to be a very popular buzzword. While we have been focused as an industry on being more sustainable the very essence of what we do has always been to care for the earth and preserve what many would call our most precious resource, water. If you ask several people what sustainability is you will get several different answers, but I think everyone agrees it is the ability to continue our efforts to keep our water safe while at the same time limiting our negative effects and resource consumption.

The more we realize the importance of our role as protector of the waterways we can't help but be influenced in our private lives. When we spend so much time at work trying to figure out how to deal with endocrine disruptors and lower our phosphorus levels, how can we continue to contribute to the problems in our personal lives? Sustainability has slowly worked its way into my home and life. I began growing an organic garden two years ago and purchase most of what I can't grow at local farmers markets instead of buying produce that has been trucked hundreds of miles and adds to the carbon footprint. Recycling and composting are also great ways to decrease your "footprint."

As you search for ways to limit power consumption at work, do you start wondering how practical a solar panel would be for your own home? The fact is, we cannot and should not separate the environmental concerns of our occupation from our private lives. We should integrate our continuing efforts to improve the world we live in.

Although carbon credits and saving money are important, for many of us sustainability is about being good stewards of what we are entrusted with and leaving this planet to our children and grandchildren in as good or better shape than we experienced.

Can we spend our lives as protectors of the environment, but not share our knowledge with our neighbors and, more importantly, our own children? How has your life and the environment been positively affected by your occupation?

Larry Littrell is vice president of PNCWA's NW Washington Section. You may contact him at llittrell@lkstevenssewer.org

Streamside Restoration: A Viable and Less Costly Option for Regulatory Compliance

Volunteers plant native trees to restore stream banks and create shade critical for healthy wild fish habitat on the Salmon River near Portland, OR.

As state regulatory agencies set water temperature limits for wastewater treatment facilities and other NPDES permit holders, permittees are looking for practical solutions to minimize the effect of clean, but warm water entering rivers and streams. Historically, temperature regulations meant expensive new facilities to cool the water before entering a stream—but today, conservation organizations and regulatory agencies are working toward a more ecologically beneficial approach to compliance.

In the state of Oregon, regulatory agencies and environmental organizations have built a system in which cities can restore streamside shade in places critical for fish to rest, rear and spawn instead of cooling water directly at a treatment facility's point of discharge. In other words, the increase in overall stream temperature from the facility's effluent is offset by cooling water naturally by planting trees upstream.

So how does the system work? Over the past five years, these organizations have been working on the science to calculate and quantify the benefit that planting trees provides to streams. Regulator-approved protocols can now quantify these benefits into registered "credits" that can be purchased by facilities to comply with temperature—and soon nutrient—regulations. Planting trees upstream not only provides a more natural solution, but in every case the cost to facilities has been one third to one half of a cooling tower, with numerous secondary benefits, such as trees for bird and other species habitat, reducing carbon in the atmosphere, stabilizing banks to control sediment and controlling runoff from agriculture and roads.

With regulator-approved metrics and infrastructure in place to ensure transparency and credibility of this compliance option, facility managers might ask how to actually get the projects done. To remove this uncertainty for municipalities, The Freshwater Trust, an Oregon-based not-for-profit, will finance all project costs on the front-end, and then sell the measured, quantified ecological benefits, or credits, to facilities to meet compliance requirements. With the Department of Environmental Quality set to write permits for this natural compliance solution, cities should consider restoring stream banks as a way to reduce thermal loading.

For more information, please contact David Primozich, Director of Ecosystem Services, The Freshwater Trust, 503-434-8033, primozich@thefreshwatertrust.org.