Reprint From
Environmental
PROTECTION

Microbial Massacre

By manipulating the oxygen levels in the industrial wastewater treatment process, a new breakthrough technology prompts bacteria to consume each other and thereby greatly reduces the amount of biosolids generated

By Bipin R. Ranade and Robert D. Sproull, PhD, PE

The majority of industrial manufacturers discharge their wastewater to publicly owned treatment works (POTWs) after some form of pretreatment. However, approximately one-third of industrial facilities operate their own wastewater treatment plants (WWTPs).

Most industrial WWTPs use an activated sludge process, which generates biosolids that may require dewatering, drying, storing, hauling, and landfilling. The treatment and disposal of biosolids contributes substantially to the cost of wastewater treatment operations.

Paper mills that use the Cannibal process could save even more by reducing chemical usage, power consumption, space restrictions, hauling costs, and dredging costs associated with lagoon disposal.

COURTESY OF US FILTER ENVIREX PRODUCTS

An innovative technology is now available to significantly reduce the amount of biosolids generated in WWTPs. The Cannibal™ solids reduction process from USFilter Envirex Products uses an additional mixed liquor solids "interchange" step to eliminate the daily routine of wasting biological solids. This is accomplished by regularly interchanging biosolids between the aeration process and a specially controlled sidestream bioreactor. The technology can be successfully used with batch operation as well as with any continuously operating activated sludge plant, and is compatible with a variety of biological treatment systems including fine-bubble aeration, sequential-batch reactor systems, and oxidation ditches.

The process is already being employed by more than two dozen existing municipal activated sludge plants. Five years ago, the technology made its industrial debut at a 25,000-gallons-per-day (gpd) cheese-production facility, where it has reduced wasting of biosolids by 1.5 million gallons per year.

Chuck Applegate, senior technical advisor at USFilter Envirex Products explains why the same biological treatment process works for both municipal and industrial wastewater.

"Wastes from many industrial facilities, such as paper mills, cheese producers, grain processors, and other food and beverage industries, are very similar to domestic wastes," he says. "However, it's important to thoroughly understand each site's wastewater characteristics in order to determine the economic viability of the Cannibal process."

The Process at Work

At the heart of the solids reduction process is the patented sidestream bioreactor that is integrated into the plant's activated sludge treatment system and is custom-designed for each specific project.

A portion of the return sludge is pumped to the bioreactor where the mixed-liquor bacteria are transformed from an aerobic-dominant to a facultative-dominant population by limiting the oxygen supply to the bioreactor. By carefully controlling the environment, aerobic bacteria are selectively destroyed in this sidestream reactor while enabling the low-yield, facultative bacteria to break down the aerobe remains and metabolize their byproducts. The facultative bacteria are subsequently broken down after they are returned to the aeration system where they are out-competed by the aerobic bacteria. The alternating environments in the oxygen-deficient bioreactor and oxygen-rich aeration basin destroy the biosolids produced in the activated sludge process. As a result, routine biosolids wasting is eliminated.

Facilities using the process achieve high-quality effluent in terms of biochemical oxygen demand (BOD) and total suspended solids levels. In addition, the process can nitrify and denitrify biochemicals released through cell lysis and, working in conjunction with the plant's main denitrification process, can help meet even the most stringent ammonia and total nitrogen limits.

When required, a specialized solids-separation module is installed on the return sludge line to prevent both the build-up of inerts and any accumulation of non-biodegradable volatile suspended solids (VSS) within the aerobic treatment system. The module produces a relatively clean, non-toxic byproduct that has a moisture content of 40 percent to 50 percent. The resulting byproduct can be directly landfilled. As it does not contain

biosolids, the byproduct is not classified as Class A or Class B sludge.

The entire process is monitored and controlled by USFilter's SmartCannibal™ control system. This control system regulates operations under varying load and weather conditions. It also controls odors typically associated with traditional waste sludge treatment systems.

After installing the process in 1999, a large cheese manufacturer reduced its total wasted sludge to approximately 50,000 gallons per year, compared to more than 2 million gallons per year prior to installation.

Incorporating the Cannibal process into existing activated sludge wastewater treatment plants will eliminate or greatly reduce the size of dewatering equipment.

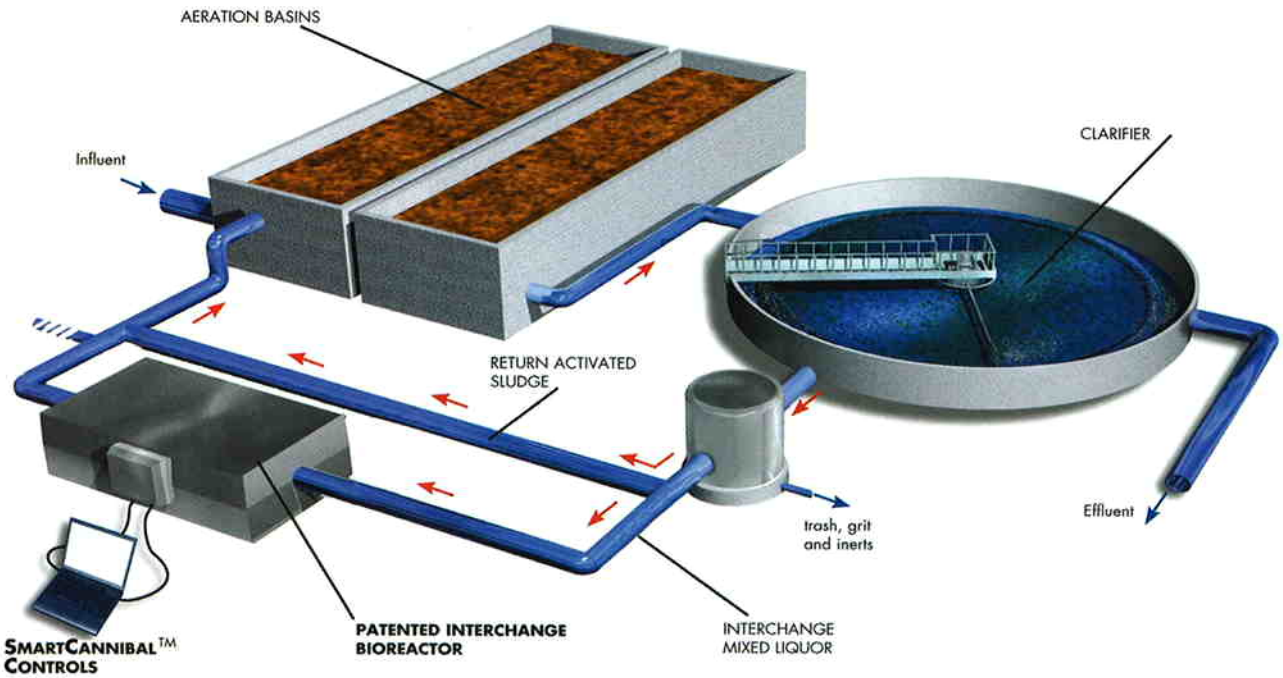
Making Cheese Economically

After installing the process in 1999, the Alpine Cheese Company in Holmes County, Ohio, reduced its total wasted sludge to approximately 50,000 gallons per year, compared to more than 2 million gallons per year prior to installation. The facility does not have any dewatering or drying equipment, which has further reduced both capital and operating expenditures. The 25,000-gpd plant uses 75 percent less power than it would with a conventional aerobic digester. Effluent BOD output remains at approximately 4 milligrams per liter (mg/L).

Robert J. Ramseyer, president of the Alpine Cheese Company, recalls selecting the process for its cost savings and efficiency. "Our system paid for itself in four years," he attests.

The facility, which needs to increase its biological treatment capacity, is cur-

A patented sidestream bioreactor, custom-designed for each specific project, is integrated into the plant's activated sludge treatment system.



COURTESY OF US FILTER ENVIREX PRODUCTS

rently in the process of expanding its WWTP. Additional vertical loop reactors and secondary clarifiers, as well as a larger Cannibal interchange reactor, are part of the planned expansion.

Applications and Cost Savings

Plants wishing to use this technology should already have an activated sludge process or be willing to install one. To make the technology more economically feasible, these plants should:

- Discharge directly into a surface stream, rather than a POTW
- Spend more than $100,000 per year for sludge disposal, with a solids disposal rate of at least $15 per wet ton
- Have a biochemical oxygen demand (BOD) loading of at least 10,000 pounds per day (lb/day)
- Be free of toxic chemicals, such as sanitizers

The process can be utilized in both new and existing facilities to give impressive savings, irrespective of size.

Incorporating the process into existing activated sludge WWTPs will eliminate or greatly reduce the size of dewatering equipment. Consideration of this technology is particularly appropriate during capacity upgrades because additional dewatering equipment would not be required with a new treatment system.

The amount of savings varies by project and depends on solids handling requirements and costs. For instance, installing the process into a 1- million-gallons-per-day (mgd) cheese manufacturing plant with a BOD loading on the order of 30,000 lb/day could save the facility at least $200,000 annually. On a larger scale, a typical 5-mgd brewery with around 2,500 parts per million BOD load should expect to save between $500,000 and $750,000 per year in operating costs. Paper mills with a similar hydraulic flow could save even more, because of their typically higher BOD loadings, by operating the process and eliminating routine wasting.

Summary

The benefits of installing the technology are self-evident regardless of plant application, age, or size. Besides providing tangible cost benefits, the process significantly reduces the liability of transporting biosolids over long distances, while improving the operating characteristics of the WWTP. New plants in particular should consider the technology, as it pays for itself quickly after installation.

Research is ongoing to fully understand the technology and find out what conditions make the microbes cannibalistic. These studies will pave the way to applying the technology to some of the more difficult-to-treat industrial wastewater applications in the pharmaceutical, hydrocarbon, and chemical industries.

EP

Bipin R. Ranade is manager of industrial sales and marketing at USFilter Envirex Products, located in Waukesha, Wis. During his 16 years of water and wastewater experience, Bipin has developed many innovative devices to help plant engineers operate their plants more effectively and efficiently. He has a BS degree in chemical engineering from the University of Mysore in India and a Marketing Management diploma from the Symbiosis Institute of Management / University of Pune in India. Ranade can be reached at (262) 521.8459 or ranadeb@usfilter.com. *Robert D. (Bob) Sproull, PhD, PE, is director of industrial sales and marketing at USFilter Envirex Products. He has 20 years of experience in developing, marketing, and selling wastewater treatment processes and equipment. Bob has an BS, MS, and PhD in chemical engineering from Purdue University in West Lafayette, Ind., as well as an MBA from Webster University in St. Louis, Mo. Sproull can be reached at (262) 521.8273 or* sproullb@usfilter.com.

Additional vertical loop reactors are part of the planned expansion at the Alpine Cheese Company's wastewater treatment plant.

COURTESY OF US FILTER ENVIREX PRODUCTS

Definitions of Terms

- Aerobic bacteria: microbes that require oxygen to survive.
- Facultative bacteria: microbes that can survive with or without oxygen.
- Inert: material that is not readily degradable. In the context of the article, examples include diatomaceous earth, clay, sand, and grit.
- Lysis: when a cell breaks apart and loses its contents.
- Wasting biological solids: refers to sending biological solids for dewatering.