

# FOP Development Group

## ACTIVATED SLUDGE WASTEWATER TREATMENT PROCESS



**USBF.com**



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# USBF™ Awards & Accolades



Frost & Sullivan  
Award for Technology Leadership

2007 – ECOfluid Systems, Inc. Awarded one of Canada's Top Ten Cleantech Companies



University of California, Davis – USBF™ technology was the highest ranked biological treatment system out of almost seventy technologies reviewed.



# USBF™ Overview

## About USBF™

The Upflow Sludge Blanket Filtration (USBF™) technology is designed for Municipal, Industrial, Private Development, the Military, Disaster Relief Agencies and Tribal Lands applications with hundreds of installations throughout North America, Europe and the Caribbean. The patented USBF™ technology with it's 30+ year track record, is considered to be one of the most affordable and effective wastewater treatment systems in the world today and was cited by the United Nations Industrial Development Organization (UNIDO) as "*an important environmental process revolution*".



# FOP Markets

**Municipal  
US Military  
Disaster Relief**

**Private Developments  
Tribal – Native Lands  
Resorts - Schools**



# USBF™ Environmental Benefits

- USBF** *reduces nutrient loading*
- USBF** *facility generates renewal energy*
- USBF** *facility qualifies for LEED points*
- USBF** *decreases waterborne pathogens*
- USBF** *system produces re-use water*
- USBF** *high quality discharge is beneficial to receiving waters*
- USBF** *reduces negative environmental impacts*
- USBF** *lowers levels of toxic chemicals and pharmaceuticals*
- USBF** *protects public health and sustains local economies*
- USBF** *reduces impact on threatened & endangered species*
- USBF** *produces less sludge and reduces landfill waste*
- USBF** *has less mechanical components*
- USBF** *reduces carbon footprint*



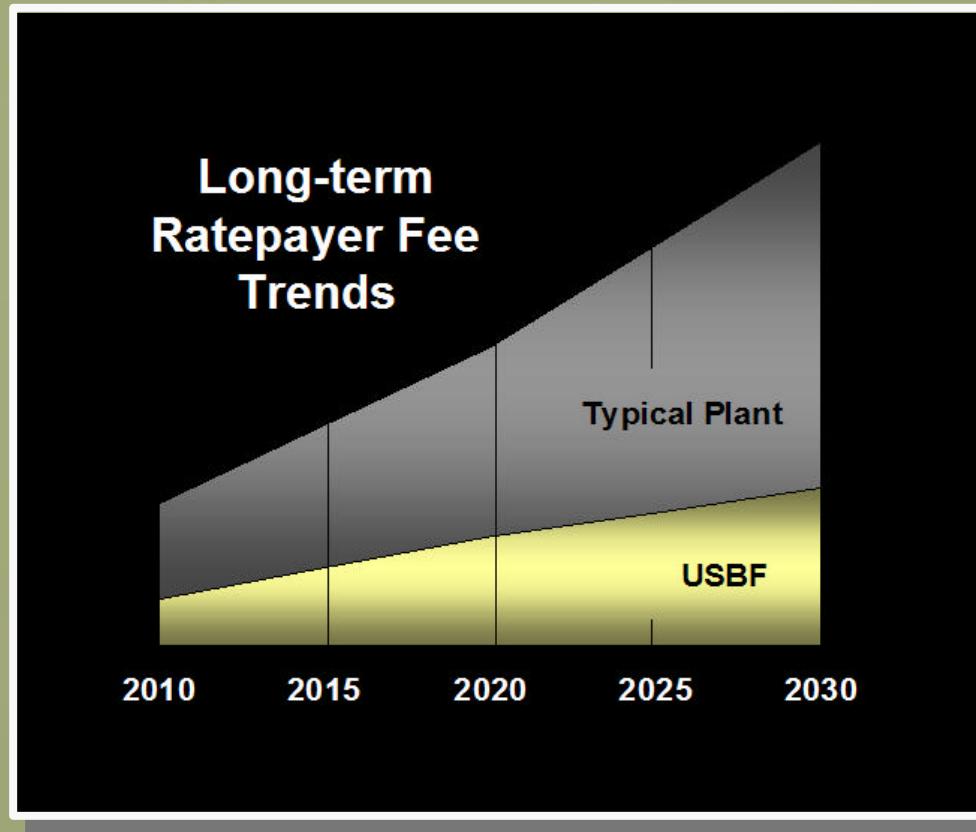
# USBF™ Economic Benefits

- ✓ Smaller plant footprint (less land cost-easy retrofit)
- ✓ Lower energy use to operate
- ✓ Significantly less maintenance
- ✓ Lower cost per design gallon to construct
- ✓ Handles fluxuating or inconsistent daily flows
- ✓ Affordable treatment of I/I and wet-weather flows
- ✓ Modular design for additional future capacity
- ✓ Increased industrial/high peak capacity
- ✓ Significantly higher automation
- ✓ Self-Correcting resilient system
- ✓ Substantially reduced repairs



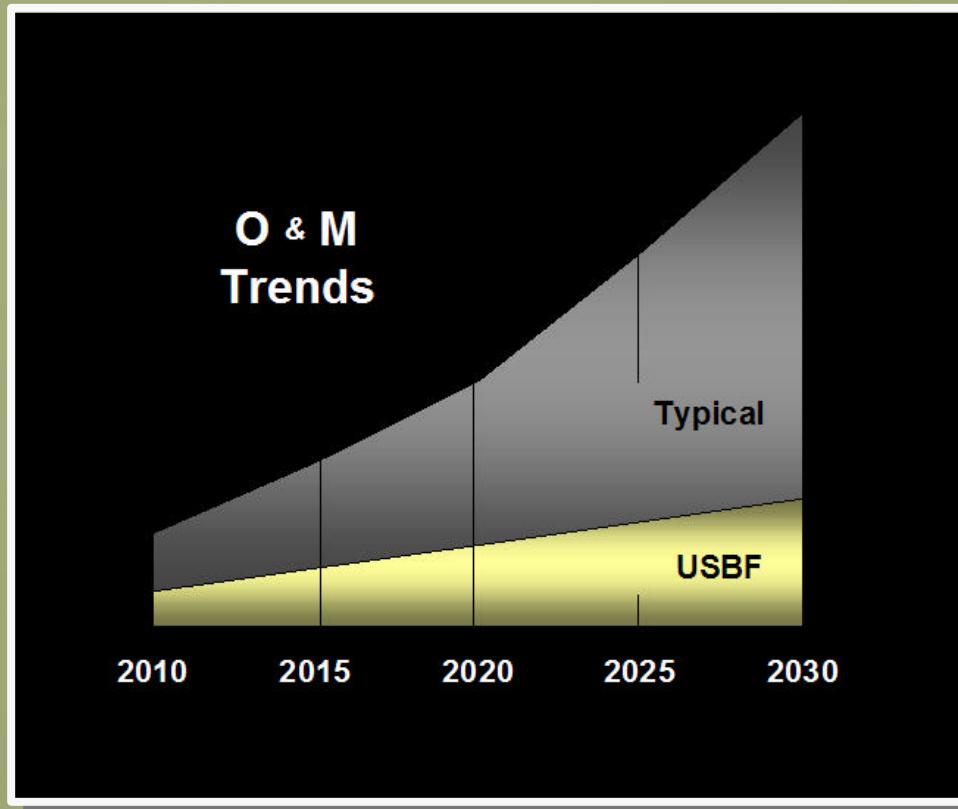
# USBF™ Ratepayer Fees

## Annual Trends



# USBF™ O&M Expenses

## Annual Trends



# USBF™ Power Consumption

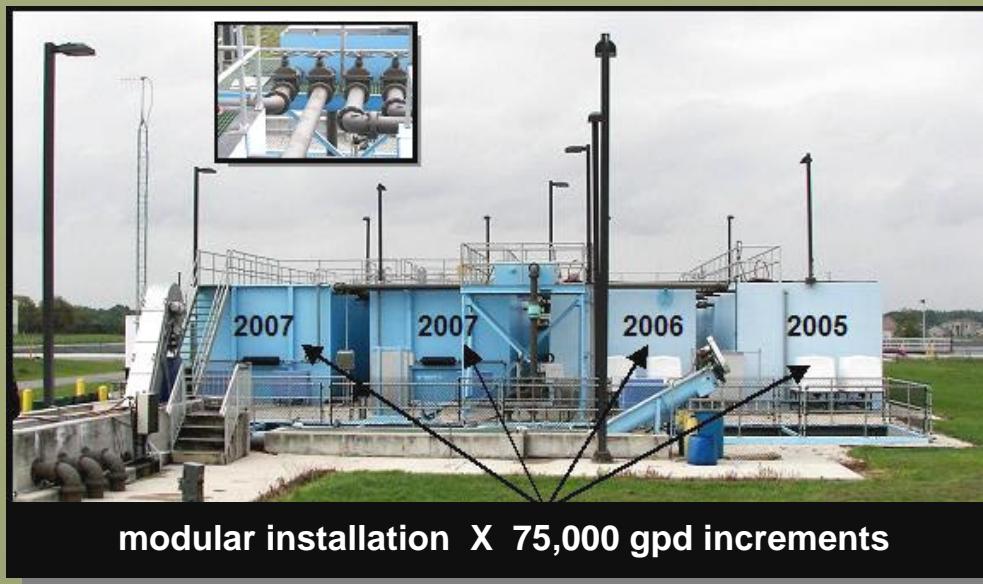
Gallons Per Day	kWh Per Day	Monthly @ 9.7¢ kWh*	Monthly Per Household
10,000	85	\$ 247	\$ 6.17
25,000	150	\$ 436	\$ 4.36
100,000	340	\$ 990	\$ 2.47
250,000	580	\$ 1,688	\$ 1.69
500,000	1,200	\$ 3,492	\$ 1.74
750,000	1,500	\$ 4,365	\$ 1.45
1,000,000	2,800	\$ 8, 148	\$ 2.03

\* US National Average is 9.67¢ per kWh



# USBF™ Modular Expansion

The award winning USBF™ system is ideal for quick and cost-efficient plant expansion. Once permitted, capacity can be increased anywhere from 5,000 gpd to 1 MGD in months rather than years without tying up your valuable capital. Communities need the flexibility, practicality and environmental security that exist with a USBF™ modular design.



*reduce risk and reserve bond capacity via incremental expansion*



# USBF™ Smaller Developments

**10,000 - 30,000 gpd facilities (40 - 120 homes)**



# USBF™ Medium Size Developments

**32,000 - 100,000 gpd facilities (130 - 400 homes)**



# USBF™ Larger Developments

**100,000 - 380,000 gpd facilities (400 - 1,500 homes)**



# USBF™ Municipal Size Developments

**800,000 - 1 million gpd facilities (3,200 - 4,000 homes)**



# USBF™ Efficiency Feature #1

## 1. Sludge Blanket Filter

The upflow sludge blanket filter introduces a substantially higher specific rate of separation than other commonly used separation techniques. Unlike conventional clarifiers, influent enters at the bottom and flows upwards. As the cross sectional area increases, the upflow velocity decreases until the activated sludge flocs become stationary and thus form a filtering media for activated sludge flowing through. High filtration efficiency is achieved and even particles with settling velocities too low to be removed by settling alone are filtered out.



# USBF™ Efficiency Feature #2

## 2. High Sludge Concentration

Most traditional plants operate at low or medium sludge concentrations, typically 2,500 – 3,500 mg/l. USBF™ process by contrast operates at higher sludge concentrations, typically 4,000 – 6,000 mg/l resulting in longer sludge age and increased biological efficiency



# USBF™ Efficiency Feature #3

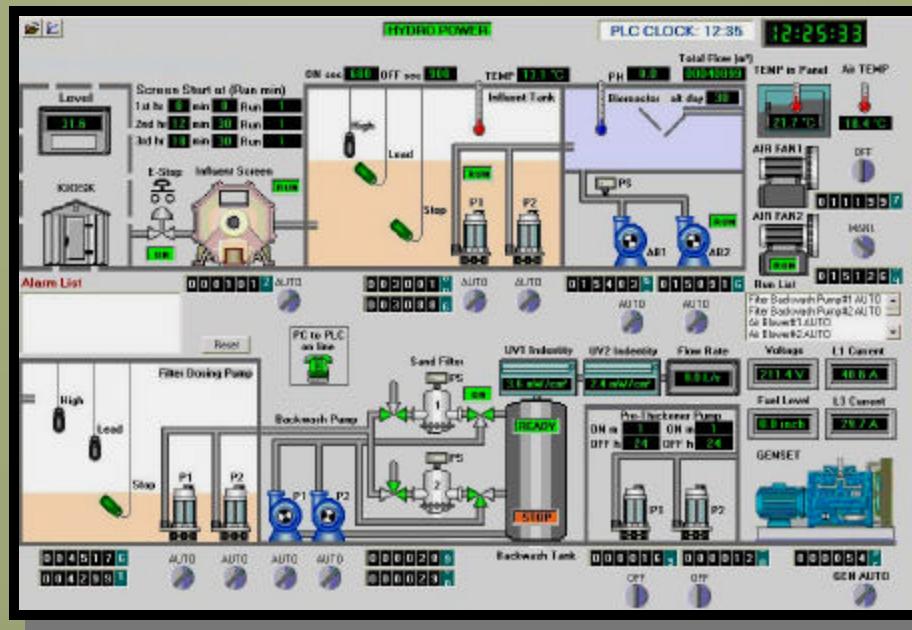
## 3. All Processes Integrated into One Bioreactor

Most conventional technologies carry out processes of nitrification, denitrification, clarification and sludge stabilization in a number of dedicated vessels. By contrast, USBF™ process incorporates these processes inside a compact bioreactor, reducing equipment size and liquid handling requirements.



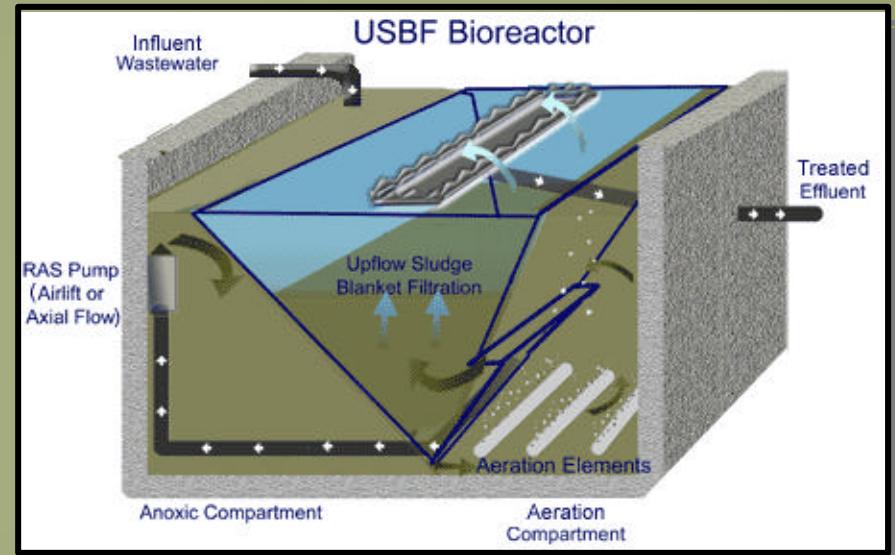
# SCADA Remote Monitoring

The Supervisory Control And Data Acquisition (SCADA) system, which monitors equipment-running status and receives data from transmitting instruments, makes USBF™ plant supervision undemanding. Any upset conditions and equipment malfunctions are alarmed and annunciated through the SCADA system to designated remote locations and to the operator on call. Limited direct operator input is required.



# USBFTM Bioreactor

Biological treatment takes place in the USBFTM bioreactor. Raw sewage enters the anoxic compartment where it is mixed with activated sludge recycled from the bottom of the sludge blanket filter by an airlift pump. A submersible mixer ensures adequate mixing and keeps the solids in suspension. From the anoxic compartment the mixed liquor flows to the aerobic compartment, which is equipped with fine bubble aeration diffusers. Aerated and moved in a plug flow manner, it eventually enters the bottom of the upflow sludge blanket filters.



The mixture of microbial cells and water enters the filter at the bottom and, as it rises, upward velocity decreases until the flocs of cells become stationary and thus form a filtering media. A high degree of filtration efficiency is achieved as colloid and very fine particles are filtered out. As the flocs become large and heavy, they descend to the bottom and subsequently are recycled back into the anoxic zone. Upflow sludge blanket filtration has a substantially higher specific rate of separation than sedimentation. In addition, the technology accommodates high peak flows and flow swings in a self-regulating manner – the higher the flow, the higher the sludge flocs rise and the larger the filtration area becomes.

# USBF™ Site Constructed Plant



# USBF™ Packaged Plants

## Steel Construction

- Shop prefabricated, sandblasted and painted before shipment and installation - above or below ground.
- Can be designed to include pump tanks, sludge storage and chlorine disinfection compartments, all within the steel tank package.



# USBF™ Custom Design Plants

## Satellite Plants

- The plants typically consist of USBF clarifier inserts installed within concrete or coated steel vessels.
- Clarifier inserts can be fabricated from polypropylene (shown here), epoxy coated steel or stainless steel.
- Depending on the capacity, clarifiers are shop prefabricated or field assembled. Installation is simplified by all-bolted design.



# USBF™ Packaged Plants

## Polypropylene Construction

- Typically used for plants with capacities up to 20,000 GPD.
- Tanks are installed underground.
- Strong, light and easily shippable.
- Fast and easy installation.



# USBF™ Plant Retrofits

1. Inserts are either prism or conical shape and can be installed within virtually any existing vessel.
2. The feature allows for easy and efficient retrofit of existing under-performing wastewater treatment plants.
3. Retrofits typically result in the plant performance and capacity enhancement.



# USBF™ Agricultural and Industrial

Slaughterhouses

Dairy plants

Animal manure treatment

Pulp mill effluent



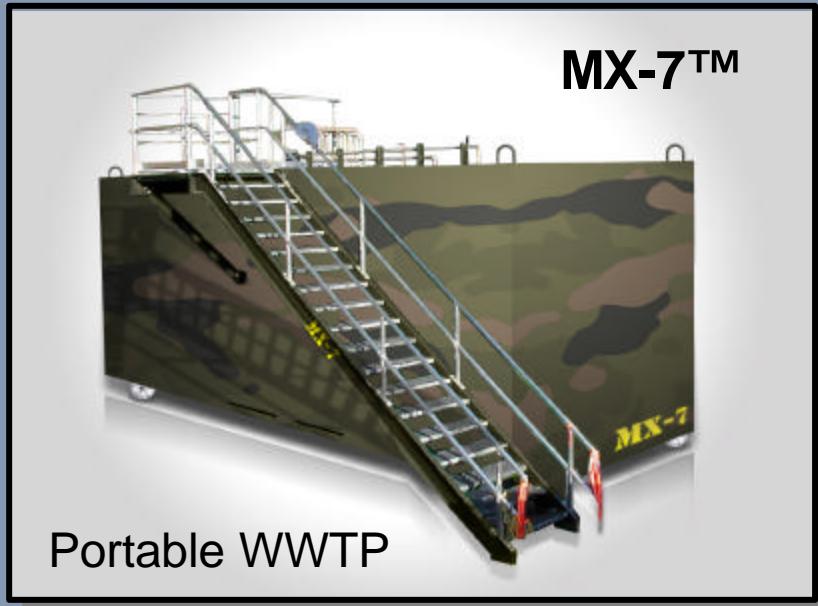
Fig.21



Fig.26



# USBF™ US Military (MX-7™)



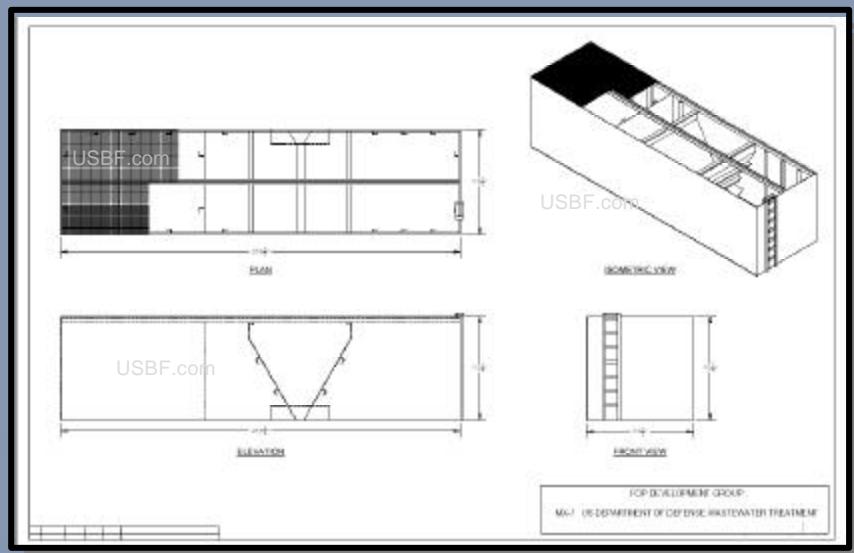
Portable WWTP

MX-7™ Package Plant is designed to treat up to 7,000 gpd of 'municipal' type wastewater to advanced secondary treatment level of less than 10 mg/l for both BOD and TSS. All MX-7™ equipment and components are shipped within a 40' ISO container. The systems can accommodate fluxuating flows ranging from 500 gpd to 8,000 gpd without upset. Systems utilize traditional or portable power sources. FOB any US Port.

Existing US Navy SeaPort-e Contract Vehicle Available



# USBF™ US Military (MX-7™)



Once removed from the container, MX-7™ is set on a concrete pad, or on sand finished, level ground bed. Crane or backhoe capable of lifting 15,000 lbs is required. Using the supplied equipment, components and shop prefabricated piping, the final site assembly is fast and uncomplicated. Empty container is used as control and process rooms, and as field warehouse.



Existing US Navy SeaPort-e Contract Vehicle Available

# USBF™ US Military (MX-30™)



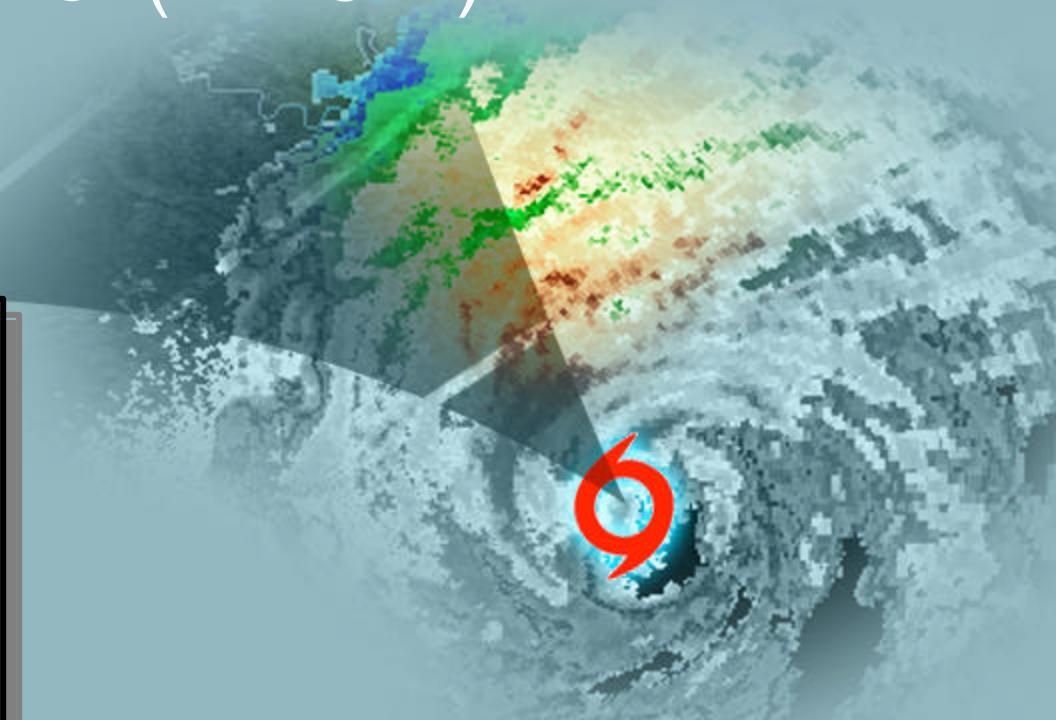
Existing US Navy SeaPort-e Contract Vehicle Available

The plant design allows for easy transportation, delivery and installation. Typically, each unit will be installed above ground on a concrete pad or compacted, level sand. Below ground installation are very common. Because each self-contained unit operates independently and the process is completely modular, units can be added or removed to increase or decrease capacity if and when required. Ideal for fluctuating troop deployment and training.



# USBFT<sup>TM</sup> Disaster Relief (DR-5<sup>TM</sup>)

## EMERGENCY RESPONSE PORTABLE WASTEWATER TREATMENT



***"It's not a matter of if, it's a matter of when."***

The threat of natural disasters or terrorists' attacks on America's water supply and wastewater treatment systems is real and would be extremely disruptive, even devastating, to the country in a variety of ways. In a matter of minutes, hurricanes, tornadoes, flooding or bioterrorism could severely affect hundreds if not thousands of unsuspecting citizens. In addition to the inconveniences created, unusable wastewater systems (caused by physical damage or intentional contamination) would have staggering effects on health, the environment and the ability to defend our country if these attacks were made on systems at military bases or critical locations. Without a reliable sanitation system, many defense functions would be paralyzed. The DR-5<sup>TM</sup> is a portable, generator powered plant producing municipal quality treatment.

Image Courtesy of: NOAA

# USBFTM Reuse Water Program

## Recycled and Reuse Water

Water is becoming an increasingly precious and scarce commodity in many areas across the globe. Moreover, as population growth skyrockets, communities must carefully and efficiently use what water is available to maximize the beneficial use of this valuable resource.

The recent surge in water recycling activity can be linked to improvements in technology as well as to growing public acceptance and recognition of the economic, social, and environmental benefits of recycling. Each FOP treatment facility will produce reuse quality discharge with reduced nutrients.



# USBF™ Nutrient Reduction

## Nutrient Reduction

Nitrogen is removed by nitrification and denitrification processes. Nitrification is autotrophic and all USBF integrated bioreactors are designed for complete nitrification of ammonia to  $\text{NO}_3^-$ . Denitrification however, is heterotrophic and requires carbon source. Conventional plants' "separate-sludge denitrification" requires that carbon is added, typically in the form of methanol. This adds to operating costs, and if used in excess, it increases effluent  $\text{BOD}_5$  content.

USBF technology's "single-sludge denitrification" approach uses an endogenous carbon source to maintain the denitrifiers. Influent is combined with nitrified mixed liquor in the anoxic compartment providing the carbon source needed for denitrification. Relatively high nitrified mixed liquor recycle rates are employed and sufficient denitrification retention times provided. Total nitrogen reduction to less than 10 mg/l is readily achieved as demonstrated by the results from one of the USBF plant with identical to the proposed configuration.



# USBFTM Routine O & M

## OPERATIONS & MAINTENANCE REQUIREMENTS

### GENERAL DESCRIPTION

One operator is typically required on site twice a week for approximately 2-3 hours per visit. During that visit, the routine O&M of the plant may consist of the following tasks.

#### Observation

1. While approaching the site, listen for unusual noise and take note of odors, if present.
2. Before doing any cleaning or plant adjustments, check the plant discharge (clarity/quality) and bioreactor appearance (foam, floating sludge, scum etc.).

#### Testing and Sampling

1. If samples are taken to be analyzed by a professional laboratory, do it before disturbing the bioreactor.
2. Commence by measuring Dissolved Oxygen (DO) concentrations in the anoxic and aeration compartments; do a Settled Sludge Volume (SSV) test with the Mixed Liquor Suspended Solids (MLSS) out of the aeration compartment; check the bioreactor (effluent) pH and the effluent ammonia nitrogen concentration using test kits.

#### Records Keeping

1. Log all onsite test results and observations in log sheets and compare to historical data.
2. Log pump run times (influent and effluent pumps) and blower run times and air pressure in log sheets; compare them with the historical data; if data are inconsistent, troubleshoot.

#### Operations & Maintenance

1. Adjust bioreactor DO and RAS (Returned Activated Sludge) as needed.
2. Once all the sampling and/or onsite testing is completed, start wasting sludge from the bioreactor (since the process generates sludge, it must be wasted – usually to a sludge holding tank).
3. Clean/hose down the basket screen (if applicable) and all bioreactor tank walls, collect screenings and dispose of as needed.



# USBF™ Routine O & M

4. Refer to air blower manual for O&M requirements; blower bearings require grease-lubrication about once a month (every 500 hours); oil changes are required roughly every 1,500 hours; blower drives need lubrication approximately once a year.
5. Always refer to equipment O&M manual for proper equipment maintenance.
6. General plant and site housekeeping.

## Operator Qualification

1. Only one qualified person is required to operate packaged USBF plants; however, FOP recommends training at least two operators for redundancy.
2. FOP can demonstrate to local operators the routine operation and maintenance of their system. If requested, FOP can conduct further O&M training for personnel to become more familiar with wastewater treatment.
3. Usually, wastewater treatment plants are classified to provide an indication of the degree of knowledge and training that is required of an operator of that facility. Classification provides both the facility operator and the owner with an indication of the level of certificate the facility operators should hold.

For example, in British Columbia, a USBF packaged wastewater treatment plant with flows of approximately 10,000 gpd might be classified as "Small Wastewater System – Mechanical". Wastewater operators will generally be certified, paralleling the facility classification. The requirements for a certified "Small Wastewater System Operator" are:

1. Minimum 1.2 continuing education credits (CEU's).
2. Minimum of at least six (6) calendar months (minimum 50 hours) of hands-on experience operating the system or one equivalent to it or higher.



# USBFTM Below Ground Installations



# USBFTM Below Ground Installations



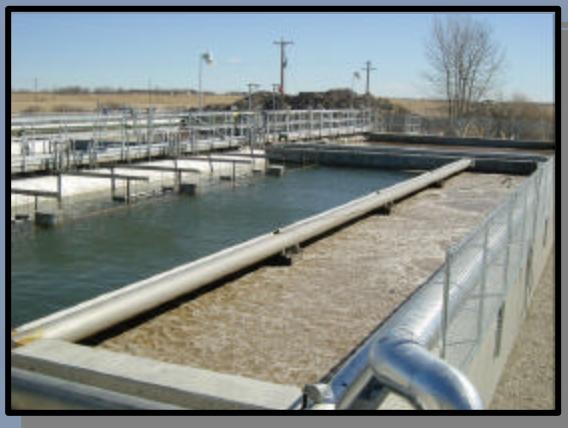
# USBFTM Below Ground Installations



# USBFTM Above Ground Installations



# USBF™ Above Ground Installations



# FOP: A Solution-based Company

## Team FOP

Our team creates value for our clients by utilizing proven environmental applications. FOP partners, management, and staff offer extraordinary experience in environmental services and financial solutions. Our focus is on solving the significant challenges facing communities and our clients.

FOP can help mitigate the risk in any project. When procuring your wastewater treatment or other environmental services from FOP, we ensure that you save money, exceed all environmental requirements, meet compliance deadlines and manage essential projects on time and within budget. The award winning USBF™ system is ideal for quick and cost-efficient plant expansion. Once permitted, capacity can be increased anywhere from 5,000 gpd to 1 MGD in months rather than years without tying up your valuable capital. Clients need the flexibility, practicality and environmental security that exist with a USBF™ modular design and FOP's expertise.

