

**ANNEX IV**

**SEWAGE TREATMENT PLANT SPECIFICATIONS**



**purestream *ES***

LLC  
*Advanced Environmental Treatment Systems*

# BESST

**BIOLOGICALLY ENGINEERED SINGLE SLUDGE TREATMENT**

*The latest  
technology in  
advanced biological  
wastewater treatment*

# BESST- brings cutting edge technology



## The Technology

**BESST™** (Biologically Engineered Single Sludge Treatment) is a Patent Pending process that is a culmination of activated sludge processes dating back to the 1920's. The **BESST** process is the most advanced wastewater treatment process available, and is the result of almost 60 years of research, development, practical experience and testing. Combining the principals of single sludge treatment for BOD<sub>5</sub>, TSS and nutrient removal, and sludge blanket clarification for efficient solids separation, this process places all the components into one vessel. The end result is a compact system that can be provided in either a steel package plant for smaller systems or built in place concrete systems for larger municipalities and high strength industrial waste streams. Either configuration provides an efficient, cost effective wastewater treatment plant with extremely low maintenance and operating costs. With its efficient use of mixed liquor, the **BESST** process requires less sludge wasting resulting in lower hauling costs for waste sludge.

The **BESST** process has no capacity limits, and is used in a wide range of applications. Plants serving development and municipal sectors, industrial, and food processing wastewaters, have been designed and are in highly successful operation throughout the US, Mexico, Central America and the Caribbean.



## The Process

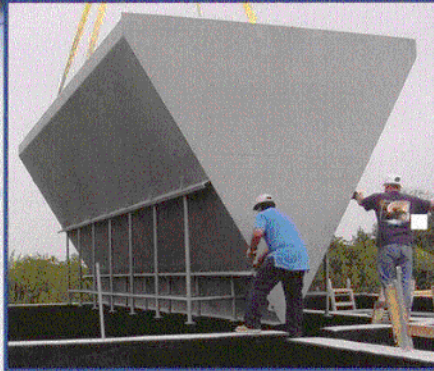
The **BESST** process is based on Lawrence and McCarty biological kinetics and hydraulic models dating back to the early 1900's. Utilizing the benefits of Pre-Anoxic Single Sludge activated sludge process; the **BESST** system uses the endogenous carbon source found in all sanitary waste to denitrify in the anoxic zone without the use of methanol or other exogenous carbon sources. The raw wastewater enters the anoxic zone first where it is mixed with nitrified Return Activated Sludge from the sludge blanket clarifier. Submersible mechanical mixers are installed in the anoxic compartment to facilitate homogeneous mixing, and increase the denitrification efficiency. From here, the mixed liquor flows in a plug flow manner to the aeration zone where fine bubble diffusers provide the oxygen required for nitrification and BOD<sub>5</sub> reduction.



After aeration, the mixed liquor enters the bottom of the separation compartment where solids and treated effluent are separated by a patented velocity gradient sludge blanket clarifier. The operation of the velocity gradient sludge blanket clarifier is self-regulating. As the flow enters the bottom of the clarifier, a velocity gradient is created in such a way that the bottom 2 to 3 feet of solids are kept in a completely mixed state which eliminates the need for the operator to scrape the clarifier (solids will not bulk). While the solids rise, their velocity decreases creating a sludge based, fluidized bed filter, which removes fine and colloid particles from the treated effluent. Trapping these particles increases the weight of the solids, causing them to drop to the bottom of the clarifier, where they are returned to the anoxic zone by an airlift or mechanical pump. The internal circulation loop created by this plug flow is typically set at a minimum of four (4) times the average daily flow, increasing nitrification and denitrification dramatically.

The effluent weir is equipped with a scum baffle and scum skimmer which aids in the reduction of TSS in the effluent. The efficiency of the process, and velocity gradient sludge blanket clarifier, produces effluent quality well below 10 mg/l BOD<sub>5</sub>, <10 mg/l TSS, less than 1 mg/l ammonia, less than 10 mg/l total nitrogen (<5 mg/l TKN) and effluent phosphorous levels between 2 and 3 mg/l by "Luxury Uptake" and less than 0.5 mg/l with the use of metal salts.

# to advanced biological wastewater treatment



## The Features & Benefits

**BESST** technology incorporates many innovative and advanced features that increase its efficiency and reduces both capital and operational costs.

### 1. Mechanical Reliability

The **BESST** process is designed with 100% backup of all electromechanical equipment and failsafe controls. This ensures reliability of operation even when there is a mechanical failure.

### 2. Single Sludge Treatment

Of the three methods of single sludge treatment, the Pre-Anoxic method is the most efficient and effective method for nutrient removal and mixed liquor stabilization. By designing the **BESST** process with the anoxic zone as the first compartment to receive wastewater, the sludge becomes more stable and has better settling qualities than typical activated sludge processes, resulting in a lower SVI which equates to better settling sludge. This increase in sludge settleability increases the efficiency of the sludge blanket clarifier and aids in achieving between 4% and 6% solids in the sludge storage tank, reducing sludge hauling costs dramatically. In addition, the raw wastewater entering the anoxic zone provides the endogenous carbon source required for denitrification. No addition of exogenous carbon is needed to achieve Total Nitrogen levels below 10 mg/l and Total Kjeldahl Nitrogen less than 5 mg/l. The aeration chamber is designed for efficient BOD<sub>5</sub> and TSS removal to levels less than 10 mg/l, and with dissolved oxygen levels between 2.0 mg/l and 3.5 mg/l, the nitrification rate is extremely high, resulting in ammonia levels below 1 mg/l.

### 3. Mixed Liquor Suspended Solids (MLSS) Concentrations

The **BESST** process is designed to operate at MLSS concen-

trations well above the typical levels for other activated sludge processes. With a design range between 3000 mg/l and 6000 mg/l, more microbial cells are available to "feed" on a wider range of organic material in the waste stream, including some previously considered non-biodegradable.

### 4. Reduced Capital Costs

The efficiency of the **BESST** process is not only in the biology and hydraulics, but in the construction as well. By integrating all of the components into one tank, the installation costs and capital costs are reduced dramatically. In many cases by more than 40% when compared to other activated sludge processes. In addition to the upfront savings, the **BESST** process also reduces operating costs by as much as 50%. By maximizing the biological engineering and utilizing the mixed liquor to its fullest potential, less sludge is wasted from the system reducing hauling costs by up to 75%, and lower horsepower electrical components are required for operation resulting in lower electric costs.

### 5. No Odor

The stability and age of the sludge, combined with the aerobic conditions, result in a process with **NO UNPLEASANT ODORS**. This enables the process to be installed in locations in close proximity to populated areas without the need for costly buildings or tank coverings.

### 6. Hydraulic Flexibility

The velocity gradient sludge blanket clarifier's half triangle design is the most efficient design for solids separation. By taking peak flows into account at the design stage, the clarifier can hydraulically withstand a continuous peak of up to 3 times the design flow. This allows for instantaneous peaks of up to 1200% of the design flow for up to 2 hours. The sludge based fluidized bed is also self regulating in these peak conditions, as the flow increases, the sludge rises in the clarifier and expands increasing both the filtration volume and surface area.

### 7. Modular and Flexible Design

The small footprint and single tank design allows for easy expansion for future needs of the community or development. By placing the package plant design in parallel allows for additional tankage to be easily added as flow demands increase. The efficiency of the **BESST** design also lends itself well to retrofits, often times increasing the treated flow capacities by as much as 20% without the need for additional tankage.



# BESST

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## Special Applications

Although the **BESST** process can be applied successfully to all biologically degradable wastewaters, with minimal operator attention, it is especially suited for the following applications:

1. Environmentally sensitive areas requiring advanced treatment, such as:
  - Golf Course Communities
  - Resort Areas
  - Commercial Fishing Areas
2. Highly Variable daily hydraulic flow patterns found in:
  - Subdivisions
  - Schools
  - Small Communities
  - Shopping Centers
  - Campgrounds
3. Unusually strong and/or variable organic loads created by industrial wastes, such as:
  - Food Processing (Meat, Poultry, Vegetable...)
  - Dairies
  - Tanneries and Textile Mills



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