PURPOSE

The Cyclic Biological Treatment (CBT™) Process was developed by International Wastewater Technologies (IWT) to process on-site wastewater. The high quality effluent produced by the CBT™ Process protects our precious ground water, watersheds, and quality of life.

Frequently, the design of treatment systems must cost effectively address a wide array of challenges over and above simply treating wastewater:

- Limited or Inadequate Infrastructure
- Land Use
- Odor Control
- High Water Tables
- Equipment Maintenance
- Energy Usage
- Aesthetics

IWT has developed the CBT™ Process, with patented influent velocity reduction devices, to address these issues while maintaining cost efficiency.

BACKROUND

For quite a long time, the most widely used wastewater treatment method has been the activated sludge process. Traditionally, the activated sludge process uses separate basins to accomplish flow equalization, aeration, solids settling, effluent withdrawal, and filtration. This process is a very reliable and proven method of treatment, but unfortunately uses an excess amount of tankage, equipment, and energy.

Land and energy costs have risen considerably, and will continue to do so in the future. In order to conserve land and energy, the wastewater treatment industry has focused on methods of performing multiple treatment steps of the activated sludge process in a single basin. The Sequencing Batch Reactor (SBR) was developed to aerate, settle, and withdrawal effluent from a single basin. The primary drawback of SBR's has been the need for a separate basin and mechanical equipment to divert and hold influent so as not to upset the settling and decant processes. Attempts have been made to accept influent on a continuous basis, but usually at the cost of increased mechanical equipment and maintenance.

IWT has made great strides in the improvement of this area of wastewater technology. The patented and patent pending CBT™ Process successfully accommodates continuous inflow of wastewater while utilizing a single treatment basin. The CBT™ Process accomplishes this without the need for an influent control valve or separate basin to hold diverted flow. It does not utilize a baffle wall with underflow weirs which may create turbulence within the sludge blanket during the settle phase, creating potential

for washout. The CBT™ Process uses influent velocity reduction devices with no moving parts that simply control influent hydraulics better than other designs of similar theory.

INFLUENT VELOCITY REDUCTION DEVICES

In order for the CBT™ Process to perform the functions of flow equalization, aeration, settling, and effluent withdrawal within a single basin, it must be able to accept influent flows at all times. Two factors are critical to accommodating constant flows of influent without disruptions to the settling and decanting phases. First, turbulence due to splash energy must be mitigated. IWT developed the Influent Gate Housing to perform this task. Second, the influent must be delivered to the main reactor basin without upsetting the sludge blanket during settling and decant. The Pre-React Zone Director does this by creating a large flow-through area to the biomass, thus reducing velocity. Additionally, the Pre-React Zone Director has angled flanges at the bottom to direct influent downward and outward into the biomass in a laminar fashion.

STANDARD CBT™ PROCESS CYCLE

The CBT™ Process normally operates six four hour cycles per day. Each four hour cycle consists of two hours of aeration, one hour of settling, and one hour of effluent withdrawal (decant). These phases are controlled through the use of electronic timers, in conjunction with water level controls.

AERATION PHASE

DESCRIPTION:	The aeration phase is normally the first two hours of the cycle. Oxygen is required by microorganisms that consume organic pollutants (BOD_5) in typical residential wastewater. The oxygen requirement for BOD_5 removal is calculated using traditional activated sludge process standards. Oxygen demand and mixing requirements are both met by supplying diffused air to the entire basin, including the Pre-React Zone.
LENGTH:	2 Hours
TREATMENT:	BOD_5 Oxidation Mixing Nitrification
INFLUENT:	Yes
AERATION:	Yes
SETTLE:	No
DECANT:	No

SETTLING PHASE

DESCRIPTION:	The settling phase is normally the third hour of the cycle. During settling, solids-liquid separation occurs. The solids settle to the bottom of the basin, a thin scum layer forms on the surface, and a clear supernatant forms between the two.
LENGTH:	1 Hour
TREATMENT:	BOD_5 Oxidation Solids/Liquids Separation Denitrification
INFLUENT:	Yes
AERATION:	No
SETTLE:	Yes
DECANT:	No

DECANT PHASE

DESCRIPTION:	The decant phase is normally the fourth hour of the cycle. During the decant phase, the patent pending CBT™ Decanter removes the supernatant from below the surface for discharge. If sludge wasting is required, it will be typically be done at the end of the decant phase.
LENGTH:	1 Hour
TREATMENT:	BOD_5 Oxidation Solids/Liquids Separation Denitrification Sludge Wasting
INFLUENT:	Yes
AERATION:	No
SETTLE:	Yes
DECANT:	Yes

PEAK FLOWS

Residential wastewater does not flow at a constant rate; peaks and valleys are normal throughout the day. The CBT™ Process deals with peak flows using water levels and level switch overrides. From the top down, there are four water levels used as part of the CBT™ Process:

- Alarm Water Level (AWL)
- Top Water Level (TWL)
- High Water Level (HWL)
- Bottom Water Level (BWL)

BOTTOM WATER LEVEL (BWL)

In a typical activated sludge treatment facility, the volume of tankage and air required for treatment is determined by the amount of organic pollutants that need to be removed from the wastewater stream. In the CBT™ Process, this is referred to as the Bottom Water Level (BWL). The water level in the reactor basin is never permitted to go below this level. As the process accepts influent and decants effluent throughout the cycle, the water level will vary, but always be above the BWL.

Should abnormally low flows be encountered, the water level may lower to the BWL before the end of the Decant Phase, causing a level switch to deactivate the CBT™ Decanter.

HIGH WATER LEVEL (HWL)

The reactor basin capacity between the BWL and HWL is sized to accept the design peak flows. The operating water level of the basin will normally lie between the BWL and HWL.

Should abnormally high levels of flow be encountered, the water level may rise to the HWL before the Aeration Phase has completed. This causes a level switch to cease aeration and allow early settling should early effluent decanting become necessary.

TOP WATER LEVEL (TWL)

The reactor basin capacity between the HWL and TWL is sized to allow enough time for solids to settle in preparation for an early decant.

Should abnormally high levels of flow be encountered, the water level may rise to the TWL before the Decant Phase has begun. This causes a level switch to activate the CBT™ Decanter early.

ALARM WATER LEVEL (AWL)

Should the water level in the reactor basin rise to the AWL, there has been either a mechanical failure or flows have far exceeded the design peak flows.

A level switch will activate audio and visual alarms indicating immediate attention to the system is required.

ADVANCED TREATMENT

Along with providing extremely reliable secondary wastewater treatment, the CBT™ Process also meets most tertiary treatment standards without additional mechanical filtration or chemical addition.

DENITRIFICATION

In an environment absent of dissolved oxygen, naturally occurring bacteria use organic carbon in the form of incoming sewage to convert nitrate to nitrogen gas, carbon dioxide, and water. The CBT™ Process is ideally suited to achieving high levels of denitrification by virtue of its cyclical nature and velocity reduction devices. During the air off phases of settle and decant the reactor basin becomes anoxic (having very low dissolved oxygen). During this phase, raw sewage is introduced directly into a large percentage of the the sludge blanket via the Pre-React Zone Director, providing an ideal source of organic carbon.

PHOSPHORUS REMOVAL

Phosphorus Removal by the CBT™ Process is by means of incorporation into cell tissue. It is estimated that the phosphorus content of the cell tissue is approximately one-fifth of the nitrogen content.

The CBT™ Process provides an environment to enable the microorganisms in the activated-sludge mixed liquor to remove an excess amount of phosphorus required for growth. The CBT™ Process Influent Gate Housing and Pre-React Zone Director provide an efficient method for the microorganisms to remove the phosphorus, as the influent wastewater is directed through the activated-sludge blanket during the air-off phase of the cyclic process. The unique components of the CBT™ Process system mitigate influent flow velocities to allow the activated-sludge blanket to perform as a natural biological filter, thereby effectively extracting the organics and nutrients in the wastewater as it passes through the layer of biomass. This feature of the CBT™ Process is non-mechanical and does not require the addition of chemicals. Further phosphorus removal is accomplished in the main react zone during all phases of the CBT™ Process.

In the anaerobic phase of the CBT™ Process, the influents organic matter ferment into volatile fatty acids. These fatty acids initiate a biological selection process, which is beneficial to the acinebactor microorganism. Its large phosphorus storing capability characterizes the acinebactor bacteria. When the air is turned on, the acinebactor bacteria will remove more phosphorus than it metabolically requires, thus further reducing the amount of phosphorus in the wastewater, without the use of chemicals.