# Proprietary Treatment/Approved Products to Treat Residential Sewage

# Application

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Contents

# Proprietary Treatment/Approved Products
# to
# Treat Residential Sewage

# Application for Registration

## PURPOSE

Advanced Aeration, Inc. (AAI) is seeking to achieve Proprietary Treatment Products, Category A Approval from the State of Minnesota so that its Vacuum Bubble® Technology (VBT™) unit – Model 100 Series – may be approved to provide pretreatment in residential sewage treatment systems.

AAI supports its application with a discussion of the scientific principles of operation together with data showing the effectiveness of VBT™ in reducing waste strength and also in facilitating restoration of residential sewage treatment systems.

## HISTORY

**September 1992** - NSF International published its "Final Report Evaluation of the Sewage Aeration Systems Aerob-A-Jet Model 100". (Aerob-A-Jet is the former name of the technology now superceded with Vacuum Bubble® Technology). The NSF report states that "The evaluation, described in this report, does *not* constitute Certification or Listing by NSF against Standard 40 or Criteria C-9." Though the test was not designed to show compliance of the unit with a performance standard, the test conducted by NSF International showed reductions in the concentration of Biochemical Oxygen Demand (BOD), Total Suspended Solids (TSS), and Volatile Suspended Solids (VSS).

**2001** - Living Machines, Inc. of Taos, New Mexico assessed 5 different aeration devices for their oxygen transfer efficiency (OTE). The standard VBT™ unit for home septic systems – Model 100 – was included in this test. Living Machines, Inc. expanded the tests to assess the effectiveness of the VBT™ in a series of biological tests. The diffusers involved in the study created turbulence which, Living Machines, Inc. correctly asserted, is a disadvantage in effective aeration. Living machines, Inc. recognized the lack of turbulence associated with VBT™ operation.

**2002** - The United States Air Force, in conjunction with Sam Houston State University, Huntsville, Texas and the Texas Research Institute for Environmental Studies (TRIES) began an investigation of the efficacy of VBT™ in the development of portable sewage treatment units for deployment worldwide and to the Colonias on the Texas-Mexico border. The results of this study are presented in support of this application.

**Fall of 2003** - AAI purchased Sewage Aeration Systems, Inc. of Lockridge, IA and all the rights to the technology formerly known as Aerob-A-Jet. Advanced Aeration, Inc. has taken the basic technology and improved its engineering, focusing on quality engineering methods and standards to create equipment with high reliability and uniformity of production and assembly. In all other aspects, and specifically the principles and practice of operation, Advanced Aeration, Inc.'s VBT™ is identical to the former Aerob-A-Jet.

**2005** – State of Florida granted AAI the right to use VBT™ as an alternative repair to be installed in the first chamber of a multi-chambered tank.

**2006** – The State of Texas approved the use of VBT™ as an accessory device in the first compartment of any dual-compartment septic tank in Texas.
State of Virginia approved the installation of VBT™ in a septic tank with the intention of enhancing the performance of a Type I system.

**2007** – Florida approved the use of VBT™ in all applications – new, modified and repair.

## MODE OF OPERATION

AAI's patented Vacuum Bubble® Technology (VBT™) operates by drawing air through an air tube under a partial vacuum. This air passes through an air plate containing a number of small apertures. Distal of the air plate is a propeller that 'chops' the air further into very small bubbles. As the propeller turns (at approx 3,000 rpm) the air pulled through the air plate is pushed down into the water that is re circulating from below the propeller. Because the bubbles are produced in a partial vacuum, their individual internal pressure is lower than that of the surrounding water, consequently the bubbles collapse further, becoming neutrally buoyant. Their average dimensions are 0.25mm in diameter. These micro bubbles disperse through the water in a manner similar to colloidal particles via Brownian movement. Through its continuous production of bubbles of air, 0.25mm in diameter, VBT™ creates an Oxygen Transfer Potential (OTP) that enables aerobic bacteria to metabolize organic waste with the production of water and carbon dioxide as waste products.

The propeller is usually between six and twelve inches below the water surface in the tank. The unit is placed in the top of a tank either fixed to the superstructure or within a float that allows for the unit to rise and fall with the level of the water. This latter arrangement ensures that the air plate and propeller are always in the water, and in the event of a sudden rise in the water level, the motor is protected from being submerged.

The technology is extremely energy efficient. The model of VBT™ – Model 100 Series – typically installed in septic tanks uses a 1/15Hp electric motor. It has been shown that the ratio of the volume of the tank to horsepower should be no greater than 5,000 gallons per horsepower. The technology is such that it requires little or no maintenance, and units have been installed in septic tanks in numerous locations nationwide that have run continuously in excess of 8 years.

The VBT™ units are simple in design, using an electric motor from reputable companies (e.g. Bluffton Motor Works, formerly Franklin Motors), and the technology carries a 1 year parts and labor warranty. AAI has outsourced all engineering requirements to reputable engineering firms in different parts of the United States. Accepted Quality practices are adopted in the assembly of the units and each unit is tested prior to shipping. Installation and maintenance of all VBT™ units is undertaken by companies/individuals licensed in their respective States and experienced in specific wastewater markets such as, in the case of this application, onsite wastewater (residential septic) systems. These companies have specific personnel who have been designated as Licensed Service Providers (LSP) by AAI; these individuals have undergone training developed and delivered by AAI to install and maintain this technology. Maintenance of the units is recommended annually on the typical residential installation. If non-typical waste is expected, e.g. high strength from gourmet cooking, home brewing, medications, etc. a more frequent interval may be required.

### Micro Vacuum Bubbles®

The micro Vacuum Bubbles® produced by AAI's VBT™ are –

1. Negatively buoyant and remain suspended in the water for many minutes.
2. 0.25mm in diameter and have a greater surface to volume ratio than larger bubbles.
3. Distributed by diffusion through the water column.

1, 2 and 3 above create a sustained Oxygen Transfer Potential (OTP) in the water.

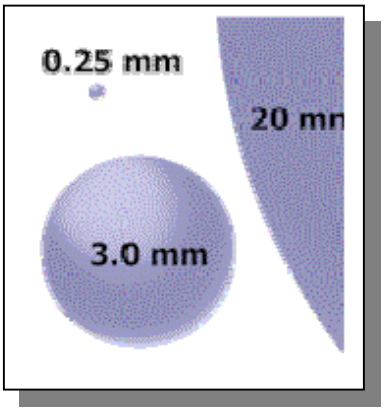
### Bubble Size and Aeration

- Compressed air diffusers produce bubbles 20mm or greater in diameter.
- Fine-pore diffusers produce bubbles between 2mm and 4mm in diameter.
- VBT™ creates bubbles 0.25mm in diameter

One 20mm Bubble
Surface Area – **12.6cm²**

= 300 3mm Bubbles
Total Surface Area – **84cm²**
**6x greater** than 20mm Bubble

= 500,000 0.25mm Bubble
Total Surface Area – **1000cm²**
**80x greater** than 20mm Bubble
**12x greater** than 3mm Bubble




AAI's VBT™ addresses Biochemical Oxygen Demand (BOD) problems, and waste treatment concerns by improving the performance of aerobic bacteria. As the aerobic bacteria oxidize waste through consuming oxygen, VBT™ makes additional oxygen readily available by continuously producing very large quantities of micro Vacuum Bubbles®.

### VBT™ vs. Conventional Aeration Methods

Advanced Aeration Inc.'s VBT™, instead of using the compressed air/fine pore system of conventional aeration equipment, uses a patented process to create bubbles in a partial vacuum.

VBT™ only very gently mixes the effluent, thus minimizing the disruptive impact of vigorous mixing and optimizing the contact time between the aerobic bacteria and the substrate. The gentle mixing also amplifies the Brownian motion naturally occurring in the water, thus ensuring the migration of the micro bubbles throughout the water column. The breakdown of the organic matter in the septic tank is thereby enhanced with Vacuum Bubble® Technology.

### Comparison of Forced Air and Vacuum Bubble® Aeration

| Forced Air | Vacuum Bubble® |
|---|---|
| Regardless of size, internal pressure is higher than that of the surrounding water | Formed in a partial vacuum – internal pressure lower than that of the surrounding water |
| Bubbles expand as they rise through the water column | Bubbles collapse to reach equilibrium |
| Bubbles rise rapidly to the surface | Bubbles remain in the water for many minutes |

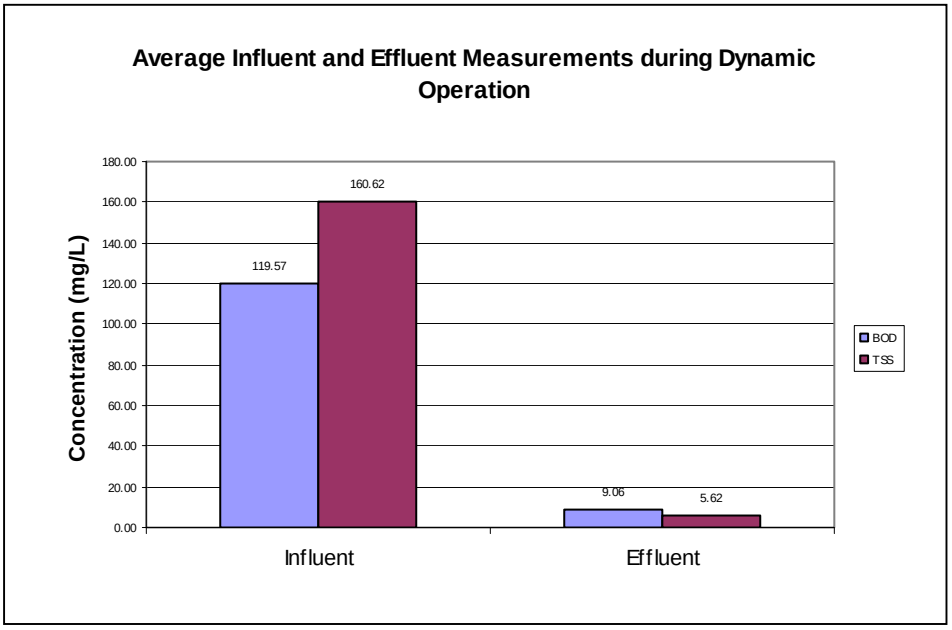
## A) RESEARCH AND DEVELOPMENT STUDY

### United States Air Force and Vacuum Bubble® Technology

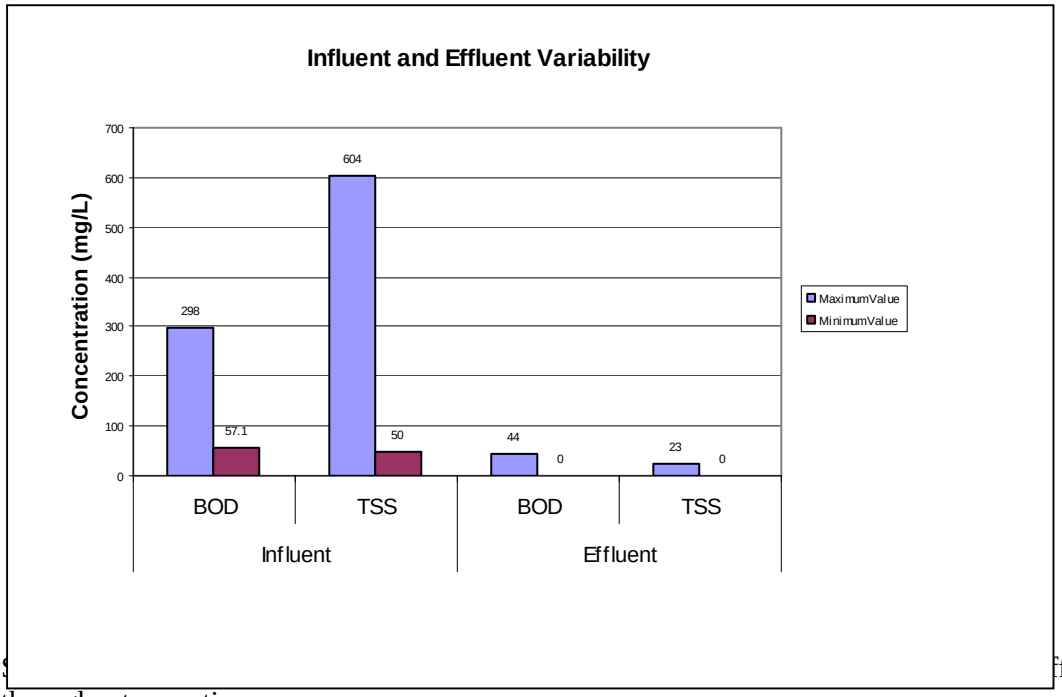
The United States Military finds itself deploying its men and women to distant and remote parts of the world, and into locations where there is no infrastructure to support normal daily activities. The Military refers to these locations as "bare bases". For health reasons, and from environmental considerations, the Military has shown a concern to develop biological treatment systems capable of treating a variety of waste (Municipal, Industrial, and Biological) for its deployments. For almost 5 years, the Texas Research Institute for Environmental Studies (TRIES) at Sam Houston State University, Huntsville, Texas, worked with the US Air Force's Air Force Institute for Operational Health (AFIOH) to conduct feasibility and engineering studies to develop these portable units. There have been many issues and problems to overcome in this development process, but throughout, the inclusion of VBT™ in the configurations to treat the organic waste has been the one consistently successful and trouble free component.

The objective of this research was to investigate a viable and economic treatment process for municipal wastewater streams. Dynamic tests were conducted between September 9 and December 18, 2003. Pilot scale tests involved a Vacuum Bubble® Technology (VBT™) unit in combination with bioaugmentation of a consortium of various microorganisms. Biological retention times ranging between 3.18 hours and 9.56 hours were evaluated to determine the optimal biological retention time required to effectively produce $BOD_5$ and TSS effluent levels of less than 20 mg/L.

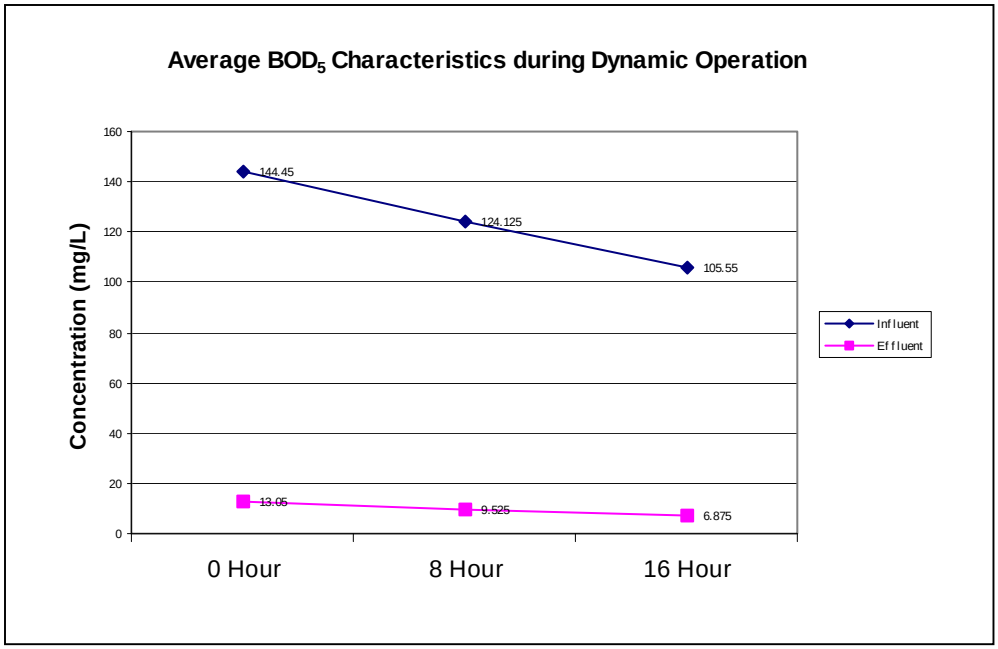
The proof of concept bioreactor met and exceeded the $BOD_5$ and TSS goals of less than 20 mg/L for Phase I research. The proof of concept system proved to be capable of treating municipal wastewater in a dynamic fashion with an overall retention time less than 11 hours with a treatment capacity ranging between 2,880 and 3,600 gallons per day. Future objectives involve constructing a prototype unit capable of treating a minimum of 7,700 gallons of municipal wastewater per day.



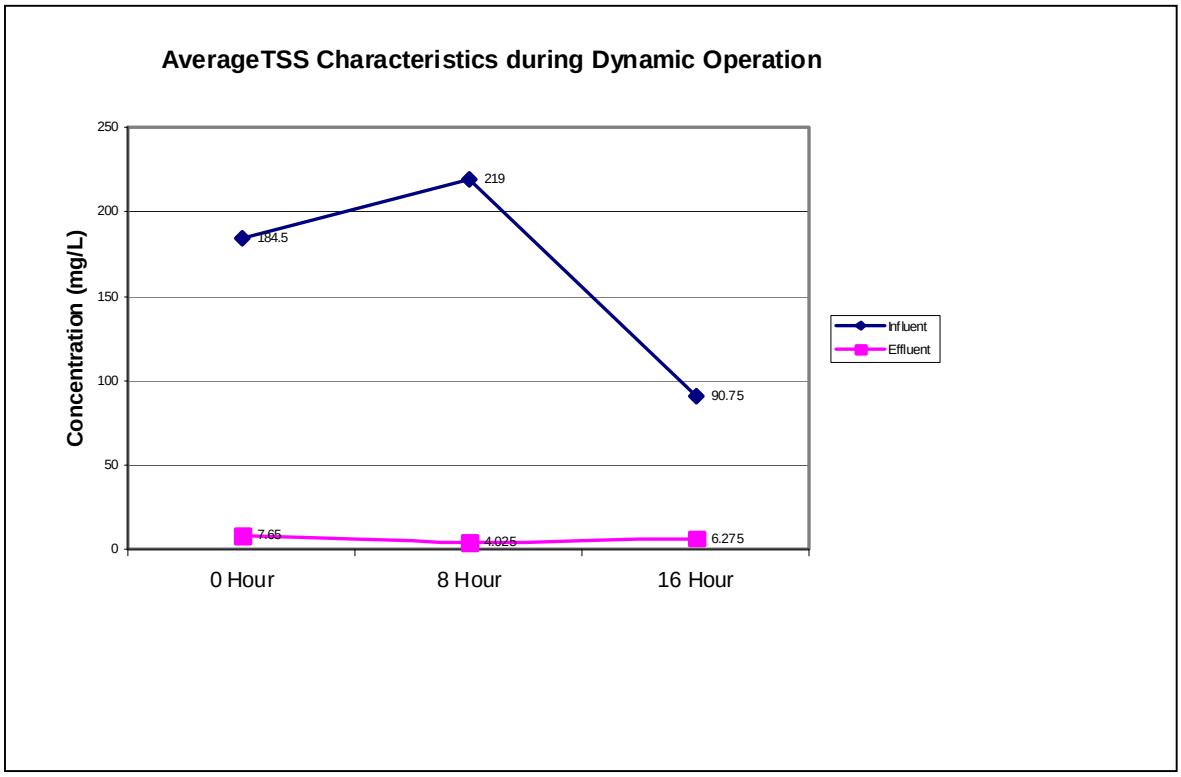

Average influent and effluent values for 5 tests that met the project objectives of effluent discharge with 20 mg/L $BOD_5$ and TSS.




S ffluent throughout operation.




Time course measurements of the average Influent and Effluent $BOD_5$ readings following conversion of the system to dynamic operation.

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## B) RESULTS OF PREVIOUS TESTING

## Independent (Third Party) Tests of VBT™

### 1. NSF International Test

#### Method

NSF International conducted a performance evaluation of the Vacuum Bubble® Technology Aerator (VBT™) at its NSF Wastewater Treatment Test Facility in Chelsea, Michigan. The VBT™ was installed in a precast concrete septic tank having a hydraulic capacity of 750 gallons, and was tested by dosing the tank at a rate of 400 gallons per day with comminuted municipal wastewater from the Village of Chelsea, Michigan. The testing took place over a six-month period, during which a seven-week stress test was conducted. Both influent and effluent were sampled daily for $BOD_5$ and TSS. The VBT™ was located just outside the outlet tee, with the bottom submerged approximately 13 inches below the water surface. The VBT™ was operated in a continuous run mode. As indicated earlier, this evaluation did "*not* constitute Certification or Listing by NSF against Standard 40 or Criteria C-9."

#### Evaluation

After a start up period of three weeks, the plant was subjected to a loading sequence of 16 weeks at design loading (400 gpd), 7 weeks at stress loading, and 4 weeks at design loading (400 gpd). The stress test loading was designed to evaluate how the plant performs under non-ideal conditions, including high and low hydraulic loadings, and electrical or system failures. During the testing, 24hour composite samples were collected of the influent and the effluent, five times per week. The samples were analyzed for $BOD_5$, suspended solids (TSS) and volatile solids (VSS).

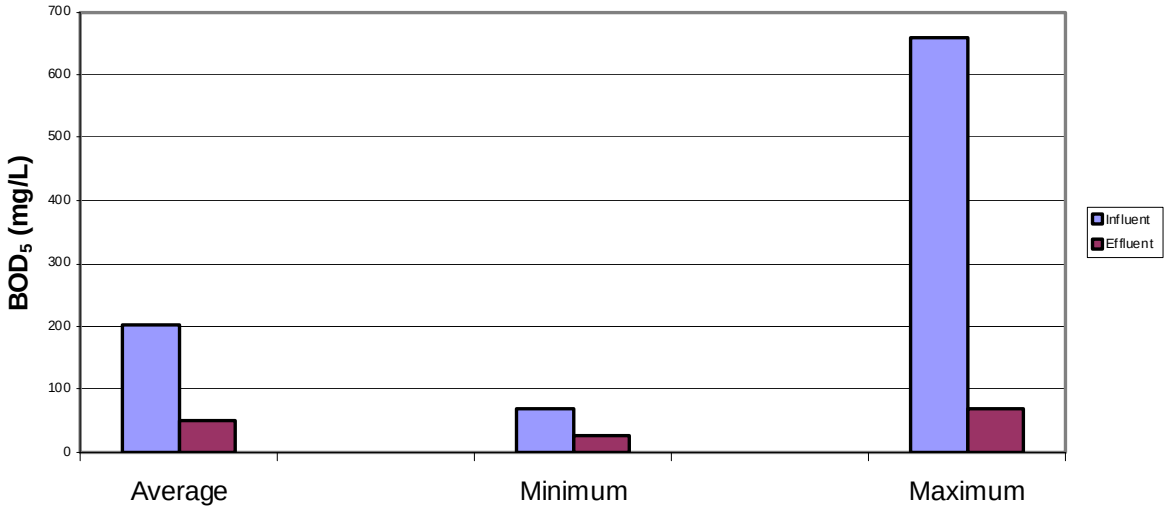
#### Results

The results of chemical analyses and on-site observations and measurements made during the evaluation period are summarized overleaf:

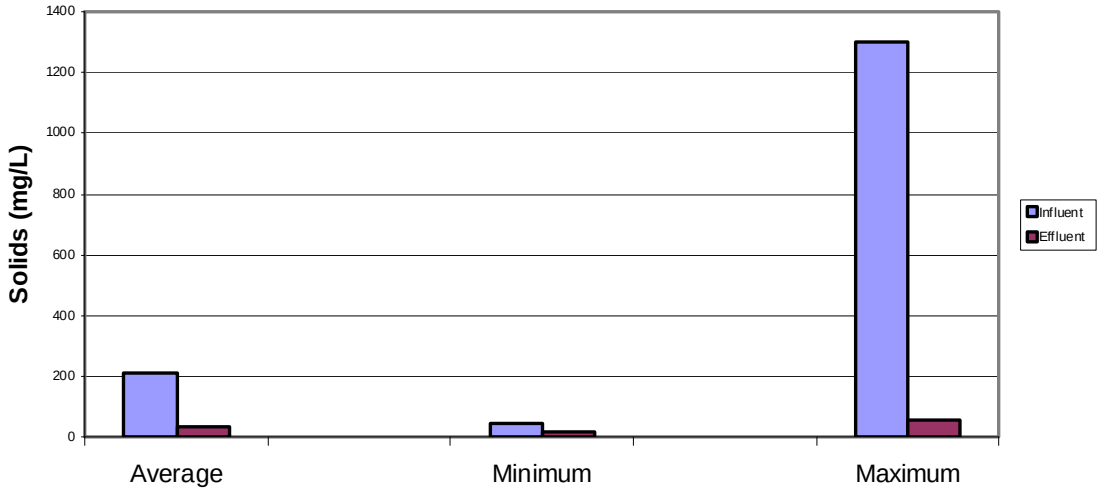
**Summary of Analytical Results**

| | Average | Minimum | Maximum |
|---|---|---|---|
| **$BOD_5$ (mg/L)** | | | |
| Influent | 202 | 70 | 660 |
| Effluent | 51 | 28 | 70 |
| **% Reduction** | **74.8** | **60.0** | **89.4** |
| | | | |
| **Suspended Solids (mg/L)** | | | |
| Influent | 212 | 44 | 1,300 |
| Effluent | 36 | 19 | 56 |
| **% Reduction** | **83.0** | **56.8** | **95.7** |
| | | | |
| **Volatile Solids (mg/L)** | | | |
| Influent | 178 | 34 | 1,000 |
| Effluent | 31 | 13 | 46 |
| **% Reduction** | **82.6** | **61.8** | **95.4** |

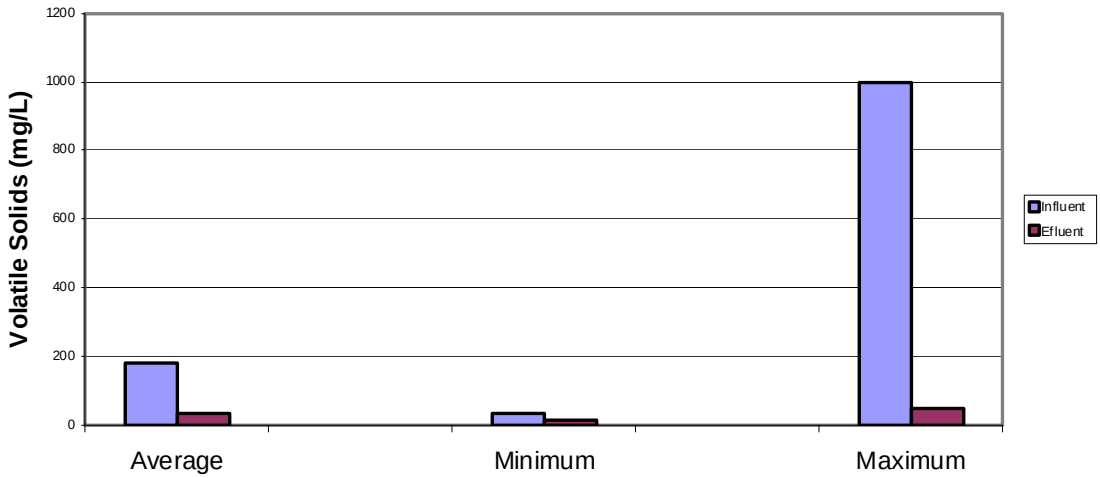
**Summary of NSF Analytical Results - $BOD_5$**



**Summary of NSF Analytical Results - Suspended Solids**




**Summary of NSF Analytical Results - Volatile Solids**




## Conclusions

The standard septic tank with a VBT$^{TM}$ installed reduced the average $BOD_5$ of the influent (202 mg/L) by 74.8% to 51 mg/L. Similarly, average suspended solids of the influent (212 mg/L) were reduced by 83% to 36 mg/L. Of significance is that the VBT$^{TM}$ modified septic tank was able to reduce the highest loading $BOD_5$ (660 mg/L) and TSS (1,300 mg/L) values by 89% and 95% respectively. It can be concluded that if two VBT$^{TM}$ systems were placed in series, the resulting average effluent $BOD_5$ and TSS noted above (51 mg/L and 36 mg/L respectively) would be reduced by an additional 74.8% and 83.0% to 13 mg/L and 6 mg/L respectively.

### Comparison of Published Data on Standard Septic Tank Performance

Many studies have been conducted in which the effluent from septic tanks was sampled and analyzed to evaluate the quality of the effluent from the tank. Published data from several studies, along with the results obtained from the NSF evaluation of Vacuum Bubble® Technology, are summarized below. The data compares the Vacuum Bubble® Technology to several standard anaerobic septic tanks.

| Std. Septic Tanks Studied | | | BOD | | TSS | |
|---|---|---|---|---|---|---|
| | Ave. BOD | Ave. TSS | Low | High | Low | High |
| 1 | 138 | 49 | 7 | 480 | 10 | 695 |
| 2 | 138 | 155 | 64 | 256 | 43 | 485 |
| 3 | 140 | 101 | n/a | n/a | n/a | n/a |
| 4 | 240 | 95 | 70 | 385 | 48 | 340 |
| 5 | 120 | 39 | 30 | 280 | 8 | 270 |
| Ave. | 155 | 88 | 43 | 350 | 27 | 448 |
| **VBT™** | **51** | **37** | **28** | **70** | **14** | **64** |
| **% Reduction** | **66.7%** | **57.5%** | **35%** | **80%** | **48%** | **86%** |

On average, standard septic tanks generate effluent that is three times the strength of that by a VBT™ modified septic tank.

## 2. Standard Oxygen Transfer Efficiency (SOTE) Test

In 2001 Living Machines, Inc. of Taos, New Mexico assessed 5 different aeration devices for their oxygen transfer efficiency (OTE). The standard VBT™ unit for home septic systems – Model 100 – was included in this test.

The tests were conducted in a circular tank 84" in diameter and 56" deep filled with 1,340 gallons of water, one tank per aeration device. Baseline data were gathered prior to each test following the introduction of 7.88 grams of sodium sulfite ($NaSO_2$) per gram of dissolved oxygen in the water. To ensure an oxygen concentration of zero gm/L an additional 50% of $NaSO_2$ was added to the water. After mixing the water and the $NaSO_2$ in the tank the aeration device was turned on and oxygen measurements were taken at different levels in the tank every 30 minutes for 24 hours.

> *"OTE was measured as kg of oxygen transferred per kW from the beginning of the test to half of theoretical oxygen saturation."*

Though the VBT™ Model 100 was not the best in terms of standard OTE it was second to a technology known as MixAirTech.

## SOTE Results

1. Tested 5 different aeration devices.
2. The highest Standard Aeration Efficiency (SAE) was achieved by the MixAirTech diffuser – 0.0545Kg$O_2$/KwHr.
3. VBT™ was ranked in the middle of all devices tested.

The Living Machines Inc. report stated that

> *"The ideal aeration device would provide efficient oxygen transfer without turbulence"*

and the report contended

> *"Although the oxygen transfer performance of the Aerob-A-Jet is significantly less than that of the MixAirTech diffuser the lack of turbulence is desirable."*

The VBT™ unit proved to be 38% more energy efficient than the diffuser.

The report concluded that the SOTE test alone was insufficient to

> *"distinguish other performances between the two devices"*

and that biological data was also required. The VBT™ was tested against the fine bubble diffuser (MixAirTech) using two identical HDPE tanks of artificial wastewater with nitrifying activated feed sludge added. The artificial wastewater was created by adding "Mol-Mix" liquid cattle feed supplement to local well water.

## Biological Test Results

Biological test on artificial wastewater

| | **BOD (5 day), mg/L** | | **TSS, mg/L** | |
|---|---|---|---|---|
| **Test Day** | VBT™ | Diffuser | VBT™ | Diffuser |
| 1 | **550** | 550 | **<10** | <10 |
| 2 | **330** | 520 | **105** | 171 |
| 3 | **260** | 270 | **66** | 233 |
| 4 | **150** | 240 | **78** | 324 |
| 5 | **<100** | 270 | **82** | 276 |
| | **81% Reduction** | **50% Reduction** | **Diffuser 336% > VBT™** | |

Living Machines, Inc. concluded -

1. Vacuum Bubble® Aeration was the best in removing Biological Oxygen Demand (BOD)
2. Reduction in BOD was accomplished without creating excess TSS. The diffuser produced 336% more TSS than VBT™, and the VBT™ decreased BOD by 30% more than the diffuser

The samples for these tests were analyzed by Severn-Trent Laboratories, Houston, Texas, expressly for Living machines, Inc.

(Adapted from *Living Machines, Inc. "Test of VBT™ versus fine bubble diffusers", 2001).*

## 3. Baylor University Assessment of VBT™ (A copy of the full report is included in the Appendix)

The Baylor University, Baylor, Texas study sought to determine the impact of VBT™ on the performance of the leach field. Wastewater from the regional sewerage system was dosed to two 750-gallon septic tanks that were placed in series. The study followed the NSF/ANSI Standard 40 design loading format. Effluent from the second tank was pumped into two columns containing different soil types. The effluent from the soil columns drained into sample bottles which were refrigerated and collected every 48 hours. The study was conducted between December, 2007 and May, 2008.

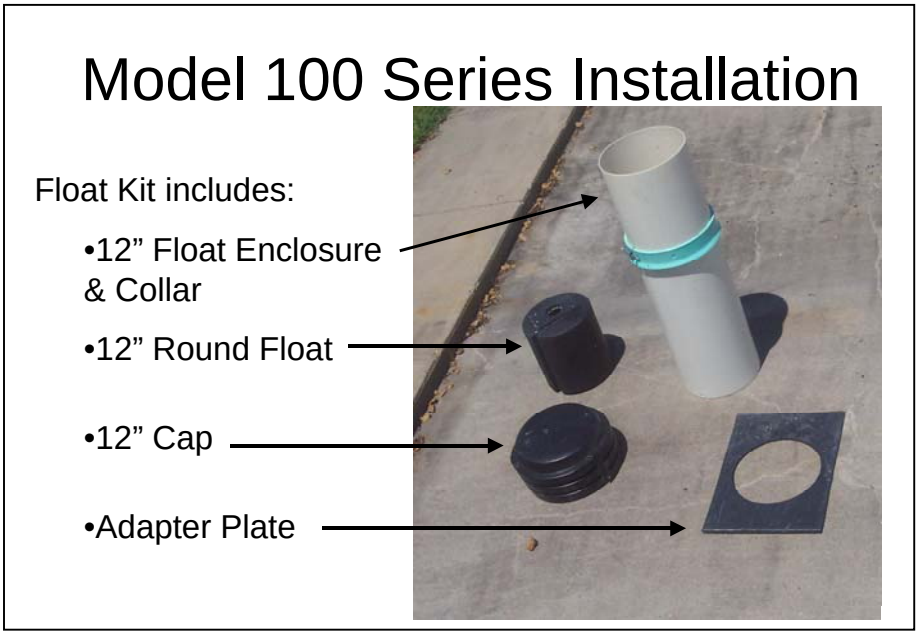
$CBOD_5$ was reduced to 435 mg/L (81%) from the raw values to the effluent from the first tank and to 29.4 mg/L (87%) from the raw values to the effluent leaving the second tank. The corresponding values for TSS were 22.6 mg/L (88% reduction) and 7.4 mg/L (96% reduction).

E. coli numbers were reduced 85% after passing through the first tank, and 98% through the second tank. The Fecal coliform count was reduced by 93% after the first tank, and 98% after the second tank.

## C) DESIGN AND INSTALLATION CRITERIA

The Vacuum Bubble® Technology unit – Model 100 Series – is designed for installation in existing home septic systems that discharge into sub-surface drain fields. The VBT™ can be mounted in a manhole riser or similar penetration of the tank lid that allows the VBT™ to be set at the proper elevation. VBT™ can also be installed in tanks with changing liquid levels (pump tanks) via use of a float system to insure against motor inundation. Typical tank size in Minnesota is expected to start at 500 gallons, but a tank that provides at least 12 inches of liquid below the propeller of the VBT™ is the minimum requirement. In other words, a successful installation could use a tank that is less than 500 gallons capacity.

The VBT™ unit is installed directly into the aperture in the roof of the tank provided an adapter plate is used to prevent the unit from falling into the tank. The ideal installation requires the use of a float kit. The float kit is comprised of –




The float kit ensures that the propeller and air plate of the VBT™ unit are always a minimum of 6” below the surface of the water in the tank. The float kit also ensures that in the event of a large and sudden rise in the level of the water in the tank, the electric motor is not submerged.

Installation requires that an electric power outlet (120v) is available within 24” of the location of the VBT™ unit when installed in the septic tank. In the event such an outlet is not available at this

location the electrical cord and plug attached to the VBT™ unit must be connected to a waterproof extension cord that is installed according to local electric safety codes.

See Appendix for VBT™ Model 100, 200, and 300 Series Installation Manuals and Warranty Document.

## D) PERFORMANCE AND RELIABILITY DATA

### Onsite Wastewater

### **Grinder Tank Application, North Carolina**

#### Background

A major housing development is underway in North Carolina, and one phase of the development is now complete. As a part of the development, grinder tanks have been installed for each household and the waste from these tanks is pumped to a treatment plant via lift stations.

#### Problem

Residents of the housing development complained of odors emanating from the grinder tanks on their properties.

#### Solution

Vacuum Bubble® Technology (VBT™) was identified as a technology with the capacity to solve this problem.

#### Method

Quantitative measures of Hydrogen Sulfide ($H_2S$) levels were taken using a Rig Rat III gas detection device. Data was collected from April 25, 2007 to May 21, 2007.

$H_2S$ levels were recorded before and after VBT™ treatment and high, low, and mean values were identified for the pretreatment and treatment levels

#### Results

Pre-treatment $H_2S$ levels ranged from 0.009 ppm to 0.560 ppm with a mean of 0.0554 ppm. After VBT™ treatment $H_2S$ levels rarely registered over 0 ppm.

The following charts illustrate these results.

Chart 1

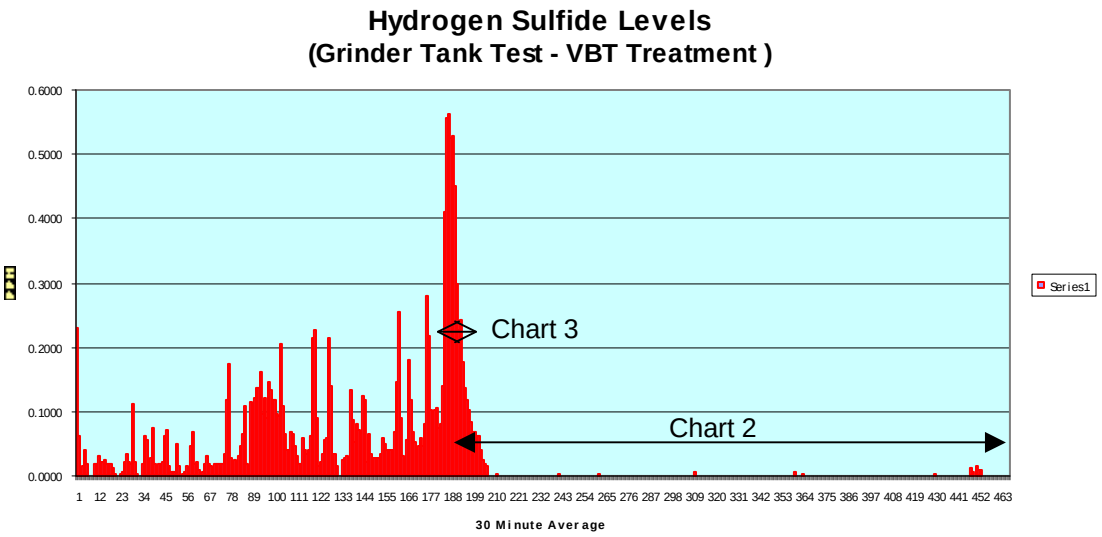



Chart 2

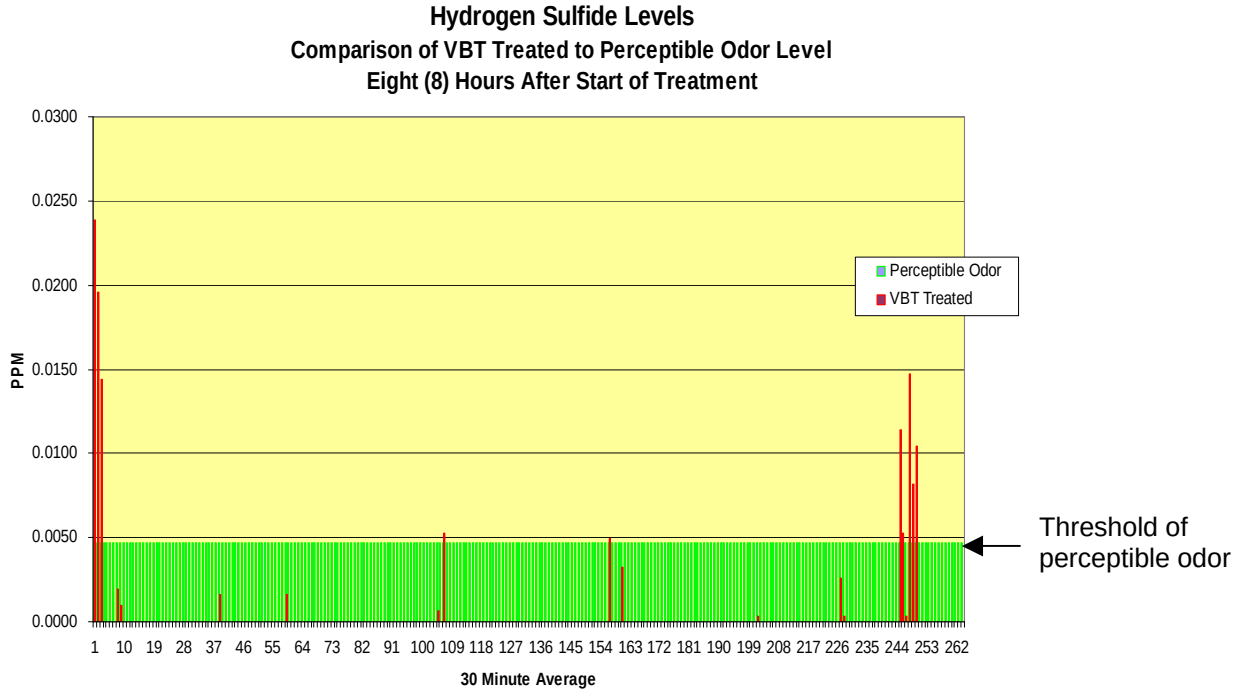
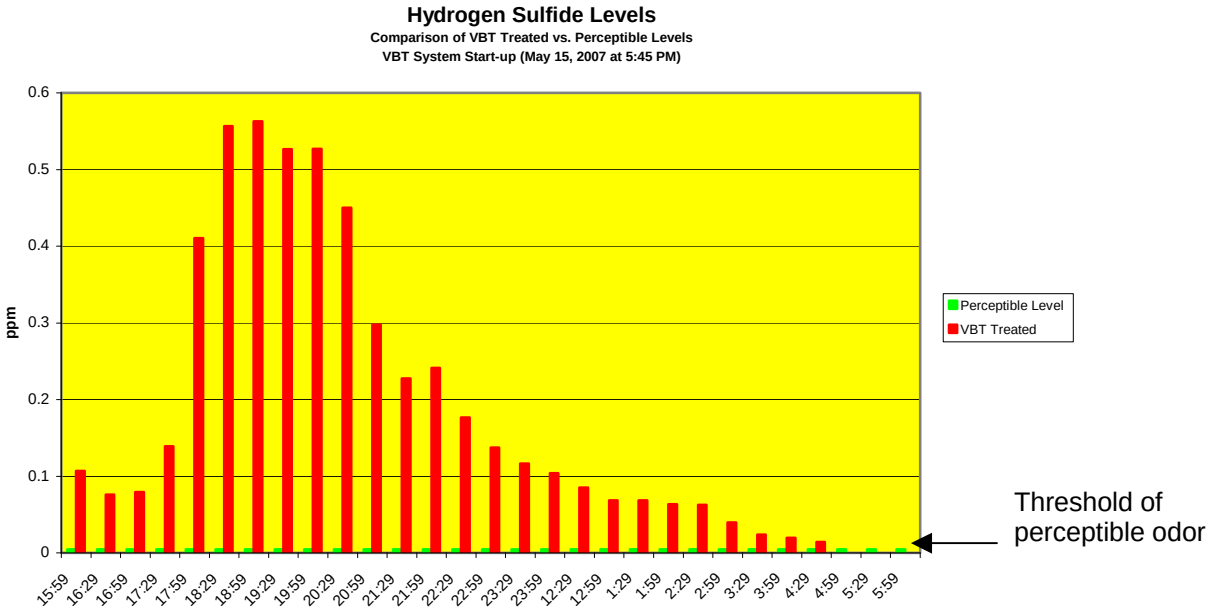


Chart 3




Threshold of perceptible odor

## E) THE TECHNOLOGY

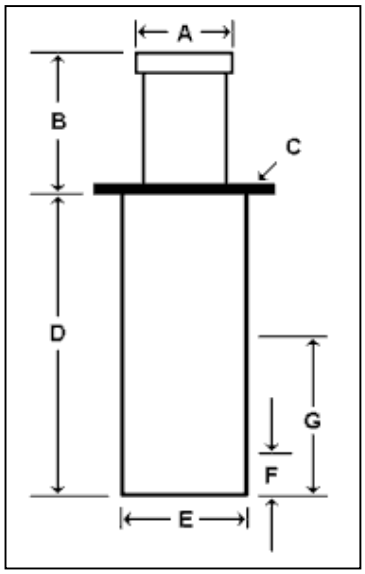
### Vacuum Bubble® Technology (VBT™) Aerator Model 100 Series

The Vacuum Bubble® Technology Aerator Model 100 Series is sized for on-site wastewater treatment, small commercial applications, and pretreatment of industrial wastewater. Several configuration options give flexibility to meet differing requirements. Available options include an all-weather housing, self-monitoring electronic controller, and a basic GFI controller.

## VBT™ 101 Specifications

| | |
|---|---|
| **Cubic Feet/Minute (Air)** | **0.22** |
| **Cubic Feet/Day (Air)** | **317** |
| **Lb. Oxygen/Day** | **5.49** |
| **Lb O2/Hp/Hour** | **3.4** |

| | |
|---|---|
| **A: Motor Diameter** | **4.17”** |
| **B: Motor Height/1 Phase** | **6.5”** |
| **C: Adapter Plate (Dia.)** | **5.5”** |
| **D: Air Tube Length** | **19.75”** |
| **E: Air Tube Diameter** | **2.375”** |
| **F: Min Water Line** | **6.0”** |
| **G: Max Water Line** | **16.0”** |




**Motor – Bluffton MW 1/15Hp**

| | |
|---|---|
| **Voltage 1 Phase** | **115** |
| **Full Load Amps** | **1.0** |

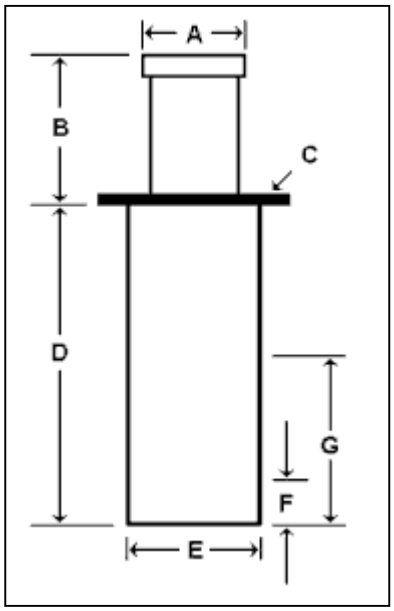
## Vacuum Bubble® Technology (VBT™) Aerator Model 200 Series

The Vacuum Bubble® Technology Aerator Model 200 Series is designed for medium sized industrial, commercial, and livestock applications in a tank mounted system. A GFI controller is available for the VBT™ 200.

### VBT™ 200 Specifications

| | |
|---|---|
| **Cubic Feet/Minute (Air)** | **1.25** |
| **Cubic Feet/Day (Air)** | **1,800** |
| **Lb. Oxygen/Day** | **32** |
| **Lb $O_2$/Hp/Hour** | **5.33** |
| **Approx. Flow (Gal/Day) @ 300 PPM $BOD_5$** | **6,500** |

| | |
|---|---|
| **A: Motor Diameter** | **4.17"** |
| **B: Motor Height** | **8.5"** |
| **C: Adapter Plate (Dia.)** | **6.5”** |
| **D: Air Tube Length** | **22.0"** |
| **E: Air Tube Diameter** | **4.5"** |
| **F: Min Water Line** | **6.0"** |
| **G: Max Water Line** | **16.0"** |




**Motor – Bluffton MW 1/4HP**

| | |
|---|---|
| **Voltage** | **115** |
| **Full Load Amps** | **2.8** |

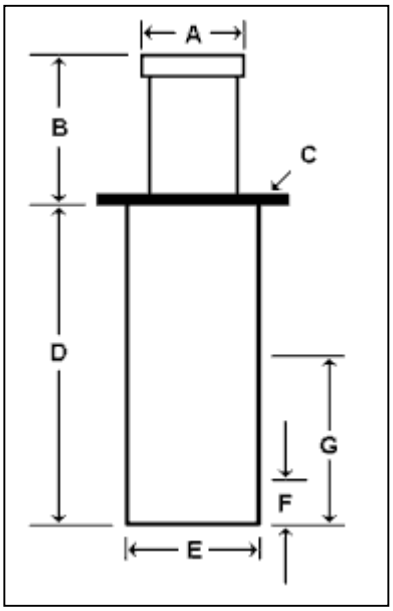
## Vacuum Bubble® Technology (VBT™) Aerator Model 300 Series

The Vacuum Bubble® Technology Aerator Model 300 Series is ideal for mid sized CAFO facilities, small to medium sized municipal sewage processing sites, and portable sewage treatment modules. This unit has a flotation platform available as an option.

### VBT™ 300 Specifications

| | |
|---|---|
| **Cubic Feet/Minute (Air)** | **5.00** |
| **Cubic Feet/Day (Air)** | **7,200** |
| **Lb. Oxygen/Day** | **132** |
| **Lb $O_2$/Hp/Hour** | **5.5** |
| **Approx. Flow (Gal/Day) @ 300 PPM $BOD_5$** | **26,000** |

| | |
|---|---|
| **A: Motor Diameter** | **7.3”** |
| **B: Motor Height** | **10.12"** |
| **C: Motor Mount (Square)** | **12.0"** |
| **D: Air Tube Length** | **22.5"** |
| **E: Air Tube Diameter** | **8.5"** |
| **F: Min Water Line** | **6.0"** |
| **G: Max Water Line** | **16.0"** |




**Motor – WEG 1Hp**

| | |
|---|---|
| **Voltage 1 Phase** | **115/230** |
| **Full Load Amps** | **12.8/6.4** |