

# **Reduction of Hydrogen Sulfide (H<sub>2</sub>S) Odors In Biosolids Storage & Dewatering Facility With a Bio-Organic Catalyst (BOC)**

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## **ABSTRACT:**

An extensive exploration has been underway for a number of years to determine the effectiveness and economic value of using a bio-organic catalyst (BOC) composition to substantially reduce odors in municipal wastewater treatment and collection systems. The BOC composition is based upon a unique and proprietary biochemistry that contains biologically derived biocatalysts, surface modifying synthetic compounds, and other proprietary ingredients that contribute to their novel catalytic properties and enhanced oxygen availability. BOCs have capabilities that integrate *solubilization*, *oxidation*, and *catalysis* characteristics (S - O - C). The ability of BOC to increase dissolved oxygen and gas transfer rates, at the same or lower energy levels, and acceleration of biological processes, has shown great potential for solving chronic odor problems, advanced biosolids processing, and cost reductions in operations. Directly applicable to the evaluation program described herein, is the possibility of using a BOC additive to lower sludge odors connected to belt press dewatering systems, through direct injection of a highly diluted dosing of the BOC, prior to the sludge storage tanks. Secondary benefits of BOC additive to biosolids processing are based upon reductions of other operating costs, and improvement in quality of biosolids.

## **KEYWORDS:**

Biosolids, Sludge, Odors, Hydrogen Sulfide Gas (H<sub>2</sub>S), Total Solids (TS), Total Suspended Solids (TSS), Volatile Suspended Solids (VSS).

## **INTRODUCTION:**

Mattabasset Municipal Wastewater District (MMWD) located in Connecticut, USA identified the elimination of community complaints and improved dewatering facility air quality as the primary objectives in undertaking the following evaluation program at their municipal wastewater biosolids dewatering and incineration facility. This evaluation program was to test the operational efficacy and economic values of the BOC biocatalytic additive.

This evaluation program at (MMWD) was to determine the ability of the BOC to substantially reduce odors, improve sludge moisture content, and reduce energy and chemical costs through direct injection of the BOC into the sludge feed line prior to the sludge storage tanks.

The MMWD municipal wastewater treatment facility processes, through a belt press dewatering and incineration facility, its own sludge (35%), as well as outside sludge (65%). The dewatering and incineration of outside sludge represents an important revenue source for the wastewater facility.

Substantial odor containment and airflow infrastructure investment, including a biological scrubbing tower, had been made previously. Real-time analytical controls provided the facility with very robust capability to evaluate odors, flow rates, chemical usage, and energy usage.

Hydrogen Sulfide (H<sub>2</sub>S) volatile odor reduction in the general geographical footprint of the facility's dewatering building, and within the enclosed work areas, housing the biosolids storage and handling systems, was the primary goal of this evaluation program.

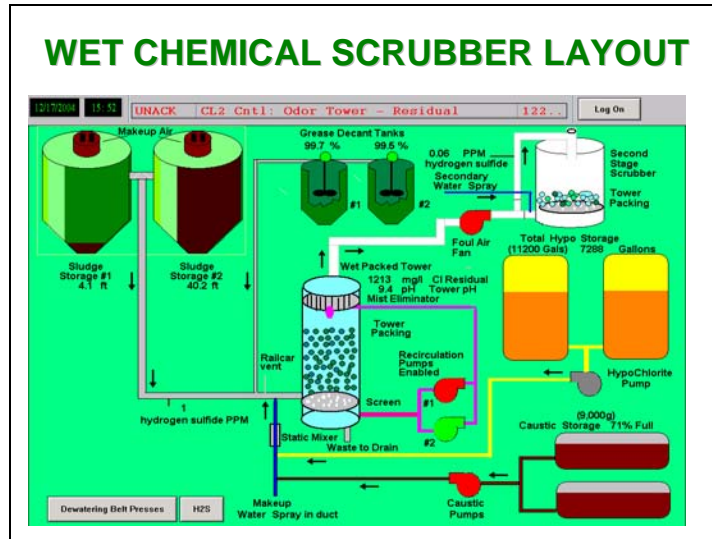
Current processing rates of MMWD wastewater facility is approximately 350,000 tons (gallons) of biosolids daily. Facility has two 500,000-gallon biosolids holding tanks equipped with in-line gas sensors and a wet chemical gas-scrubbing tower, which uses Sodium Hypochlorite as an oxidation agent. Potassium permanganate and/or caustic soda is used in dewatering and handling systems for odor and pH control. Reduction and or elimination of these chemical agents were an additional objective of this evaluation program.

The BOC biocatalyst is not an odor-masking agent, such as essential oils, nor is it a bacterial/enzyme product, or traditional oxidizing chemical. BOC compositions have previously shown significant reduction potential on odors through two principal mechanisms: 1) Physically altering the shape of the odor-causing molecules; and 2) Changing the microbial ecology to a more aerobic state to rapidly oxidize odorous gases and prevent their subsequent formation.

Prior applications of BOC in odor reduction strategies have been directed at substantially reducing odors, and eliminating the conditions that cause odors throughout municipal wastewater systems; including, collection systems (FOGs, slime layers, low dissolved oxygen conditions), residuals collection and transport, biosolids processing and dewatering.

### **METHODOLOGY:**

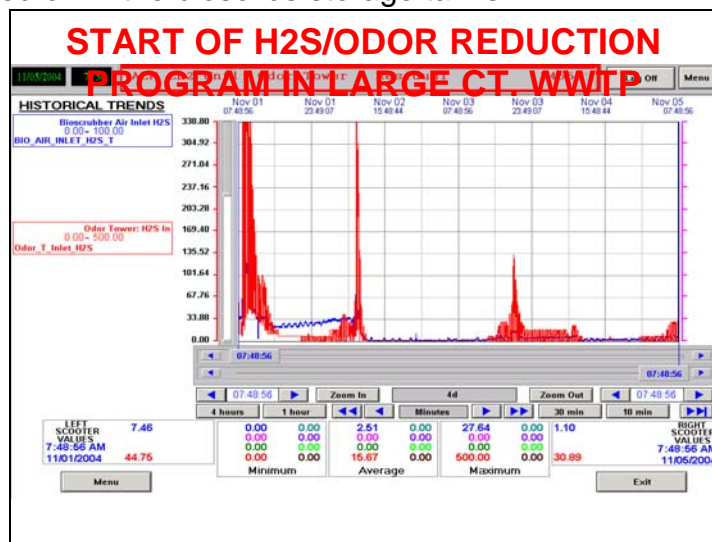
A SCADA based in-line hydrogen sulfide gas sampling system and hydraulic flow monitoring system was available to determine H<sub>2</sub>S gas concentrations within the biosolids storage tanks and biological air filtration system, septic and industrial waste stream loads into the biosolids storage tanks. The measurement system included; H<sub>2</sub>S concentration levels, power usage of aeration blowers to storage tanks, chemical usage in wet chemical scrubbing tower, and fuel oil consumption by the incineration system.



### Base Line Measurements:

Prior to introduction of BOC biocatalytic agent, the following measurements were made:

1. The average H<sub>2</sub>S gas readings, within the biosolids storage tanks, run 100 - 150 ppm, as measured at the inlet of the wet chemical gas-scrubbing tower, with periodic high concentrations of up to 500 ppm when aeration mixers are initially turned on in the biosolids storage tanks.

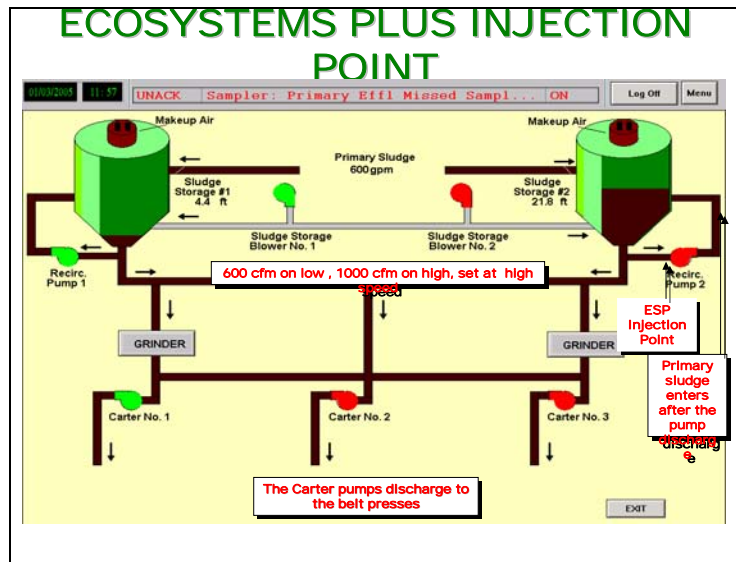


2. The average H<sub>2</sub>S gas readings run 6 - 8 ppm, from the dewatering belt press air extraction system, as measured at the inlet of the biological scrubbing unit, with periodic high concentrations of up to 12 - 14 ppm.

3. There are periodic and correlated elevations in the H<sub>2</sub>S gas measurements, within the biosolids storage tanks from various outside sources, typically through discharge of 40,000 gallon rail cars and 5,000 tankers, of their residual wastes into the facility's biosolids storage tanks, for subsequent dewatering and incineration.
4. The average H<sub>2</sub>S gas readings remain consistent under varying volumes within biosolids storage tanks, indicating that quality of outside discharges, rather than quantity of discharge volumes, is a determining factor in H<sub>2</sub>S gas concentrations.
5. Auxiliary oil costs relating to meeting optimal incineration rate average for the month of Nov, 2004 were 231 GPD (US), 6,932 (US) gallons per month, with a maximum of GPD of 415, and a minimum 11 GPD.

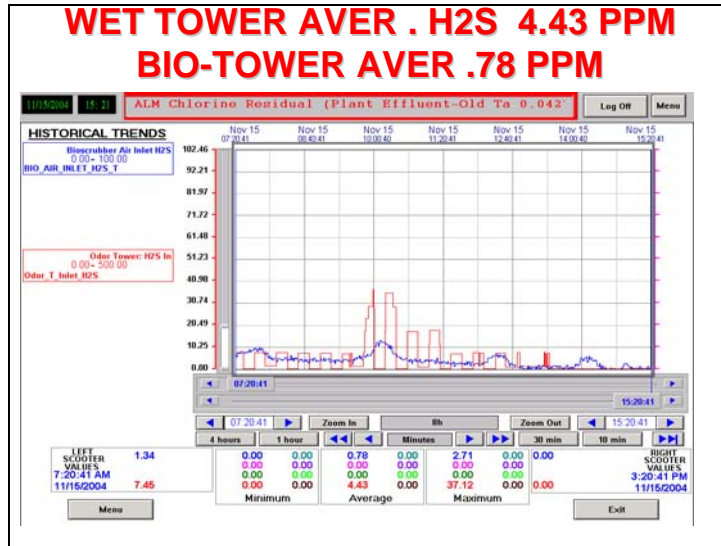
**Installation of the BOC Injection System:**

1. A LMI chemical feed pump, was used to inject BOC (16 ml. per minute) or (6 gallons (US)/24 Hrs.) which is diluted with potable water at the rate of 2 gpm). This mixture was injected in the sludge holding tank to optimize dispersion of BOC throughout biosolids in storage tanks. (This yields a BOC treatment rate of 18 ppm per million gallons of sludge processed at the belt presses). BOC biocatalyst is injected from a 55-gallon drum, connected by a 50-foot polyethylene tube that connects to an available injection point at the top of the intake pump for the biosolids storage tanks.

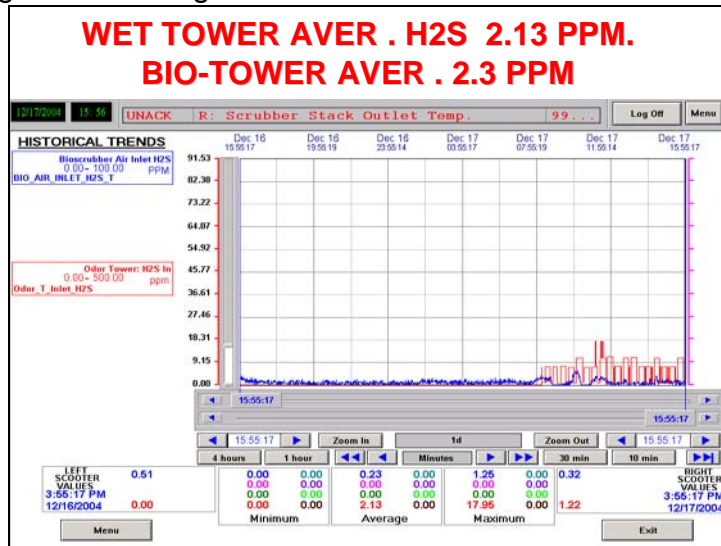


**RESULTS:**

1. Reduction of H<sub>2</sub>S gas readings within biosolids storage tanks: Base Line average of 100 - 150 ppm, down to less than an average of 3 ppm, upon injection of BOC biocatalytic agent.

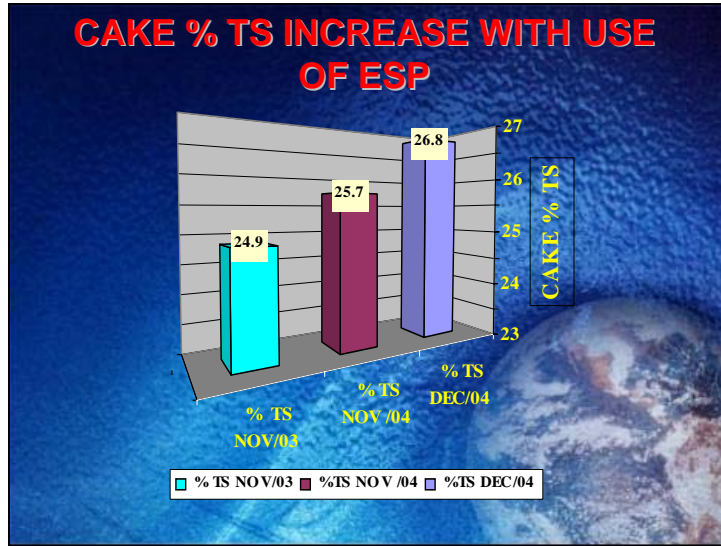


2. Reduction of H<sub>2</sub>S gas readings into biological scrubbing tower: Base Line average of 6 - 8 ppm, down to less than 1 ppm, upon injection of BOC biocatalytic agent. Resulting in less than 0 ppm of H<sub>2</sub>S gas being discharged in the biological scrubbing tower exhaust.

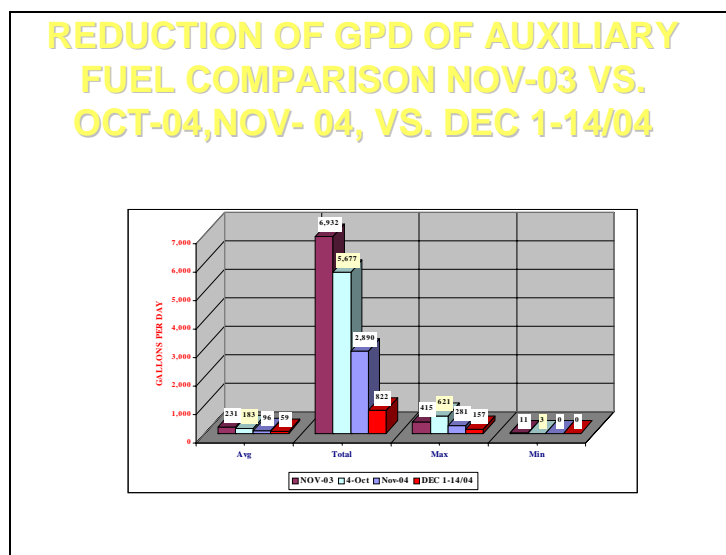


3. Reduction of H<sub>2</sub>S gas odors, to staff, within work areas adjacent to dewatering belt presses and handling systems. (Subjective Reports - Unanimous)
4. Belt Presses and Gratings in the dewatering facility were noticeably cleaned, resulting in potentially greater micro pore performance.

5. The percentage TS of dewatered biosolids was increased from 24.9 % (The base line of Nov-03), vs. to 25.7 % of (BOC treatment began Nov.1 of 2004.) With Dec of 2004 increasing to 26.8 % TS.



Reduction of GPD of Auxiliary Fuel Comparison Relating to meeting optimal incineration rate average for the base line month of Nov, 2004 were 231 GPD (US), 6,932 (US) gallons per month, with a maximum of GPD of 415, and a minimum 11 GPD. BOC treatment BEGAN Nov 1 2004 There was a 58 % reduction GPD. Fuel Consumption GPD was further reduced by 38.5 %.



Use requirements for oxidation chemicals and pH control, Sodium Hypochlorite, was reduced 60 % and Sodium Hydroxide was reduced 88 % while the Biosolids Tanks were treated with BOC.

The Chemical Wet Scrubbing Tower was then disconnected, allowing a complete elimination of chemical costs, employee-handling requirements, and energy costs. The facility's own sludge volumes produced the most difficult to treat odor causing biological conditions, potentially due to the lack of anaerobic digestion of the sludge prior to their transfer to the storage tanks.

6. Optimum dosage rates were established by operator.
7. Community odor complaints were eliminated for the first time in 5 years.
8. Operational cost savings from lower chemical usage, and reduced electrical requirements, result in a net savings to facility, after the cost of BOC biocatalytic agent.

## **DISCUSSION:**

The evaluation program at MMWD with the BOC biocatalytic additive demonstrated good performance in substantially reducing H<sub>2</sub>S odors within the sludge storage tanks and dewatering filter press facility. Additionally, use of the BOC biocatalytic additive demonstrated good economic value through providing chemical usage reductions, improvement of operating costs, as well as contributing to overall quality improvements within the treated biosolids.

BOC appears to lower the threshold for conversion of the sludge biomass from an anaerobic biological bias to an aerobic biological bias. This capability resulted in stopping production of H<sub>2</sub>S gases from the bulk biomass within the sludge storage tanks and dewatering belt press facility. There are dosage response characteristics, wherein minimum dosage levels are required for the anaerobic to aerobic conversion of sludge biomass to occur. Sludge reactivity to this biological conversion varies with source and previous biological treatment of sludge. Dilution of BOC additive with water provides improved dispersion throughout entire biomass of sludge volume. Effectiveness of BOC additive appears to continue for period after BOC dosing discontinued. This may be due to cycling of BOC from filtrate discharges back to influent, impacting sludge from primary clarifier and return activated sludge.

Availability of adequate air, or oxygen, through air mixing within sludge storage tank appears to be an important variable in effecting the biological conversion of sludge biomass. Within proper parameters, BOC additive is more effective in reducing odors than use of more traditional oxidative chemicals, such as Sodium Hypochlorite and Potassium Permanganate. The solubilization of FOG components of sludge appears to

contribute to cleaning of filter belt presses, and reduction of moisture content, through improved release of water during dewatering. The reduction in fuel oil requirements also indicates the reduction of moisture content, and possible other factors which contribute to lower, or optimum, sludge quality for incineration. There may also be preliminary indications that this sludge quality improvement can provide subsequent odor management benefits to facilities that transport biosolids, and for use of municipal biosolids in nutrient land applications.

### **Areas for further exploration:**

Effectiveness of BOC additive appears to be susceptible to seasonal use of salt on roads for deicing, as the increased salinity entering the collection system inhibits oxygen transfer, leading to substantially higher sulfides entering wastewater facility and impacting sludge quality being transferred to sludge holding tanks. This issue will require additional treatment of influent wastewater to improve oxidation of sulfides within collection systems during seasonal conditions where increased salinity occurs.

Improved solubility and lower thresholds for gas transfer from use of BOC additive may lead to viability of introduction of BOC additive within collection systems, or at beginning of wastewater facility, in order to allow longer saturation of BOC additive with organic solids. This attribute may also have value in lowering resident requirements for anaerobic biological processing and quality of sludge discharged from anaerobic digesters. Additionally, increased solubility of organic solids, including FOG components, may reduce total sludge volumes produced within wastewater plant.

### **CONCLUSIONS:**

The use of a BOC biocatalytic additive shows excellent viability in reduction of odors in municipal biosolids dewatering processing. Application of the BOC biocatalytic additive shows effectiveness when injected directly into the sludge transport lines, providing there is availability of adequate oxygen, which lowers the threshold of achieving biological conversion of sludge biomass. Probable mechanism of action appears to be tied to improved solubility of biomass and/or higher concentrations of dissolved oxygen within sludge storage tanks. Reduction of chemical usage and fuel oil for incineration provides operating costs offsets, which make use of BOC biocatalytic additive economically viable for operators. Infrastructure containment and air handling systems can be optimized, and potential investment costs deferred, when a BOC biocatalytic additive is used to treat sludge biomass odors. Additional benefits are possible with use of BOC additive in improving quality of sludge for subsequent incineration, transport, and land applications. Optimization of use of BOC biocatalytic additive is tied to identifying specific sludge processing parameters of facility, dosage requirements, injection points, and configuration of sludge dewatering and transport system.

**In summation, the following conclusions can be drawn from this evaluation program:**

1. The BOC biocatalytic additive is an effective odor reduction agent
2. Cost reductions are obtainable in chemical and fuel oil usage
3. Improvements in biosolids quality are evident
4. Improvements in community and worker quality of life is obtainable
5. Direct injection to sludge transport lines is viable, under proper parameters
6. Availability of oxygen, or air, is necessary for optimization
7. Handling safety and ease of use is an attractive feature to operators

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