Bioscience, Inc.
Environmental Products and Services

ISO 9001: 2008 Certified

Bioscience Technical Services
Odor Control With Microcat® ANL Odor Control Formula

Microcat ANL is a blend of strict and facultative anaerobic microbes selected for their ability to oxidize sulfides to elemental sulfur (collectively referred to as sulfur bacteria). Because it is a blend of several species and strains, some components of the blend can function when oxygen is present, some can use alternate electron acceptors such as nitrate, others only function in the absence of oxygen, and some are photosynthetic. Fatty acids are also metabolized by the strains in Microcat ANL.

Sources of Odor

Odors generally are associated with organic matter decomposition under anaerobic conditions. Odor problems can develop in composting facilities due to insufficient aeration or rapid ammonia production. Although composting is considered an aerobic process, there may be limiting factors (including the cost of turning piles and rainfall) that limit aeration.

Odors may be generated in any section of a sewage collection system or wastewater treatment plant. These odors may be a result of industrial discharges; reactions which take place between combinations of industrial and municipal wastes mixing in the system; or anaerobic bacterial metabolism. In the collection system biodegradation of organic matter rapidly consumes all or most of the available oxygen after which anaerobic processes take over. Odors escape from lift stations and maintenance access manholes as well as the headworks to the wastewater treatment plant. Perhaps the most serious foul smells are those that develop in interceptor sewers and lift stations, as they are often located in residential and/or commercial areas.

In recreational waters and treatment ponds and lagoons, odors are typically generated in bottom or lower layers of sediment or in the water column from which the oxygen has been depleted by aerobic decomposition of organic matter.

In the wastewater treatment plant odors are generated in the primary clarifiers and scum pits, aeration basins, secondary clarifiers, sludge processing equipment, and sludge storage areas. Sludge in drying beds, on vacuum filters, in storage tanks, or in sludge dryers at the wastewater treatment plant is also a strong potential source of odor.

Hydrogen sulfide (H_2S) is the most common cause of odor complaints – probably the source for more complaints than all other malodorous compounds combined. In addition to the rotten egg odor, H_2S causes serious corrosion problems costing many millions of dollars each year, serious health and safety concerns, and can diminish the effectiveness of any wastewater facility due to toxicity to the biomass that is necessary for biological treatment.

Volatile fatty acids, such as acetic, propionic and butyric acid, have a sharp or sour odor. Generally, these compounds must be present at higher concentrations than hydrogen sulfide to be offensive but they can be produced at significant concentrations and are typically a component of odors from anaerobic processes.

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Production of Hydrogen Sulfide

The generation of hydrogen sulfide in wastewater results principally from the biochemical decomposition of the waste components. Bacteria remove electrons (oxidation) from the organic molecules, gaining energy. The electrons are then passed to an acceptor. This results in reduction of the acceptor. The electron acceptor can be an inorganic or organic substance. Under aerobic conditions, free molecular oxygen (O_2) is used by the microbes as the electron acceptor in a process that produces water.

$$C_6H_{12}O_6 + O_2 \longrightarrow CO_2 + H_2O + \text{biomass}$$

Under anaerobic conditions, various compounds or ions can be used by different groups of microbes as the electron acceptor. If neither oxygen nor nitrate is present, microbes that use sulfate as an electron acceptor predominate and these microbes generate sulfide.

$$C_6H_{12}O_6 + NO_3^- + H^+ \longrightarrow CO_2 + H_2O + N_2 + N_2O + \text{biomass}$$

$$C_6H_{12}O_6 + SO_4^{--} + H^+ \longrightarrow CO_2 + H_2O + HS^- + \text{biomass}$$

Thus, the sulfur cycle becomes a critical step in the breakdown of waste under anaerobic conditions. Sulfides are present in three forms: hydrogen sulfide (H_2S) at low pH, hydrosulfide ion (HS^-) at neutral pH and sulfide ion (S^{-2}) at high pH. The ionic forms stay dissolved in water while the neutral H_2S is easily volatilized. The oxidation of H_2S under highly aerobic conditions, e.g. in the biofilm above the waterline in sewers, generates corrosive sulfuric acid.

$$HS^- + O_2 \longrightarrow SO_4^{--} + H^+$$

Production of Fatty Acids

Anaerobic metabolism typically generates volatile fatty acids such as acetic, propionic, butyric and longer chain acids. Although these compounds can be metabolic products of a variety of substrates such as amino acids, sugars and lipids, they are formed in high amounts from the breakdown of fats. These compounds contribute to the sour odor of anaerobic polluted water.

$$CH_3\text{-}(CH_2)_n\text{-}COOH + H_2O \longrightarrow CH_3\text{-}COOH + CH_3\text{-}CH_2\text{-}COOH + CH_3\text{-}(CH_2)_2\text{-}COOH$$

Applications

The primary usage of Microcat ANL is in primary clarifiers, ponds and lagoons, open tanks, and secondary clarifiers. Recommended maintenance dosage ranges from 1-30 ppm depending on sulfide concentration and biochemical oxygen demand (BOD); dosage is normally higher initially until a population is established, then reduced to the maintenance dosage. See for example case study BSE033 and the example table below.

Microcat ANL has been demonstrated to maintain low sulfide levels in collection systems and to reduce odor in sludge storage and processing operations. In such applications, it replaces nitrate based chemicals for odor and corrosion control in the collection system and chlorine and masking agents in sludge processing. See case studies BSE72 and BSE104.

Microcat ANL can be used for treatment of composting facilities to reduce odor from compost piles. See BSE056. ANL targets H_2S and volatile fatty acids but will have minimal effect on released ammonia. ANL is especially effective when added to leachate and runoff from composting operations and sprayed onto the surface of compost piles.

We recommend dilution of ANL (one gallon ANL plus 4 gallons water) and application of the diluted product at 10 gallons per 1000 ft^2 for surface odor control. If treating leachate or runoff in a holding pond, only 1.5-5 gallons per million gallons of pond water are required.

General Conditions for ANL Applications
The following conditions are recommended:
- pH: must be between 6.0 - 9.0.
- eH: must not be below - 350 millivolts
- Temperature: must not exceed 108° F.
- H2S: must not exceed 80 ppm dissolved when ANL is introduced.
- Toxic conditions - which adversely affect the naturally present biomass will have the same effect on the ANL microbes.

Some Example Applications

Industry	Maintenance Dosage	Results
Dairy/Cheese	40 ppm of flow/day	Eliminated H_2S odors Reduced effluent BOD_5 Reduced pond aeration costs
Rendering	40 ppm of flow/day	Eliminated odor complaints Reduced aerator costs BOD/TSS permit standards met
Meat Packing	10 ppm of flow/day	Dramatically reduced H_2S odors
Municipal	6 ppm of flow/day	Dramatically reduced odor calls Pond H_2S levels <.05 ppm Reduced surface solids accumulation
Municipal/Food Processing	7 ppm of flow/day	Drastically reduced H_2S levels BOD removal increased up to 90%
Municipal	1.25 ppm of flow/day	Dissolved H_2S reduced from 5 to <1ppm
Municipal	2 ppm of flow/day	Reduced trickling filter odors
Pulp and Paper	2 ppm of flow/day	Primary clarifier odor eliminated Belt press room H_2S levels reduced From 50 ppm to <2 ppm
Soy Bean Refining	11 ppm of flow/day	Odor complaints eliminated Effluent COD/TSS improved

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