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BAT 505 NTX

Technical sheet

BAT 505 NTX is a bio-augmentation and odour control product useful in all municipal and private waste processing operations including landfill and compost. BAT 505 NTX is helpful wherever organic materials are decomposing intentionally or unintentionally.

Many of the odorous compounds associated with waste processes are the products of incomplete oxidation[1]. Others are the products of anaerobic decomposition volatilizing on exposure to oxygen during mechanical processing or moving of materials[2]. Still other odours are the result of insufficient biological activity to utilize chemically available nutrients before they combine and volatilize[3]. Insufficient microbial activity is common even in the presence of abundant food (organics and nutrients) due to stresses in temperature, moisture, and physical conditions such as machine activity and materials movement.

BAT 505 NTX utilizes a series of proteins containing significantly increased quantities of hydroxyl radicals in addition to amino acids. The proteins are emulsified in a nitrate solution in conjunction with a series of minerals. Nucleic acid and nucleotides are also included. In short, BAT 505 NTX is composed of enzyme complexes (apoenzymes and coenzymes) in conjunction with reserves of molecular and cellular essentials.

The function of the enzymes (proteins) is to facilitate and speed certain reactions in known compounds of decomposition that are odorous or are precursors to odorous compounds. Enzymes speed up the rate and occurrence of given reactions by as much as 45,000 times! However, enzymes are specific to certain reactions and types of reactions. Therefore, the sets of enzymes (proteins) included in BAT 505 are those enzymes known to react with the compounds commonly encountered in the decomposition of garbage, yard waste, and food waste.

All enzymes are catalysts. This means that they enable a reaction without being consumed, decomposed, or bonded to the products of the reaction. They can continue to make the same reaction occur so long as they encounter the target compounds, thus providing the most treatment for the least amount of concentrate.

Every compound and substance has a specific molecular shape. This does not change. Every molecule of acetaldehyde will have the same shape every time. Every molecule of ethyl alcohol will have the same shape every time. Protein enzymes function by eliminating or diminishing the barriers to a chemical reaction.

For two compounds to react with each other they must come into contact and they must come into contact in such a way that the components of each compound that are directly involved in the reaction touch appropriately. Since the molecules are 3 dimensional, this contact is not simple, and the more complicated the molecule, the more difficult and less likely contact becomes. This problem is solved enzymatically by the existence of countless proteins with different molecular shapes. Specific compounds fit perfectly into specific enzymes to make contact with everything from water to a vitamin or mineral to specific parts of another compound. A simple illustration would be to think of the compound as a key and the enzyme as the lock and aperture. The key will only fit the proper aperture. The wrong shape enzyme won't help anymore than the wrong lock or key. Consequently, an enzyme exists for every molecular shape in our world.

We stated earlier that the protein (enzyme) complexes in 505 were emulsified in a nitrate solution. The emulsifying agents are saponin glycosides with available carbohydrate levels as high as 77%. As these emulsions relax, the glycosides become immediately available as energy food to any extant microbial population. This availability can help generate new bio-activity and increase stress resistance to less than perfect temperature or moisture conditions. Saponin glycosides have also proven valuable in providing the same type of stress relief against unfavourable pH changes or high salt environments.

The emulsions are housed in a nitrate bath and diluted with water prior to application. The function of the nitrate is to provide an immediate alternative to sulphate as food for sulphur reducing bacteria. The reduction of sulphate causes the formation of reduced sulphur compounds. Nitrate provides an equally desirable reducing agent (source of compound oxygen) with non-odorous nitrogen gas as the by-product. Some percentage of RSC (Reduced Sulphur Compound) formation is thus replaced by nitrogen formation. Additionally, hydroxyl radicals from the proteins and added ribose in 505 facilitate oxidation of extant and newly formed RSC's. Typically, the hydroxyl group reacts with a sulphide to form an amino hydroxyl sulphate (through oxidation).

Initially, this increase in sulphate and nitrogen levels, and a corresponding decrease in sulphide levels, results in a change of pH caused largely by the decrease in hydronium ions. Each sulphate has fewer hydronium ions than a sulphide. The nitrogen produced in the reduction of the nitrate has no hydronium ions and the products of the corresponding oxidation and subsequent reactions – including ammonia - are rich in hydroxide ions. So a slight rise in pH toward the basic occurs. This also facilitates decreases in RSC formation.

The aforementioned hydroxyl group becomes “re-available” as part of the same sequence by which the sulphides are originally reacted (ionically) into amino hydroxyl sulphides and then (by oxidation) into amino hydroxyl sulphates. The pH change in the environment facilitates the ionic separation of the amino hydroxyl sulphates back into a sulphate group and an amino group.

The amino group is then free to react with another sulphide. Thus the amino hydroxyl groups as well as the enzymes function catalytically, allowing large-scale treatment with the minimum of concentrated 505. This set of reactions is illustrated below.

Phase 1 Illustration: Ionic Conversion of Sulphide to Amino hydroxyl sulphide.

$$\begin{array}{c} NH_2 \\ | \\ R\text{—}CH \\ | \\ NH_2 \end{array} + 2H_2S + O_2 \rightarrow \begin{array}{c} NH^+ + SH^- \\ | \\ R\text{--}CH \\ | \\ NH^+ + SH^- \end{array} + 2H_2O$$

Phase 2 Illustration: Oxidation of the amino hydroxyl sulphide to Amino hydroxyl sulphate.

$$\begin{array}{c} NH^+ + SH^- \\ | \\ R\text{--}CH \\ | \\ NH^+ + SH^- \end{array} + 5O_2 \rightarrow \begin{array}{c} NH^{++} + SO_4^{=} \\ | \\ R\text{--}CH \\ | \\ N^{++} + SO_4^{=} \end{array} + 2H_2O$$

Phase 3 Illustration: Ionic separation of the sulphate and amino hydroxyl group.

$$\begin{array}{c} N^{++} + SO_4^{=} \\ | \\ R\text{--}CH \\ | \\ N^{++} + SO_4^{=} \end{array} + 4H_2O \rightarrow \begin{array}{c} NH_2 \\ | \\ R\text{—}CH \\ | \\ NH_2 \end{array} + 4H^+ + 2SO_4^{=} + 2O_2$$

In summary, BAT 505 NTX works against odour in 3 ways. Initially, enzymes in the product allow immediate reactions aiding in the decomposition of many odorous gases. Secondarily, immediately available glycosides provide potential bio-energy and stress relief to increase bio-degradation of troublesome compounds. Thirdly, available nitrate provides an alternative reducing agent to sulphate, decreasing occurrence of RSC's. Additionally, side reactions of the enzymes and the nitrate increase conversion of sulphides back to sulphate and make slight changes in the pH which increase stress factors against RSC's.

BAT 505 NTX is applied as a liquid diluted with fresh water. Depending on odour intensity and type of application equipment utilized, dilution may be from 100 parts water to 1 part 505, up to 1000 parts water to 1 part 505.

BAT 505 is completely biodegradable within 36 hours. BAT 505 is also non-toxic. At Concentrate, BAT 505 has an LD 50 of greater than 2 grams per kilogram. Its dermal irritation rating is Category 4 ‡, or non-dermal irritant.

It should be noted that additional materials or exposure of new materials will create the need for new treatment. In the case of static materials (such as compost, mulch, or drying beds), length of successful treatment will be determined by BOD and COD of the mass, humidity, temperature, and other external conditions. In the case of dynamic materials (such as landfill face, gas wells, or mechanically agitated compost), treatment should be "as needed" or continuous until agitation or movement ceases.

1: Decomposition begins aerobically but insufficient oxygen is available to complete the total reaction pathway prior to volatiliztion. Examples are alcohols oxidized to aldehydes or ketones, further oxidized to carboxylic acids yielding esters including acetates. If the oxidation sequence ceases at any point – including oxidation of the acetates – the resulting compounds are odorous.

2: Examples are reduced sulphur compounds such as dimethyl disulfide and hydrogen sulphide, and reduced nitrogen compounds such as ethylamine and trimethylamine. Reduced nutrient compounds have distinctive, strong, and unpleasant odours.

3: The most common example is simple ammonia. However, ammonium radicals also are precursors to ptomaine diamines such as cadaverine and putrescine.