Accelobac® 20 Description Sheet and Case Studies

The **Accelobac® 20** strains contained in the product are specially selected bacterial strains which have been adapted to help degrade a great variety of compounds often found in the discharge waters of refineries, petrochemical plants, pesticide manufacturers, in chemical spills and in soil and ground water which have been contaminated with such chemicals. Many chemical manufacturing plants operate various processes on alternating times and schedules. This pattern often results in intermittent and non-uniform introduction of different types of compounds into the waste treatment system and can result in poor acclimation levels of the biological microflora of biota. Because of the non-continuous nature of the flow and the types of chemicals entering the system, the indigenous microflora have a difficult time adapting to the changing nature of the carbonaceous waste. **Accelobac® 20** containing products can help by supplementing natural microflora with biomass that is pre-acclimated and adapted to bio-oxidation of toxic and resistant carbonaceous compounds resulting in greater treatment reliability and removal efficiency.

In order for the product to be successful in bioaugmentation of a waste treatment system, it must have several attributes:

it must contain sufficient types of bacteria of the type which can degrade the targeted pollutants.

it must contain microflora that can survive on the targeted waste substance alone and be able to utilize it as a sole source of carbon when supplemented with mineral nutrients.

it must contain microflora which are extremely resistant to the toxic effects of the targeted pollutant fraction.

it must be able to multiply and metabolize in the presence of certain heavy metals.

Accelobac® 20 strains satisfy all the above criteria plus many others. These unique strains of microflora can degrade and detoxify a large array of substituted and unsubstituted aliphatic and aromatic hydrocarbons.

Accelobac® 20 strains have been shown to be more resistant to heavy metal content than any other products. Growth on petrochemical compounds and their concurrent biodegradation occur even when 100 mg/L of cadmium, arsenic, copper, iron, lead, tin, zinc, cobalt, selenium and silver are present.

Accelobac® 20 strains are able to sustain growth over a wide range of temperatures from 45 degrees Celsius to temperatures approaching refrigeration on a large number of carbon sources.

Oftentimes, waste waters or soils in the areas of spills or routine hydrocarbon contamination must be supplemented with nitrogen, potassium, and phosphorus to allow the complete breakdown of the hydrocarbon.

The general use over the entire area and then concentrated use of the bacteria in areas of heavier contamination should then be an effective treatment technique. In general, coverage application in a trouble spot (where contamination is very high) of 0.5 – 1.0 lb per 100 square feet.

There are several ongoing uses for these bioaugmentation products:

1. Test of feasibility treatment of surface soil at a site in central Florida. A Florida dye manufacturer had allowed hydrocarbons such as benzene, toluene, xylene and ethylbenzene to saturate soil. The treatment is described below. As can be seen from the charts, the ethylbenzene was essentially 100% removed, as was the toluene, while the xylene reached a 90% degree of removal. The most active area for the action of the bacterial product was in the top 12 inches of soil where tilling, supplementation, and oxygen could reach.

DATE	DEPTH	BENZENE	TOLUENE	ETHYLBENZENE	XYLENE
11/7/84	1.5’	.99 ppm	5.8 ppm	.15 ppm	.07ppm
(1)	1.5’	1.00 ppm	1646 ppm	30.00 ppm	37.0 ppm
	Surface	1.00 ppm	2073 ppm	28.00 ppm	42.0 ppm
	1.8’	.14 ppm	19 ppm	.06 ppm	.5 ppm
6/17/85	Surface	BDL(3)	.9 ppm	- - -(2)	BDL
	Surface	BDL	2.5 ppm	- - -	.5 ppm
	Surface	BDL	10.0 ppm	- - -	2.5 ppm
	Surface	BDL	4.0 ppm	- - -	.75ppm
	Surface	BDL	3.2 ppm	- - -	.13ppm
7/11/85	Surface (treated)	BDL	BDL	BDL	3.0 ppm
	Surface (treated)	BDL	BDL	BDL	3.7 ppm
	Surface	BDL	0.5 ppm	BDL	4.1 ppm

(1) Start of biological treatment
(2) Data not reported
(3) Below the detection limit

2. Pilot plant scale work with a major forest products plant in western Pennsylvania and in southern Virginia indicated that over 20% more lignin and cellulosic fiber can be digested in typical lagoon sludge when treated using a combination of bioaugmentation agents.

3. A Mississippi metal fabricating and machining company indicates that bioaugmentation with the specific product (**Accelobac® 20**), allows the lagoon to be continuously seeded with specific microflora, that the microflora can survive in the aerobic treatment system, and that the microflora can assist in meeting discharge standards for light machine oils in lagoon water. Full scale application of the product has been implemented since 1987.

4. Customers in the power transmission assembly and manufacturing business in the southeastern United States have used **Accelobac® 20** to continue supplementing ponds and lagoons in order to help meet discharge limits for machine and hydraulic oils.

GENERAL CONSIDERATIONS FOR THE USE OF BIOAUGMENTATION PRODUCTS FOR ASSISTING THE CLEANUP OF SPILLS OR SOIL CONTAMINATION

1. Any spills (or portion thereof) which can more easily or economically be cleaned up by physical techniques should be remediated in this manner. For example, any waste that can be recovered or removed by pumping, skimming, or scraping should be done in conventional manner. This usually removes a high concentration of waste very rapidly. Bioaugmentation and resultant biodegradation of wastes is best used as a "polishing" technique: ridding the soil or environment of wastes that are either too dilute or are too widespread so as to make the removal by physical means impractical or too expensive. Once the largest portion of waste is removed by physical techniques, then the microflora that are augmented into an area can finish degrading the wastes remaining. Bioaugmentation to help eliminate the deleterious effects of spills and to clean up that area of the environment should not be used as the sole technique in most large, highly concentrated spills, or where exceedingly deep penetration of the soil with high concentrations of toxic substance exist.

2. Petroleum products in general (such as kerosene, gasoline, fuel oil) are considered carbonaceous waste (contain carbon). These products usually do not include appreciable nitrogen, potassium, or phosphorous which microorganisms need to metabolize the hydrocarbon. This means that in most cases, the spill area must be supplemented with nitrogen and phosphorous, and sometimes potassium and other needed nutrients. These substances often may be added in the form of regular fertilizer. Slow release lawn fertilizers are superior to garden fertilizers because there is less chance of polluting runoff with them. In addition, because they are coated, they are generally more soluble in the hydrocarbons themselves than are typical fertilizers. Finally, the nitrogen: phosphorous ratio in these lawn fertilizers is better than in many garden fertilizers for microbial supplementation.

   The application of the fertilizer should be made at a rate coinciding with that needed to maintain a 200:10:1, C:N:P ratio in the area. There may be some exemptions from this general rule. In spill areas, the application should be made monthly. Analysis will, in turn, tell after applications whether the nitrogen or

phosphorous is building up in the soil or waste water faster than the microbes can make use of it and further applications should be adjusted accordingly.

3. The microbial mixture being used to treat waste should be added in a slurry made at the rate of 1 lb or less per gallon of chlorine-free water. The slurry should be mixed in containers free from pesticides, disinfectants, algicides, or other chemicals. The slurry is sprayed over the area to be treated and usually some wetting agent or biodegradable, nonionic biodegradable surfactant is included with the slurry. This helps to emulsify the petrochemicals so that surface area subject to attack by the microbes is greatly expanded. Triton X-45 (manufactured by ICI) or equivalent biodegradable nonionic surfactant type competitive products are generally suitable when the spills include kerosene, fuel oil, jet fuel, crude oils, Varsol, gasoline, etc. the slurry should be added to a spill area as soon as it is prepared. Generally, shallow soil incorporation of the microbe/surfactant/fertilizer mixture is advisable (as with a power cultivator, tiller, plow or other soil turning device). Periodic turning of soil results in recontact of bacteria and carbonaceous contaminants. This physical treatment aerates the soil, adding much needed oxygen for optimal rate of waste breakdown. Periodic tilling assists in redistributing moisture, temperature and added nutrients. Effective removal of hydrocarbons will be at very slow rates where aeration is not present.

4. Determination of heavy metal content of the soil can be important for the success of the project. High concentrations of heavy metals such as lead and mercury can affect the efficiency of the removal of hydro carbonaceous compounds from the soil environment. Some bacteria are more affected by metallic ions than others. Chromium, cadmium, zinc, and manganese are more deleterious to some microbes than others. Removal of metals can be accomplished in some cases by a certain category of microbes, a certain class of autotrophic bacteria. However these bacteria are not easily cultivated nor preserved for practical application. They can cause the metal to be more easily physically or chemically separated from a system, but do not cause the metal to mysteriously disappear from the environment.

5. Periodic testing during the bioremediation project is essential. Often closely monitored feasibility or demonstration trials are run early in the course of the project to determine the expected effects of the bioremediation agents used. These small trials help to determine the proper concentration and type of bioremediation to be used along with timing for most economical action, as well as a host of other necessary information.

6. Where ground water is a problem, being close to the surface of the soil, or in close proximity to hydrocarbon spill, it is common practice to dig strategically placed wells surrounding the area of the spill and in the center of the spill. Pumping is carried out so as to isolate the spill and to prevent the flow of the spill from moving into the general ground water. This technique for the minimization of flow of the waste results in volumes of water which are contaminated and must be treated. The biological treatment aid is usually added to the resultant waste water and the waste is removed from the water in aqueous/aerobic phase. In some cases specific types of mobile treatment equipment are used. These equipment types include up flow biotowers, biological reactor vessels, settling and floatation equipment, etc.

7. Highly polymerized or exceedingly long chained or high molecular weight hydrocarbons are more resistant to breakdown due to their protected multiple bonding, insoluble nature, and lack of surface area for catalytic and/or microbial attachment. The biooxidation of the heavier portions of crude oils, tars, etc. is very slow for this reason.

8. Other parameters which affect biological activity must be monitored and adjusted where necessary for optimal rates of bioremediation to occur. Examples of these parameters include pH; chlorine, bromine (or other halogen) concentration: H2S, sulfite and other reducing agent concentration; and cyanide concentration.

9. When a blend of organic carbonaceous compounds is encountered, some compounds will almost always be degraded first and more rapidly than other compounds. Consortia (more than one strain or type of microbe) of microorganisms are almost always more effective biorremediants than single microbial strains. The consortium of microbes work to rid the system of toxic intermediate compounds more rapidly and often results in the more efficient removal of a broad spectrum of chemical compounds from an ecosystem due to the greater variety of crucial hydrolytic enzyme systems than one strain may possess.

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