Accelerated Bioremediation:

Accelerated bioremediation is the term that we apply to the LGM Environmental Services method of bioremediation. There are several factors that are important in accelerating the rate of bioremediation. Sufficient oxygen, sufficient nutrient levels, mixing of contaminants, microbes and nutrients: all of these certainly factor into the equation. However, probably the most important factor that we have found is the density of microbes in the environmental media. Once this density requirement has been met, and the appropriate levels of oxygen and nutrients are present, degradation occurs in a matter of hours or days. Continued mixing accelerates the process; thus, in waters or stirred sludges the degradation rates can many times be expressed in terms of hours, whereas in soil typical degradation rates are expressed in terms of days. In a bioreactor degradation rates can be as short as minutes, since there is continuous mixing and nutrient feed.

All of the LGM Environmental Services bioremediation products start with the microbes. We tailor the microbial populations to the specific contaminants of concern. We have standard products for petroleum hydrocarbons, including TPH, BTEX, PAH, phenols and other distilled products from petroleum. We offer standard products for chlorinated solvents, such as tetrachloroethene (PCE), methylene chloride, trichloroethane and PCE byproducts. We have standard products for PCB's and pesticides, both chlorinated and non-chlorinated. Additionally, we offer the capability to custom prepare a product specifically tailored to a waste stream.

We can selectively degrade specific mixtures of compounds, or single components, because of the way that we culture our microbes. We start with microbes that have been naturally selected for the general class of compound, for example, hydrocarbons or chlorinated hydrocarbons. We then culture them in a bioreactor under very specific conditions, using only the compounds that we want to degrade as a food source. This allows us to successfully treat many compounds in environmental media that have historically been difficult to treat, such as low dissolved oxygen aquifers, sludges and wastes, and aerobic environments contaminated with chlorinated hydrocarbons.
This tailored microbial mixture is then mixed with both macronutrients and micronutrients. These are selected carefully to provide proper nutrient levels in a bioavailable form, and the concentrations vary depending upon the contaminants of concern and the type of application, and, if required, we add dispersing agents to absorb the contaminants and provide additional surface area for microbial growth. This is all packaged in a form that is easily applied to the environmental media of concern. For soils, the appropriate product is a powder that is tilled into the soil, either in-situ or in excavated material, whereas for waters, sludges or subsurface injections the product of choice is a water-soluble mixture that is dissolved and injected into the area or material to be treated. For contaminated surfaces the water-soluble product may be dissolved and sprayed on, either with a hand sprayer or a high-pressure sprayer.

If applied in the prescribed manner, the bacterial concentrations will be in excess of what is required to effect accelerated treatment, and the nutrient levels will be sufficient to degrade most concentrations of contaminants. Treatment typically takes 1-3 weeks for soils, depending upon the specific contaminant. In the case of chlorinated hydrocarbons the treatment requires more time, since the microbes are slower growing, and typical treatment times range from 3-10 weeks for soils. Also, especially in the case of chlorinated compounds, treatment requirements are typically well in excess of 99% removal, thus requiring more time for treatment. Treatment times are substantially accelerated in a bioreactor. Typical times for removal of >90% of petroleum hydrocarbons are 12-24 hours and 3-5 days for >90% removal of chlorinated hydrocarbons. Subsurface aqueous treatment times can be very long, due to the slow rate of diffusion through an aquifer. Typically the bacteria and nutrients migrate at the same rate as the water; for especially impermeable systems this may lead to treatment times measured in years. There are special techniques for treating aquifers, which we can provide to interested parties upon request.

Treatment efficiency for accelerated bioremediation can be very high. Typically we measure contaminant degradation in terms of orders of magnitude. Thus, one order of magnitude degradation is the same as 90% treatment efficiency; two orders of magnitude the same as 99% treatment efficiency, etc. When plotted in log space versus time contaminant degradation normally results in a relatively straight line, and we can tell from the slope of the line whether or not a particular treatment is proceeding normally. Typical removal rates for soil range from 5-15 days per order of magnitude; thus, we would estimate that 99% removal would normally take 10-30 days for most soils. As concentrations decrease the removal times increase due to the lack of bacterial/contaminant contact, so degradation of the remaining 1% typically takes much longer than the degradation of the first 99%. This can be partially avoided in a bioreactor due to mixing efficiency, in which degradations of 99.9% or greater can be realized in less than 24 hours due to mixing efficiency.

Temperature and pH do play a role in the treatment process. The ideal temperature for treatment is approximately 28C (82F). The microbes can tolerate temperature extremes from 5C (40F) to 45C (110F). Outside of these temperature ranges the microbes will function less efficiently and/or die. Please note that this does not mean ambient air temperature; rather, this refers to the mean soil temperature. Even if there is ice on the surface, 3 inches down the soil temperature may be 40-50 degrees F. Only in climes where there is prolonged freezing does temperature become an issue. There are special techniques for treating soils and waters in extreme temperatures, which we can provide to interested parties upon request.