

The Use of Solmar Formulations for Treating Oily Wastes

Although biodegradation techniques have been used for environmental problems with petroleum products for many years, traditional methods have frequently taken too long to achieve desired results. Physically disposing of unwanted hydrocarbon residues, tank bottoms, spills and runoffs has become a real problem not only from a cost standpoint, but from potential legal ramifications as well.

The use of specially selected culture formulations with appropriate application techniques has proven to be very cost effective means in dealing with such problems. Tank cleanouts, spill cleanups, land farming operations, on site detoxification programs and sump cleanup have all benefited from bioaugmentation. Many instances have occurred, wherein heavy tarry wastes have even been converted through bioaugmentation to products of economic value.

PRINCIPLES OF USE

The basic concepts are not difficult. Systems are seeded with formations of carefully matched organisms that can use the various petroleum products to increase their biomass and as energy sources. Application techniques maximize the biological activity and enable the various organisms to handle the original array of compositions present as well as those formed through catabolism.

Nearly every program needs to be looked upon as a case unto itself, however. Some guidelines are provided here for consideration. A Solmar Corp. Representative should be consulted prior to initiating any program. In nearly all instances bioinhibition or biodegradation response studies should be conducted by Solmar Corp. to assure suitability of any program.

Certain principles need to be borne in mind. The Solmar Formulations are based upon preserved microorganisms which become activated when put in water.

Like all living organisms the various essential elements must be included in their diet, such as calcium, carbon, iron, magnesium, nitrogen, phosphorous, etc. Application techniques must take this into account.

Time requirements of any program are dependent upon many different factors including the nature of the compositions present, the complexity of these compositions present, the temperature, pH, salinity, final disposal techniques, the amount of aeration and agitation available.

For example, bacteria perform most efficiently at 35⁰ C. Their efficiency is roughly halved for every 10⁰ C shift. Pasteurization occurs above 50⁰C.

Similarly a pH of 7 is best with activity being approximately halved for every shift of 1 pH unit. Variable pH's have a very deleterious effect on the bacteria.

Aeration is crucial. The initial degradation steps require oxygen. Furthermore the bacteria operate far more efficiently aerobically. Aeration also provides agitation, which increases the oil/water interface surface area dramatically. The bacteria then have a greater opportunity to degrade the oils.

Some compositions are more easily degraded than others. Straight chained compounds generally breakdown much more quickly than aromatics or cross-linked structures. It may take longer to break down a large number of different compositions than if fewer are present. The viscosity and quantity of oil to be degraded influence the time required for the program.

ANTICIPATED RESULTS

Programs vary considerably. Where emulsification is present, many systems experience demulsification as the hydrophilic-hydrophobic balance of the emulsifying agent is disrupted by biodegradation. This can be facilitate phase separation techniques.

Where distinct phases exist and little degradation has occurred, treatment with the Solmar formulations may produce an emulsion, thereby accelerating biodegradation.

In the treatment of lagoons or sumps degradation may seem slow initially and then appear to speed up, as the system approaches a state of equilibrium. Following this, sludge from the bottom frequently is freed up, which then covers the surface. It is subsequently broken down.

Where heavy oils exist, they may be converted to lighter oils of economic value. If the surface oils are not to be reclaimed, it is important that they not dry out. Mixing, cascading, or spraying with recirculation are helpful.

For soil-bound oil, bioaugmentation can be very helpful. The time required for degradation depends upon the nature of the oils, its concentration, depths of penetration and soil conditions. The time can vary from days to months.

The cultures are very helpful in reducing odor levels. Since Solmar formulations cannot themselves generate hydrogen sulfide, they can provide control of sulfide emissions.

Most of the hydrocarbons will be used as food and energy sources with the consequential end products being carbon dioxide, water, cell mass and biological waste products.

TREATMENT SCHEDULES

Solmar formulations are useful in sumps, tank or lagoon flow through systems, or land spills.

Unless dealing with routine hydrocarbons, the correct formulation should be chosen on the basis of biodegradation response studies conducted at Solmar Corp.'s laboratory.

Treatment rates will generally be at the levels outlined below:

STATIC LAGOONS

Volume of System in Gallons	Inoculation Dosage	Add two Weeks Later	Monthly Treatment After Second Treatment
10,000-50,000	1 lb/5,000 gal.	1 lb/7,500 gal.	1 lb/15,000 gal.
50,000-300,000	1 lb/10,000 gal.	1 lb/15,000 gal.	1 lb/30,000 gal.
300,000-1,000,000	1 lb/20,000 gal.	1 lb/30,000 gal.	1 lb/60,000 gal.
Over 1,000,000	1 lb/25,000 gal.	1 lb/35,000 gal.	1 lb/75,000 gal.

Nitrogen levels should be at least 20 ppm, and phosphorous levels at least 5 ppm before beginning any program. Levels should be monitored regularly and appropriate nutrient additions made.

The cultures should be activated by mixing with two gallons of water per pound of cultures. Extended presoaking is not necessary in static lagoons, although 4 to 12 hour presoaking will build up the number of bacteria being added.

The bacteria slurry should be spread over the entire surface of the lagoon. Depending upon the size of the system, spray equipment, firehose, boat or aerial application can be made. Agitation by aeration is very beneficial.

FLOW THRU SYSTEMS

Average Daily Flow	Daily Feed Rate For 5 Days	Daily Feed Rate Treatment
Up to 25,000 gpd.	1 lb/5,000	1 lb/10,000 gal.
25,000 to 100,000 gpd.	1 lb/10,000 gal.	1 lb/25,000 gal.
100,000 to 400,000 gpd.	1 lb/25,000 gal.	1 lb/50,000 gal.
400,000 to 1,000,000 gpd.	1 lb/50,000 gal.	1 lb/100,000 gal.
Over 1,000,000 gpd.	1 lb/75,000 gal.	1 lb/200,000 gal.

Nitrogen levels should be at least 20 ppm and phosphorous levels at 5 ppm.

Presoak the Solmar formulations for 4 to 12 hours and add at treatment chamber. Divide the daily treatment into 4 or 5 applications if feasible.

Treatment chambers should have good mixing and at least 2 hours detention. As much as practical is normally recommended. Recovered oil can be reclaimed, burned, or recycled for more complete degradation.

DRY LAND SPILLS

For areas having oil depths of one foot or less:

Under one acre: inoculate with 1 lb/1000 sq. ft.
One acre or more: inoculate with 50 lbs/acre

Two weeks later reseed with 70% of the initial inoculation. Reapply a 50% dosage (of initial inoculation) one month after the second treatment. Reapply this same dosage monthly as required. Tars may require heavier seedings.

For areas having oil depths exceeding one foot, inoculation should be made at the rate of 25 to 50 pounds per 1,000 cubic yards depending on the nature of the oil and the system. Use the above reseeding schedule. Contact your local representative for the proper program for your specific site.

Nitrogen levels must be at least 20 ppm and phosphorous levels at 10 ppm.

The bacteria should be added as a slurry prepared with at least two gallons of water per pound of cultures. Usually much more water is used for adequate coverage. This should broadcast over the entire surface area. Regular aeration and mixing are necessary for degradation.

MONITORING

Regular monitoring is necessary. During warm temperatures, significant bubbling in aqueous systems indicates good microbial activity. Oil quantity monitoring is usually impractical, particularly when it can be freed up from the bottom of the pond. Bacteria counts using standard plate counts can be useful. There should be significant numbers $(30-300) \times 10^6$ CFU's. Where activity seems low check the following and correct as appropriate:

- Moisture** - Bacteria live and carry on their life processes in water. Do not allow system to dry out.
- Nitrogen** - Must always exceed 10 ppm.
- Phosphorous** - Must always exceed 2 ppm.
- pH** - Maximum activity occurs at a pH of 7. This is approximately halved for each 1 pH unit shift.
- Temperature** - Ideal temperature is 95⁰ F. Activity will decrease above or below this. From a practical standpoint, most programs should be run at 55⁰ to 105⁰ F.

If low plate counts occur, check for the presence of inhibitory substances. If not present, reseeding will assure that all species of bacteria are made available to handle residues and metabolites previously produced.