

Company Overview

Verde Environmental, Inc. began its exploration of waste material treatment and destruction in 1986. By early 1987, enough data, material and equipment had been gathered to begin testing on-site treatment of organic waste materials.



Since that time, our company has been in the forefront of the development of effective spill control, fire fighting and bioremediation products for government, industry, marine and commercial use.

Verde Environmental, Inc. is based in Houston, Texas USA. We have a worldwide network of representatives and distributors for timely delivery of our products anywhere.

Product Overview:

When a spill or other “catastrophic” incident happens, the indigenous microbes present at the site usually become “overwhelmed” by the amount and / or toxicity of the contamination and either die off or are too few in number to handle the contamination by themselves in a timely manner. Very often, the contamination seeps towards a vital waterway, threatening our precious water resources.

Verde Environmental’s Micro-Blaze[®] line of microbial products was developed to attack contaminants quickly and efficiently, turning the offending hydrocarbons and other organic compounds into harmless by-products of carbon dioxide and water.

Our synergistic blend of several microbial strains quickly digest the following commonly found contaminants:

- ◆ Spent **Hydrocarbons**; e.g. diesel fuel, gasoline, motor oils
- ◆ **Glycols**; such as antifreeze compounds
- ◆ **AFFF** wastes from fires, training exercises
- ◆ **Oils**
- ◆ **Fats**
- ◆ **Cellulose**, such as refuse paper products
- ◆ **Greases** from residential, institutional and commercial outputs

The microbial strains are suspended in the Micro-Blaze[®] formulations by a stabilizing agent until they are ready to be put to work. They lie dormant in a spore form and

Company Overview, page 2:

become activated within 15 - 20 minutes after being applied to an organic food source (i.e. hydrocarbons, other wastes) with water.

If a component, e.g. water or food source, is taken away, the microbes go dormant. Once it rains or water is applied, the microbes become active again, seeking out contaminants to digest into harmless carbon dioxide and water. Vegetative microbes will die off as their necessary components are taken away.

Although the formulations are close to a neutral pH, the bacteria work in a wide range of pH – from 4.5 - 11.5, a greater range than most other bacteria.

Two of Verde's most popular products are:

MICRO-BLAZE[®] EMERGENCY LIQUID SPILL CONTROL is a bioremediation and spill control product that not only eliminates flammability of hydrocarbons, it breaks down, degrades and digests the waste. Using this product can eliminate “cradle-to-grave” liability that traditional “dig and haul” methods require. This product is listed with US-EPA for the National Contingency Plan (NCP) as a bioremediation agent.

MICRO-BLAZE OUT[®] is the only concentrated liquid microbial fire-fighting agent on the market today. It is U/L listed for both Class A and Class B fires. Contains Micro-Blaze[®], which is on the US-EPA NCP list as a bioremediation agent. (Please see the EPA letter in the Regulatory Section of this book). Non-toxic and biodegradable, it has a strong penetrating effect and is a highly economical and environmentally preferable alternative to “traditional” but toxic aqueous film forming foams (AFFF) which must be disposed of in a costly manner.

Physical Properties:

Please see Material Safety Data Sheets for Micro-Blaze[®] Emergency Liquid Spill Control and Micro-Blaze Out[®].

Disposal Costs:

The microbes in Micro-Blaze[®] Emergency Liquid Spill Control and Micro-Blaze Out[®] actually digest the contaminants in the affected media, resulting in by-products of harmless carbon dioxide and water. The organic wastes are eliminated, not rearranged to another site. There are minimal or no “dig and haul” charges. “Cradle-to-grave” liability is minimized.

Training:

Written instructions for various methodologies and rates of applications can be provided. Usual rates of application of product are from a ½ % to 6% ratio applied with water. Verde Environmental, Inc.'s toll-free number, 800 / 626-6598, provides 24-hour consulting on application rates for various uses.

Storage Requirements and Shelf Life:

Storage of Micro-Blaze[®] products is between 32°F and 120°F. These products in concentrated form have been shown to have a shelf life of over ten years. Short-term periods of below freezing or above 120°F will not harm microbial populations.

Common Facility Applications and Benefits of Use:

Every facility can benefit from using Micro-Blaze[®] products. Some of the more common applications are:

Spill Control: Cleans up accidental spills at refineries, process plants, fueling depots; on roadways, parking lots; and around vehicle repair areas, oil and grease storage areas, etc. Eliminates the fire hazard of spilled fuels and digests the wastes, with no need to vacuum or soak up the spills with costly booms, socks, pads or other absorbents that still need costly disposal.

Wastewater treatment plants: Oversprays help digest hydrocarbon “slugs” or other organic contaminants entering the plant from a spill or release. Can be used in a “drip system” to enhance the existing facility’s bacteria to digest the incoming wastes, greases, oils, fats, etc., eliminating scum and grease buildup and odors that occur from the plant.

Firefighting training fields: Applied to the residual burn areas and the runoff areas, Micro-Blaze[®] Emergency Liquid Spill Control can degrade the fossil fuel buildup that accumulates at these sites. Application will vary according to the amount of contamination.

Food preparation sites, canteens: Treatment of the grease trap lines at these establishments eliminates the hassle of line stoppages and heavy buildup of grease in grease traps. Micro-Blaze[®] Emergency Liquid Spill Control digests the fats, oils and grease to reduce pumping costs and maintenance.

Underground storage tanks, gas tanks, etc.: Apply in and around leaking underground petroleum storage tanks (UPSTs). Micro-Blaze[®] Emergency Liquid Spill Control will inert the volatile hydrocarbons, eliminating any potential fire hazard while degrading the contamination that may be seeping towards underground water sources. Spraying around above ground tanks helps cut down pollution from leaks.

Potential Hazards / Material Reactions:

Verde Environmental, Inc.'s products are **non-toxic, non-pathogenic** and easily degradable. Please review the Material Safety Data Sheets in Section VIII.

Frequently Asked Questions About Micro-Blaze® Products

How many microbes in one gallon of product?

There are approximately *200 billion* in one gallon. Strict quality control measures ensure our customers receive plenty of viable microbes in a quality product that will work on organic and hydrocarbon contaminants.

What is a surfactant?

Surfactants make water "wetter" by breaking down the surface tension. It also emulsifies hydrocarbon-based compounds, breaking them down into more manageable molecules that the microbes can then more efficiently digest.

What are nutrients?

Sometimes called "biocatalyst", it is comprised of substances that help support the growth and reproduction of the microbes; like "vitamins" for us. Micro-Blaze® products contain a biocatalyst product called "Budkicker".

What is a microbe?

It is a microscopic organism - bacteria. Micro-Blaze microbes are found naturally in the world's soils; we select those strains that show exceptional degradation of household and industrial hydrocarbon and organic wastes.

What kind of microbes are in Micro-Blaze products?

Bacillus spores - they are natural, non-pathogenic bacteria. Upon application onto a spill or contaminated soil, they germinate and become active within 15 to 20 minutes. In ideal conditions, they double in population every 20 minutes and digest the wastes as long as all the necessary ingredients (water, oxygen and a food source, i.e. the organic wastes) are present. The harmless byproducts of their degradation process are CO₂ and water and trace amounts of organic salts.

Will these microbes harm our wetlands?

Bacillus spores, in all likelihood, are already present in the soils and waterways of wetlands. They are very tolerant of seawater and brackish water and could "be considered the dominant species of the world's oceans."¹

If they are already in the wetlands, why not use the existing microbes there to clean up any contamination?

The *indigenous*, or existing, *Bacillus* and other microbes are accustomed to existing in the normal wetlands ecosphere, digesting the typical flora and fauna wastes found in such places under normal circumstances. When an oil spill or other hydrocarbon / organic contamination enters the wetlands, the microbes present are neither in large enough numbers to start digesting the influx of material nor are they adapted to digesting that particular type of waste. They usually die off from the

toxicity or concentration of the contamination. Or, they become so reduced in number that it could take *years* before the surviving populations become large enough and acclimated enough to start effectively remediating the waste.

Micro-Blaze products' several strains of *Bacillus* microbes have been selected from the world's soils where they showed aggressive degradation of hydrocarbon and other modern, organic-based wastes. Whether they are oversprayed onto an oil spill or used to clean up a benzene tank, they work synergistically to digest the pollutants effectively and efficiently.

What are some differences between Micro-Blaze products and other products?

With some products, you have to mix the microbes with water, and then let them sit for 24 hours before they can be used. This doesn't help an emergency response situation where seconds count.

Micro-Blaze products are shipped concentrated, ready to dilute to your specific needs and applied immediately. The microbes only take a few minutes to "awaken" and begin digesting their food source -- your contamination problem.

What is the difference between microbial products and enzyme products?

Enzymes will liquefy a waste; it will *not* digest it. All an enzyme product will do is change the form of the waste. Microbes produce their own enzymes which help the microbes to digest the waste, changing it into harmless byproducts of carbon dioxide and water.

Will the microbes in Micro-Blaze products mutate?

No. After a site is remediated, the microbial populations return to a level consistent with the amount of food and water available at the site by dying off or returning to a spore state.

Will Micro-Blaze products kill grass?

No.

Will the microbes eat dirt or metals?

No -- metals and dirt are not carbon-based organics.

Will the microbes eat my asphalt driveway?

No. Due to the density of the material on a road or paved surface, it would take a very, very long time before anything occurred. The product is to be washed off the paved areas with water. The microbes cannot digest contaminants without water. The gasoline or other fuel and chemical spills on the asphalt is the cause for concern; those compounds can pit and deteriorate a road surface quickly.

How long does it take the microbes to eat a gallon of oil?

It all depends on surface area, oxygen, water and nutrients. If it is in a gallon bucket, it will take a very long time (unless you have aeration equipment, plenty of water and have monitoring for nutrients). If it is spread thin, like on a roadway, it may be digested in a very short time with favorable conditions.

Microbes are like people -- they do best with plenty of water, a food source and oxygen. The gallon of oil would best be treated with 1 quart of Micro-Blaze diluted with 10 gallons of water in a 55-gallon drum and aerated. If the gallon of oil is spilled along a roadside, good results have been obtained with a 3% solution of Micro-Blaze oversprayed on the spill from water-type fire extinguisher or even a garden-style sprayer. There is usually good air exchange and natural rainfall keep the microbes digesting the waste. No need to "dig and haul" in these cases.

On what types of compounds will Micro-Blaze products work?

- Benzene
- BTEX compounds
- Petroleum products such as gasoline, diesel, motor oils
- Glycols (antifreeze compounds)
- MTBE
- PAHs, TCE
- Acetone and paint sludge
- Polyurethane resins wastes
- Condensate from pipelines
- Organics such as greases, fats, oils, sludge, cellulose
- AFFF wastes

1: Sonenshein, AI, etal. 1993. *Bacillus subtilis and Other Gram-Positive Bacteria*. AMS. Washington, D.C., page 12.

VERDE ENVIRONMENTAL, INC.

Micro-Blaze® Microbial Products



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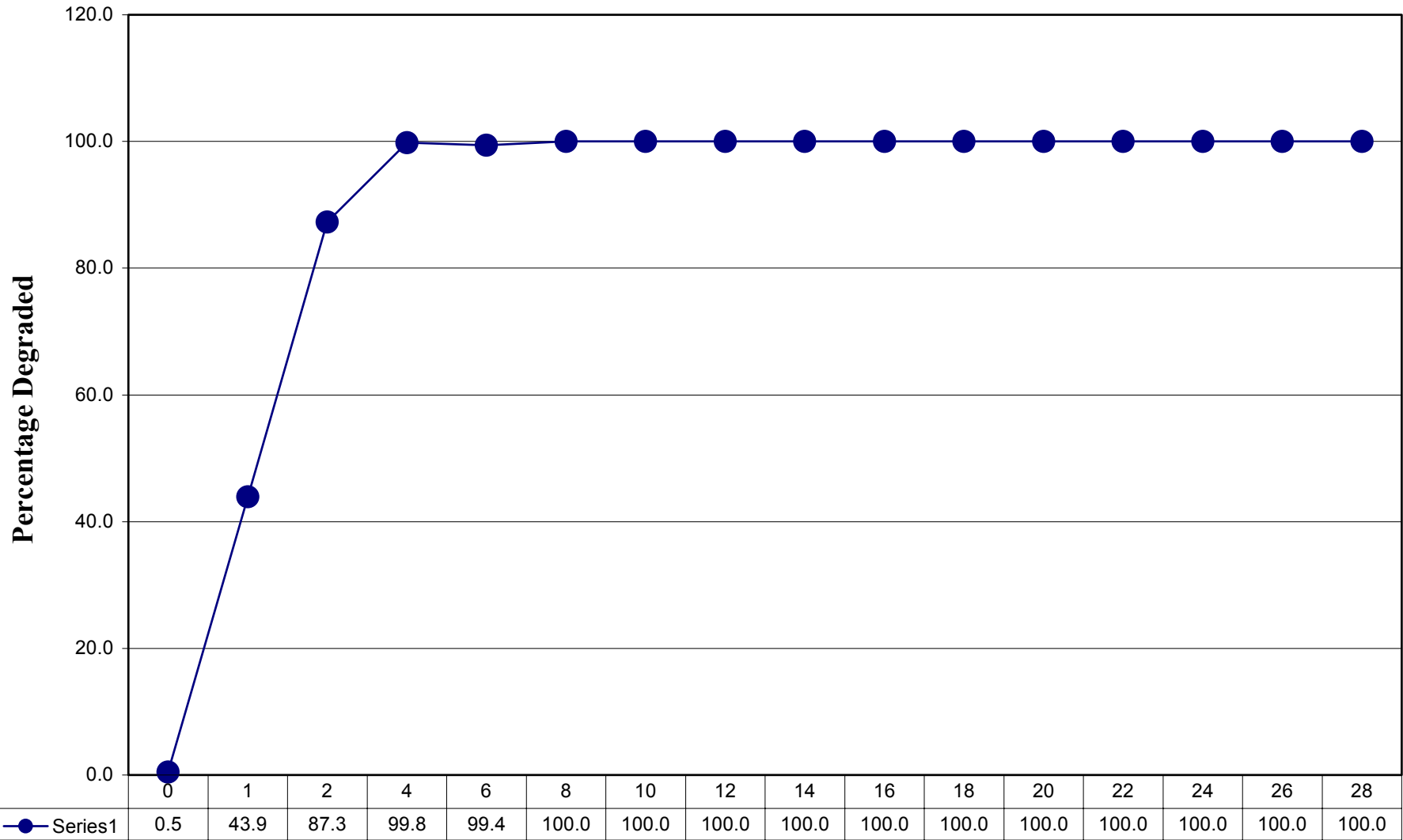
The following study, performed by U.S. EPA-approved laboratory, EFEH and Associates, shows the degradation of hydrocarbons in a solution of Micro-Blaze® Emergency Liquid Spill Control.

EFEH personnel placed ¼ cup of a gasoline/diesel mixture into one gallon of a 3% solution of Micro-Blaze® Emergency Liquid Spill Control and kept it stirred at a constant 68° F.

The study also illustrates the total degradation of the surfactants of the solution, with *no* remaining nonylphenolic compounds left.

Biodegradability of Micro-Blaze® Emergency Liquid Spill Control

Using a 3% Solution in Water, maintained at 68° F



Day Number / Numerical Percentage of Biodegradation

Bioremediation

Bioremediation has become a general term describing a process of degrading harmful or hazardous contamination into less harmful or benign components. In the industrial fields, the process harnesses microbial activities and products to aid in the cleanup of sites contaminated with organic pollutants¹.

It is an emerging treatment technology that can restore contaminated sites quicker, at a lower cost, and at lower human risk than alternative remediation technologies². Studies and case histories show how bioremediation can effectively rid a spill site of organic contaminants with fewer machine and labor costs and less profile in congested or neighborhood areas.

Method of Treatment	Year 1	Year 2	Year 3
Incineration	\$530.00 ¹	none	none
Solidification	315.00	none	none
Landfill	670.00	none	none
Thermal Desorption	200.00	none	none
Bioremediation	125.00	27.00 ²	20.00 ²

¹: Costs are per cubic yard, 1993 dollars. Actual costs will be impacted by time and competition.

²: If project warrants year two and three costs, these are average costs shown per cubic yard.

Original source: *Bioremediation Report*, King Publishing Group, Washington, D.C., 1993.

In addition to the lower costs of bioremediation, there is no litter or long-term or "cradle to grave" liabilities for the contamination like there is with landfilled pollutants because the contaminants have been digested and turned into harmless by products of CO₂, water and trace inorganic salts. Contaminated sites that can benefit from bioremediation exist in a variety of environments including surface soils and waters as well as shallow or deep subsurface environments³.

There are two main avenues of bioremediation operation: *In situ* can be used where excavation is impractical - under highways, buildings, runways, etc. This process can simultaneously treat soil and groundwater in one step, without the generation of hazardous waste products. Using an engineered treatment setup where contamination is placed for bioremediation is called an *ex situ* process.

There exists in all the world's soils and waters resident microbes that take care of digesting the usual waste streams found in its surrounding ecosystem. These are called *indigenous* microbes. Testing has been done to see if using these existing microbial populations, a process called *natural attenuation*, would remediate the contamination that entered the area. More often than not, very little remediation has occurred⁴.

Biostimulation, using aeration and adding fertilizers to supply nutrients to the indigenous microbes, also has drawbacks. It relies on the assumption that the existing microbes will be in large enough numbers to effectively degrade the contaminant and that they can readily adapt to the foreign contamination to start any degradation. This method usually results in a lengthy timeline for a project to come to closure.

Adding microbes that already have an aggressive affinity towards common hydrocarbon and organic contamination is described as *bioaugmentation*. Applying a sufficient amount of adapted microbes to the pollution site takes care of the contamination in a timely manner. There are variables to the amount of microbes to use - volume of contaminant, type and volatility of contaminants, pH of the soil or water, temperature, etc.

The several strains of *Bacillus* spores in Micro-Blaze® products provide a synergistic degradation of the organic and hydrocarbon pollutants caused by industrial and commercial processes. Its combination of surfactants, nutrients and microbes make it an ideal formulation for use on many pollutants found in spills and contaminated sites:

- Benzene, Xylene, and Toluene
- TCE
- PAHs
- Motor Oils
- Hydraulic fluids
- Fossil fuels: Gasoline, Diesel, aviation gas
- AFFF wastes
- Condensate leakage from pipelines

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- 1: "Bioremediation may be key for soil and ground water pollution cleanup", *Cornell University Science News*, October 1993.
 - 2: "Bioremediation", a course illustration for the Soil, Water and Environmental Science department, University of Arizona.
 - 3: "Field-Scale Bioremediation", course outline introduction, on website, University of California at Berkeley.
 4. Ibid.



Micro-Blaze® Emergency Liquid Spill Control

Micro-Blaze® Emergency Liquid Spill Control is a unique formulation that contains surfactants, nutrients and non-pathogenic bacteria. When applied to a hydrocarbon-based or organic spill or contaminant, the surfactant starts emulsifying (breaking down) the contaminants into smaller molecules for more efficient degradation by the microbes.

The microbes germinate and become active within 15 to 20 minutes. They double in population every 20 minutes and digest the wastes as long as all the necessary ingredients (water, oxygen and a food source) are present. The harmless byproducts of their degradation process are mostly inorganic salts, CO₂ and water.

Physical Characteristics:

- White, opaque perfumed liquid formulation
- pH: 7.3
- Completely soluble in water
- Bacteria count: 200 billion / gallon
non-pathogenic, non-toxic strains of *Bacillus* bacteria cultures
- Completely biodegradable
- Shelf life over 10 years
- Shipped in concentrated form, ready to dilute with water and apply; no mixing and waiting
12-24 hours to use

Application Rates:

General “rule of thumb”: Determine amount of contamination by volume. 10% of that volume is the amount of Micro-Blaze® Emergency Liquid Spill Control concentrate to apply, diluted. (hint: 350 gallons of contamination, have 35 gallons of concentrate.) Apply diluted to the specific percentage rate per contamination parameters (age of spill, type of contaminant, volatility, viscosity, etc.) For soils, figure using 1 gallon of concentrate for every 10 cubic yds. of contaminated soil.

Dilution rates: Usually, heavier weight oils like motor oils and hydraulic fluids use a 3% solution of Micro-Blaze® Emergency Liquid Spill Control mixed with water. *Hint:* for every 10 gallons of concentrate, dilute to a 3% solution with 333 gallons of water (10 gallons / 3% = 333 gallons water). Apply it forcefully with good pressure, so the oils will be thoroughly mixed with the solution and the waste will start emulsifying.

The LELs of lighter weight and volatile fluids can be knocked down with an application of Micro-Blaze® Emergency Liquid Spill Control in a 6% solution. Thoroughly mix and let stand for several minutes, then rinse. It will quickly mitigate the flammable liquid and reduce the fire hazard. (Dilute every 10 gallons of concentrate with 167 gallons of water; see equation above.)

For rates of application for specific situations, please contact your area Micro-Blaze® distributor or contact Verde Environmental at 800 / 626 -6598 or salesmicro@micro-blaze.com.

State and Federal Regulations

The following section is directly out of the November, 1997 State of Texas Oil and Hazardous Substances Spill Contingency Plan (RG-290).

Use of Chemical Agents, Biological Agents, and other Additives

Federal Pre-approval

40 CFR §300.905 NCP [National Contingency Plan] Product Schedule

(a) Oil Discharges.

(1) EPA shall maintain a schedule of dispersants and other chemical or Bioremediation products that may be authorized for use on oil discharges in accordance with the procedures set forth in 40 CFR §300.910. This schedule, called the NCP Product Schedule, may be obtained from the Emergency Response Division (5202-G), U. S. Environmental Protection Agency, 401 M Street SW, Washington, D. C. 20460. The telephone number is 1-202-260-2342.

(2) Products may be added to the NCP Product Schedule by the process specified in 40 CFR §300.920.

(b) Hazardous Substance Releases. (Reserved)

40 CFR §300.910 Authorization of Use.

(a) Regional Response Teams [RRTs] and Area Committees shall address, as part of their planning activities, the desirability of using appropriate dispersants, surface washing agents, surface collecting agents, bioremediation agents, or miscellaneous oil spill control agents listed on the NCP Product Schedule, and the desirability of using appropriate burning agents. Regional contingency plans [RCPs] and area contingency plans [ACPs] shall, as appropriate, include applicable pre-authorization plans and address the specific contexts in which such products should and should not be used. In meeting the provisions of this paragraph, pre-authorization plans may address factors such as the potential sources and types of oil that might be spilled, the existence and location of environmentally sensitive resources that might be impacted by spilled oil, available product application and effectiveness. The RRT representatives from EPA and the states with jurisdiction over the waters of the area to which a pre-authorization plan applies and the Department of Commerce [DOC] and Department of the Interior [DOI] natural resource trustees shall review and either approve, disapprove, or approve with modification the pre-authorization plans developed by Area Committees, as appropriate. Approved pre-authorization plans shall be included in the appropriate RCP's and ACP's. If the RRT representatives from EPA and the states with jurisdiction over the waters of the area to which a pre-authorization plan applies and the DOC and DOI natural resource trustees approve in advance the use of certain products under specified

circumstances as described in the pre-authorization plan, the OSC may authorize the use of the products without obtaining the specific concurrences described in paragraphs (b) and (c) of this section.

(b) For spill situations that are not addressed by the pre-authorization plans developed pursuant to paragraph (a) of this section, the On-Scene Coordinator [OSC], with the concurrence of the EPA representative to the RRT and, as appropriate, the concurrence of the RRT representatives from the states with jurisdiction over the navigable waters threatened by the release or discharge, and in consultation with the DOC and DOI natural resource trustees, when practicable, may authorize the use of dispersants,

surface washing agent, surface collecting agents, bioremediation agents, or miscellaneous oil spill control agents on the oil discharge, provided that the products are listed on the NCP Product Schedule.

(c) The OSC, with concurrence of the EPA representative to the RRT and, as appropriate, the concurrence of the RRT representatives from the states with jurisdiction over the navigable waters threatened by the release or discharge, and in consultation with the DOC and DOI natural resource trustees, when practicable, may authorize the use of burning agents on a case-by-case basis.

(d) **The OSC may authorize the use of any dispersant, surface washing agent, surface collecting agent, other chemical agent, burning agent, bioremediation agent, or miscellaneous oil spill control agent, including products not listed on the NCP Product Schedule, without obtaining the concurrence of the EPA representative to the RRT and, as appropriate, the RRT representatives from the states with jurisdiction over the navigable waters threatened by the release or discharge, when, in the judgment of the OSC, the use of the product is necessary to prevent or substantially reduce the hazard to human life.** Whenever the OSC authorizes the use of a product pursuant to this paragraph, the OSC is to inform the EPA RRT representative and, as appropriate, the RRT representatives from the affected states and, when practicable, the DOC/DOI natural resources trustees of the use of a product, including products not on the Schedule, as soon as possible. Once the threat to human life has subsided, the continued use of a product shall be in accordance with paragraphs (a), (b), and (c) of this section.

(e) Sinking agents shall not be authorized for application to oil discharges.

(f) When developing pre-authorization plans, RRT's may require the performance of supplementary toxicity and effectiveness testing of products, in addition to the test methods specified in 40 CFR §300.915 and described in Appendix C to part 300, due to existing site-specific or area-specific concerns.

State of Texas Pre-Approval

In all cases, the use of chemical agents, dispersants, bioremediation technology, or other additives utilized in combating spills in water in this state must be approved in advance on a case-by-case basis by the pre-designed federal on-scene-coordinator (OSC) in accordance with the *National Oil and Hazardous Substances Pollution Contingency Plan*, hereinafter referred to as the NCP (40 CFR Part 300). **The NCP, in conjunction with the federal Region 6 contingency plan indicates that for approval of any use, the OSC must first obtain the**

concurrence of the Texas Natural Resource Conservation Commission or the General Land Office except when, in the judgment of the OSC, the immediate use of the chemical agent or other additive is necessary to prevent or substantially reduce a hazard to human life. When a product is used to prevent or reduce a hazard to human life, the OSC is to inform the TNRCC or the GLO as soon as possible and to obtain TNRCC or GLO concurrence for its continued use once the threat to human life has subsided (40 CFR §300.84).

The TNRCC, GLO, and RRC all recognize that the inherent value of surface collecting agents is in their prompt use in preventing the spread of spilled oil. The person responsible for the containment and cleanup of an oil spill may use a surface collecting agent without prior approval of the TNRCC. This in no way relieves the responsible person of legal responsibility for any adverse effects caused by the use of the surface collecting agent or the spilled oil. However, **the Regional Response Team (RRT) must approve the use of any chemical agent except where the OSC feels that human life is in danger.**

During the course of cleanup and restoration activities, staff of the state agency with lead jurisdiction shall consult with representatives of the other state agencies regarding the application for the use of dispersants, chemical agents, bioremediation technology, or other additives.

Through the activities of the RRT, the various state agencies with primary jurisdiction have participated in pre-approval planning. Presently, there is an existing pre-approval for the offshore Gulf of Mexico area in federal Region 6 related to coordinators to whom the RRT has issued the pre-approvals.