Educational Innovations, Inc.®

ENV-120/125
Envirobond

DEVELOPMENT
With the emerging environmental issues picking up steam in the 80's and the panic pursuit to come up with waste management programs to meet the unfolding regulations, the direction was clear. Achieve the highest level of stabilization with the least amount of ad mixture and do it cost effectively.

The research began in early 1986 after reviewing many methods that were being employed and not seeming to solve the problems. Everything was winding up in landfills un-stabilized with huge volumes being generated. Landfills were filling up and developing problems, while increasing the liability to the generator. Absorbent products were coming on market at a rapid rate (such as sawdust modified clays, spun fabric, corncobs, peat moss, etc.) These products allow a generator to remediate one area but created a landfill problem. Even though a federal directive land-banned these, they are still used widely, disguised as sanitary garbage and landfilled. Many companies have tried stabilizing land-banned waste without the ultimate success, and which has only increased the principal polluted masses in volume by 300 - 400 %. The solution to pollution is no longer dilution but is finding the answer.

During the time from 1986 to 1990, we had researched three different polymer structures with moderate results. During that period of time, our main focus research was done on drilling fluids and aqueous stabilization. In the summer of 1990, an intensive research was launched. It was discovered that the polymers reacted differently with different hydrocarbons and with different timeframes. Since the hydrocarbons source would consist of three basic components - Parafinics, naptinics, aromatics and fractions thereof, the fractions of hydrocarbons may be water soluble and non-water soluble. The water soluble hydrocarbon structures will require a polymer structure very different from that which will bond and stabilize non-water solubles. These polymer structures for the water solubles will be discussed in a separate communication. The principal polymers of this discussion will be those that bond and stabilize non-water soluble hydrocarbons (crude oil, diesel and gasoline). After the testing of many polymer structures and determining the results, we then filed for patent covering the methods of stabilization of hydrocarbons.

WHAT IS A POLYMER?
A polymer is the bonding together of molecular structures of various molecular wts. or substances having the same molecular wt. to achieve the molecular wt. and structure for a useful function and purpose. The society that we know today would not exist without polymers. Products such as Saran Wrap™, Tupperware™, plastics used on telephones, computers, etc. are polymers.

Polymers are substances that may consist of large macromolecules, are made up of repeating units.

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The molecular sub-units that are used to synthesize polymers are called monomers and reactions by which monomers are joined together is called polymerization.

SELECTING THE RIGHT POLYMER AND DISPOSAL

The polymer structures formulated and tested are of the highest quality and consequently the most expensive. Reference the Valdez: the amount of polymer required to stabilize the entire loss would have cost only $300,000,000.00. The entire mass would have been converted to a solid. The shorelines would not have been contaminated and the mass would have been retrieved in solid form, safely stored and made available to a fuels program.

It is estimated that more hydrocarbons were spilled on the ground in Michigan and Ohio in 1991 than was lost in the Valdez spill.

Michigan is unique in that it is surrounded with 25% of the world's fresh water supply and 95% of the entire United States supply. We have a responsibility to protect all fresh water supplies, even where it is not so abundant. Selecting the polymer structure plays a major role in protecting the environment from spilled or leaked hydrocarbons.

POLYMER VS. HYDROCARBON STRUCTURES

In our research, we determined the effective polymer structures in addressing three common hydrocarbons, crude oil, diesel fuel and gasoline. Our research polymers consist of some 31 different structures with 12 different backbone structures.

- The polymer formulation had to produce bonding immediately, with 100% in five minutes.
- The polymer is hydrophobic; will float on water and will not water wet.
- The polymer density is great enough to sink through the hydrocarbon that is on water.
- The polymer mixed with soil would allow water to pass through while bonding the hydrocarbon.
- The polymer would not require mixing but only utilize an applying technique.

The polymerized masses that have been stabilized are remediated and stored and are now being considered for a liquids fuel program that will be introduced in the next few months. After a year of research with a major company, the polymer can also be used in treating oily sludges, bonding the hydrocarbons, entrapping the solids, and releasing the water. This would eliminate trying to break emulsions and filter pressing. This has been done successfully and the BTU values established. These masses would then be transported to a liquefier system to be made into a liquid fuel source, or be ground up for a solid fuel. The result is no landfill or liability. It is believed that the TCLP and TPH test may well dictate landfills on just what they will be able to accept.

While it is not our policy to recommend disposal, nonetheless, the polymers represent the best stabilization or immobilization of liquid hydrocarbons, with the least amount of ad mixture.

SUMMARY

This research began to be introduced into the oil and gas industry, so it would have responsible products at its disposal and to provide effective products to clean up accidental spills, leaks and drips. These products are now finding their way into many other market segments: Industrial, Commercial,

Shipping, Boating, Airports, Fuel Centers and Trucking. These products have already begun replacing the absorbents, clays, saw dust, peat moss and other mixtures.

FACTS

The ENVIRO - BOND™ polymers have the ability to bond with diesel fuel, gasoline, waste oils and most other liquid hydrocarbons to form a solid mass. This is accomplished by an actual molecular bonding, not just a "physical" soaking or sponging, of the liquid hydrocarbon. With the encapsulation process beginning immediately upon contact between the liquid hydrocarbon and the polymer.

This bonding and solidifying can be accomplished on any surface and a solid and manageable waste product, that will not drip when handled, is typically formed within 10 - 15 minutes after application or sooner. The application ratios being as high as 1:15 by weight, depending on the type of hydrocarbon being encapsulated. Clean up is fast, effective and cost efficient and, with less material to buy, store, handle and haul, yielding significant reductions in waste mass generated, the result is a significant reduction of disposal costs.

The ENVIRO - BOND™ polymers have the "unique" ability to suppress vapors and reduce off-gassing by 80% within the first 5 minutes. The gases/vapors are trapped within the solidified structure and are prevented from migrating to the surface area, yielding almost total elimination of any vapor release over the course of several hours or days depending upon the hydrocarbon that has been solidified.

As a result of this vapor suppressive ability, spontaneous combustion and unintentional spontaneous ignition hazards are almost totally eliminated.

On the surface of water, the polymers are completely hydrophobic and will float even after maximum encapsulation and solidification. They will not water wet even in very severe conditions and any unused polymer can be captured and reused. On any surface, including water, the polymers will only bond with the free hydrocarbon molecules. Solidifying hydrocarbons into a solid mass on water makes for a much easier surface area cleanup while removing even the most subtle slick or sheen. The polymers packaged in booms and pads make for extremely easy and effective cleanup on water, they are easy to retrieve and will remain floating indefinitely.

Harmless to fish and wildlife.

The polymers can be mixed into soil surfaces where spills frequently occur and left unattended will perform their encapsulation, stabilization and solidification duties as a spill occurs.

The bonded hydrocarbon will never leach from the solidified mass and is very easy to handle, store or dispose of.

The polymers have an indefinite shelf life.

The polymers are FDA Food Grade and are non-toxic, non-corrosive and non-carcinogenic. No exotic protection needed (goggles & masks suggested), creating safer working conditions, lower exposure risks and reduced liabilities.

The polymers are formulated to react with all organic hydrocarbons, but, are not recommended for use with "synthetic" hydrocarbons when solidification is the desired end result.

The polymer will perform without mixing, and under most conditions simple surface application will be adequate, however, with very thick layers of hydrocarbon, some mixing may be desired for quick and complete solidification.

The polymers will not dissolve in the presence of high or low pH solutions containing water.

The polymers will break oil and water emulsions by bonding with the non-dissolved portion of the hydrocarbon molecule and leaving the water free. The polymers have the ability to bond and virtually not release heavy metals that may be in solution with the hydrocarbon.

The polymers can act as a pre-scrubber to carbon filtration by removing the non-dissolved portion of the hydrocarbons before final filtration.

If the liquid media containing PCB's is of a hydrocarbon source, the polymers have the ability to encapsulate and solidify the entire mass yielding extremely manageable disposal of a solid form.

The polymers have been found to be extremely effective in the treatment of very hazardous waste by forming a solid mass that is very safe to transport and dispose of.

Typical disposal methods are landfilling or incineration of the waste, consistent with local, applicable regulations.

As a landfilled waste, the non-biodegradable polymer will never leach or release any of the encapsulated and solidified waste liquid/s. Reducing or eliminating your liabilities.

The polymer when incinerated produces virtually no ash residue and has a BTU value of 18,602.

Meets established EPA landfill requirements.

We know, based on multiple independent studies, that ENVIRO - BOND™ polymers far exceed the physical properties and capabilities of the conventional products such as cellulose, spun poly- propylene, ethylene, saw dust, peat-moss, ground foams, clay based absorbents and other such products.

Application Methods

- **Water Spills:** The salinity of water will not affect the polymer performance. It will work on both fresh and saltwater.

- **Large Spills:** Where very large spills exist, and a large volume of ENVIRO- BOND™ 403 is to be deployed, it can be best dispersed through a Venturi hopper and water (a carrier fluid) to reduce static charge. It may also be dropped from the air, pre-wetted using a C02 timed detonation device. ENVIRO - BOND™ 403 mixed with water will not clog pumping devices and the polymer will not water wet.

- **Small Spills On Any Surface:** May be applied directly to spill.

- **Special Uses:** Soils may be pre-treated with ENVIRO - BOND™ 403 where spills occur. The spilled hydrocarbons will bond with the polymer to form a solid and reduce further groundwater contamination. This will provide for a very manageable solid with reduced volume and mass.

- **Spill Treatment:** The perimeter of a spill should be treated initially to form a boom, then the inside area treated to stabilize the liquid hydrocarbons. Booms, pads, and pillows are available.

- **Filtration Effectiveness:** ENVIRO - BOND™ 403 will act as a preliminary absorbent for cleaning water contaminated with non-water soluble hydrocarbons. This would work in conjunction with activated carbon for fresh water purification. Carbon is a well-known product for extracting solubilized hydrocarbons in water and is known to bind to raw hydrocarbons, rendering it ineffective. The polymer reacts with the liquid hydrocarbons, which makes the carbon more effective.

- **Recovered Stabilized Masses:** All stabilized hydrocarbons can be reclaimed as a fuel, source liquid, or solid. The BTU value of the fuel is captured and can be used in co-generation.

- **Remediation of Land and Ocean Water Spills:** The entire area should be cleaned and disposed of in accordance with federal, state and local regulations. Open water may be remediated by a fine mesh fishing net to collect the bonded mass. Dispose in accordance with federal, state and local regulations or tendered as a fuel.

- **Mixing with Liquid Hydrocarbons:** Mixing is not necessary. The polymer will absorb and bond with liquid hydrocarbons in turbulent flow such as a rapid moving stream, river, or wave action. The polymer will break a water/oil emulsion.

Concentration/Application of ENVIRO - BOND™ 403

The amount of ENVIRO - BOND™ 403 will vary depending on the type and viscosity of the liquid hydrocarbons to be stabilized. The age of hydrocarbon may range from months to years, depending on its volatilization.

Concentration:

The amount required will usually be between 10% to 25% by weight with the addition of ENVIRO - BOND™ 403 to the liquid being stabilized, and will reduce its toxicity. Bonding begins immediately and continues for about 30 days.

Conditions:

ENVIRO - BOND™ 403 is not affected by water salinity. ENVIRO - BOND™ 403 is effective in any temperature range between -10° F to 100° F as long as the hydrocarbon is a liquid. Colder temperatures will require more time for bonding to occur. Windy conditions on water: The leading edge of the spill should be treated with follow up being treated up-wind of the body of the spill.

