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EVALUATION OF IMBIBER BEAD TECHNOLOGY FOR POL LEAK CONTROL

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EVALUATION OF IMBIBER BEAD TECHNOLOGY FOR POL LEAK CONTROL

1. Purpose. The purpose of this Public Works Technical Bulletin (PWTB) is to transmit the evaluation of Imbiber Bead technology for controlling petroleum, oil, and lubricants (POL) spills and leaks on military installations.

2. Applicability. This PWTB applies to all U.S. Army facilities engineering/public works and environmental activities.

3. References.

a. Army Regulation 200-1, Environmental Protection and Enhancement, 21 February 1997.

b. Project Directive, MEEP Project Nr ET96-69, (AFI 24-035), Final Report.

c. Environmental Technology Verification (ETV) Program – Technology Fact Sheet, Imbiber Beads.

4. Discussion.

a. During Fiscal Year 1997, the Construction Engineering Research Laboratory (CERL) conducted site visits at a major troop installation in support of updating that installation’s Storm Water Pollution Prevention Plan (SWPPP). All industrial activities, including motor pools, were visited. During these

visits, it became apparent that a major cause of storm water pollution was poor control of POL leaks from parked tactical vehicles. Drip pans are placed under almost all parked tactical vehicles at military installations to catch leaking lubricants and hydraulic fluids. However, in some cases these are simply not adequate. Large tactical vehicles leak significant quantities of POL products. These products are entering the storm drains and causing non-storm water discharges, which violate the installation's NPDES permit as well as the Clean Water Act, and AR 200-1. Often an installation's only option is to cover large parking areas, a costly alternative. An inexpensive option for protecting storm drain inlets at facilities with this problem is the use of absorbent mats and other spill control equipment. However, the ability of these materials to allow significant quantities of storm water to pass through while retaining all POL products is certainly questionable. Additionally, they may present maintenance requirements that the installation can ill afford.

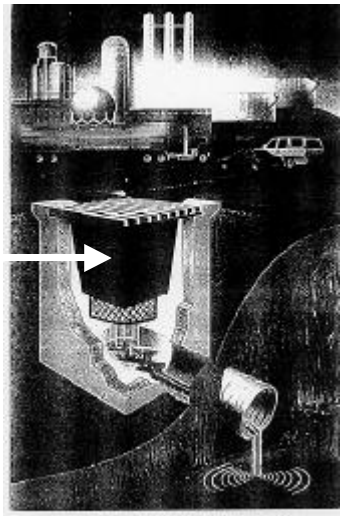
b. Adsorbents are materials that retain liquids on the surface of their particles by capillary action and surface tension. Absorbents retain liquids within their molecular structure.

Imbiber Beads™ are spherical plastic particles that absorb organic liquids. The polymer particles are small (about the size of a grain of salt or sugar) and non-porous. When these beads come in contact with a compatible liquid, they take that liquid into their molecular structure. The beads can swell up to 27 times their original volume. They will not release the liquid even when compressed or split in half, and will not absorb water. A list of compatible liquids, provided by Imbibitive Technologies, is included as Appendix A. Only those liquids with "Excellent" or "Good" absorption potential are listed. Liquids most commonly found in motor pools are the fuels and fuel oils and their components (e.g., benzene, xylene, ethylbenzene, and toluene).

The beads are commercially available and are sold both as a loose product and packaged as pillows, booms, and blankets. These products range in cost from $81.00 a carton for six 14-in. by 21-in. pillows to $340 for a 40 lb drum of bulk material to over $2,000 for a complete spill kit capable of capturing approximately 130 gallons of liquid. Used beads should be

disposed of as any other adsorbent, based on local regulations and the material absorbed.

Storm drain inserts containing the beads are also available. These inserts are placed in storm drains and are designed to prevent leaks and spills from reaching the environment through the storm water drainage system. The drain insert allows water to pass, but will absorb petroleum products. The insert consists of a metal structure into which bags and pillows containing the beads are placed. The structure is then placed inside the storm drain. It rests on the existing lip of the drain, just under the grate. The beads contained within the insert will swell as they come in contact with contaminants. As the beads swell, they seal the drain, stopping flow. Drain inserts are relatively easy to install and require few tools or modifications to the existing structure. However, accurate drain measurements are imperative to ensure a good fit. Inserts are manufactured by the company and are fabricated to fit a specific drain. Because the inserts extend below the initial drain grating, it is important to consider the slope of the drain sides, if any. An insert for a 21-in. diameter storm drain costs approximately $1,300. Replacement pillows for this system are about $80 per drain. A drawing of the drain is shown below.



IMTECH CONTAINMENT BASIN

d. Canada's Environmental Technology Verification Program (ETV) has conducted tests to verify claims made by Imbibitive Technology, the manufacturer of Imbiber Beads. Beads were placed in glass columns and loaded with water, xylene, and diesel fuel. These tests concluded that water did flow freely through the beads and that they swelled and sealed when exposed to xylene and diesel fuel. Additionally, beads were soaked with xylene and diesel fuel for 12 hours and then their diameters measured. The beads were then compressed and flattened to twice their swollen diameter to determine if liquid would be released. The beads remained intact and did not release any liquid when compressed. ETV has concluded that the beads are a true absorbent and perform as the vendor states.

The U.S. Air Force is using bead-containing materials for spill response. Pope Air Force Base (AFB), NC, has used these materials for the past year in response to spills on their flight line. Before purchasing, the base and Imbibitive Technologies conducted demonstration testing through the Air Force's Management and Equipment Evaluation (MEEP) Program. During this demo, 15 gallons of petroleum product were released onto an asphalt/ concrete area. The loose beads (mixed with sand) were applied at several positions in and around the spill.

Swelling of the beads was evident as they took the liquid into their structure.

Additional testing was conducted at Pope AFB to further evaluate the beads. Loose beads as well as bead-containing pillows and pads were given to five squadrons in the Operations Group. Each compared the beads against adsorbent pads and rags then in use. All sections involved in the test recommended the Imbiber Beads for general Air Force use for spill cleanup.

The base has also placed an imbiber bead blanket in a storm drain at the end of one of their runways to ensure that any contaminants in storm water runoff do not reach the environment. The base has found that the blanket works very well in this application. The base bio-environmental office samples the storm water effluent on a quarterly basis and has never had a compliance problem. The blanket does not restrict water flow, even during very heavy rains, and is virtually maintenance free. The only maintenance required to date is the replacement of the blanket every 3 months.

The base has continued to use the loose beads as well as bead-containing booms, mats, and pillows with good success. However, the base must occasionally respond to spills that are an immediate threat to the environment (e.g., a spill in very close proximity to a storm drain). Because the beads need time to absorb the contaminant, the base must use other spill control materials in these instances. Despite this drawback, the base still recommends the use of the bead-containing spill control materials for the majority of their spills.

e. Imbiber bead-containing storm drain inserts were also evaluated as part of this study. Of particular concern in the reduction in flow through the storm drain during large rains. It is likely that some “ponding” may result and that this may create a safety hazard, particularly during freezing temperatures. Maintenance of the drains is also a concern.

As part of the CERL study, a drain insert was purchased and installed at a motor pool at Fort Benning, GA. The drain is in the center of a parking area that contains various large tactical vehicles. These vehicles can leak significant

quantities of POL products, and drip pans have proven to be a less than successful problem solution.

The drain insert was installed in September 1999. Less than 1 month afterward, the installation experienced some extremely heavy rain over a 4-day period. Personnel checked the drain and discovered that it had plugged. The upper sand/bead filter and most of the bead-containing booms were stained black with oil and dirt. The lower filter had almost no staining. The stained filters/booms were removed in an attempt to restore water flow. However, water continued to back up and pond around the drain.

The Illinois Army National Guard has installed a drain insert at its facility at Midway Airport in Chicago. Fuel trucks at this facility must be parked in areas with secondary containment. To this end, the installation has constructed a concrete pad that is sloped such that flow is directed to a notch in the berm of the pad. An insert, consisting of a galvanized steel box with bead-containing bags and pillows inside, was inserted in this notch.

Approximately 1 month after installation, the bags containing the beads plugged with mud and other debris, which caused the drain to plug and restricted water flow. Operators removed the bags and rinsed them with water to remove the debris and restored flow. The bags are now cleaned every few months.

Other than periodic maintenance to unplug the insert and restore water flow, the drain inserts are relatively maintenance free. However, all of the absorbent materials must be replaced following a major spill. It may also become necessary to replace these materials after smaller amounts of contaminants are absorbed should they cause the drain to seal and restrict water flow.

f. Conclusions and Recommendations. The beads performed well during laboratory testing and are excellent absorbents. They will not release the absorbed product, even when compressed or cut. They do not absorb water. Loose beads and mats, pillows, and booms that contain imbiber beads are an excellent alternative for spill response.

Drain inserts tend to plug easily and can restrict water flow. The bags and pillows placed inside the drain insert can plug with debris and mud. Periodic maintenance is needed to clean

these materials. Maintenance will also be required after spills. Bead-containing bags and pillows will have to be replaced. Use of the insert in applications where debris and dirt are present is not recommended.

5. Points of Contact. Questions and/or comments regarding this document that cannot be resolved at the installation level should be directed to:

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APPENDIX A:

Absorption – Excellent (Immobilization within 5 minutes)

Allybromide	Propene	Dipropylamine	Methylbutylamine
Allychloride	Chloropentanes	Epichlorohydrin	Naphtha
n-Amylbenzene	a-Chloro-m-Xylene	Ethylacetate	Methylene Chloride
t-Amylbenzene	l-Chloronaphthalene	1 2-Epoxydodecane	Nitrobenzene
Amyl Acetate	2-Chloropropene	Ethyl Acrylate	Methylisobutylketone
Amyl Chloride	3-Chloropropenyl	Ethylbenzene	2-Octene-1
Amylene	Benzene	Ethylbromobenzene	Methylmethacrylate
Benzaldhyde	Chlorostyrene	Ethylbromide	Mineral Spirits
Benzene	2-Chlorotoluene	Ethylbutyrate	Pentane
Benzylamine	Cyclohexane	Ethylchloride	Perchloroethylene
Benzyl Chloride	Cyclohexane Chloride	2-Ethylhexyl Acrylate	Naptha 107-142
Bromobenzene	Cyclooctone	Ethylenedichloride	2-Phenylethylamine
2 Bromoethylbenzene	p-Cymene	Ethyliodide	Octane
1 Bromobutane	Decahydronaphthalene	2-Ethylhexylamine	Propylacetate
Bromotrichloro Methane	1 2-Dibromopentane	Ethylpropyl Ether	Oil of Citronella
Butyl Acetate	1 5-Dibromopentane	Ethylisobutyl Ether	Propylene Oxide
Butyl Acrylate	1 2-Dibromopropane	Ethylenebromide	3-Pentanone
Butylbutyrate	Dibutyl Ether	Freon 113	Quinoline
t-Butylbenzene	Dichlorobenzene	Ethyllaurate	Petroleum Ether 32-59
n-Butylbenzene	1 2-Dichloroethylene	Heptane	Styrene Oxide
sec-Butylbenzene	Dichloroisopropyl Ether	Ethyltoluene	Propylenedichloride
Butylbenzoate	aa-Dichloro-m-Xylene	Hexane	Tetrachloroethane
Butyl Cellosolve	Diethylbenzene	#2 Fuel Oil	Pyridine
Butylene Oxide	Diethyl Carbonate	Iodomethane	Triophene
t-Butylstyrene	Diethylketone	Gasoline	Styrene
t-Butyltoluene	Dilsobutylamine	Isobutylamine	Trichlorobenzene
Butyraldehyde	Diisobutylene	2-Heptanone	Tetrahydrofuran
Butyric Acid	Diisobutylketone	Isopropyl acetate	1,1,2-Trichloroethlene
Carbon Disulfide	p-Diisopropyl Benzene	Iodohexane	Thionyl Chloride
Carbon Tetrachloride	Diisopropyl Ketone	Mesitylene	Trichloropropane
Cellosolve Acetate	Dimethoxymethane	Isobutylacetate	Toluene
m-Chloroaniline	N,N-Dimethyl	Methylacrylate	Turpentine
2-Chlorobenzaldehyde	Benzylamine	Isopar E	1,1,2-Trichloroethane
Chlorobenzene	1 2-Dimethyl	Methylbenzoate	Vinyl Acetate
Chlorobenzol	Cyclohexane	Isoctane	aaa-Trichlorotoluene;
Cholorobromomethane	Dimethoxypropane	Methylcyclohexane	Benzotrichloride
o-Chloroethylbenzene	Dimethysulfide	Isopropylbenzene	Vinyltoluene
Chloroform	Dioxane	Methylethylketone	VMSP Naphtha
Chloro-2-Methyl	Dipentene	Methoxynaphthalene	Valeronitrille
Propene	1 1-Diphenylethylene	Methylisopropyl Ketone	Xylene
3-Chloro-2-Methyl	Diphenyloxide	Methylamyiacetate	Vinylpyridine

Absorption – Good (Immobilization within 10 minutes)

Acetophenone
50 Aniline/50 Nitrobenzene
Benzenesulfonyl Chloride
n-Butylstearate
Chloroacetone
2-Chlorothiazone
Diacetone
#2 Diesel
#2 Diesel Union-Prem.
Dimethyldodecylamine
N,N-Dimethylpiperazine
Ethyleneimine
Ethyloctynol
1-Ethynyl-l-Cyclo-Hexanol
Flourobenzene
#1 Fuel Oil
Isoamylisovalerate
Isopropylacetrophenone
Kerosene
Methylacetate
2-Methylbenzothiazole
Pentylacetate
Stearoyl Chloride
m-Toluidine

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