

Oil Spill Prevention Control and Countermeasures for Electrical Substations – Part II

An Online Continuing Education Course for Engineers

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Oil Spill Prevention Control and Countermeasures for Electrical Substations – Part II

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Introduction

The original Spill Prevention, Control, and Countermeasure (SPCC) rules were published on Dec. 11, 1973 (38 Fed. Reg. 34164). Revisions to the SPCC program were initially proposed on Oct. 22, 1991 (56 Fed. Reg. 54612). Subsequent proposals to amend the SPCC regulations were made in 1993, 1997, and 1999. Final SPCC Phase I amendments were published on July 17, 2002 (67 Fed. Reg. 47042). The final Phase I amendments became effective on Aug. 17, 2002, and are the foundation for this course. Additional final amendments to the Phase I regulations were published on Dec. 26, 2006 (Fed. Reg. 77357) to address issues applicable to “small facilities” and “oil-filled equipment.” EPA issued the “SPCC Guidance for Regional Inspectors” to help explain how the Phase I amendments should be implemented. The latest regulations and guidance can be found on EPA’s web page at www.epa.gov/oilspill. All current EPA SPCC regulations and guidelines should be consulted before SPCC implementation.

To comply with the regulations, a company should conduct an engineering assessment of each power facility to determine the potential for oil discharge and the resulting impact. This assessment is to be based on considerations of the volume of oil and the location of the facility relative to waters that may be affected. If a potential exists, the regulations require the preparation and implementation of an SPCC plan for all new and old facilities that could reasonably be expected to discharge oil into the navigable waters and groundwater of the United States or adjoining shorelines.

Note:

This course is divided into two parts. This is Part II and explains some of the tools and methods to contain oil spills, how to address oil spills in water and oil spills on land as well as oil disposal procedures.

Chapter 1: Oil Removal Materials

Sorbents

Sorbent is the term given to those products or materials that are oleophilic—oil-attracting— and hydrophobic—water repellent. That is, they have a high capacity for adsorbing or absorbing an oil product, and they tend to repel water. In usable form, sorbents must float on water long enough to adequately collect the oil and then be removed.

Oleophilic refers to a substance that has an affinity for oils and not for water.

Definitions of sorbents provided by the American Society for Testing and Materials include:

- Adsorbent—An insoluble material that is coated by a liquid on its surface, including pores and capillaries, without the solid swelling of more than 50 percent in excess liquid.
- An incomplete list of adsorbent materials used on oil releases includes plastic fibers such as polypropylene, plastic foams, straw, peat, sand, feathers, foamed glass and silicates, activated alumina, and soil.
- Absorbent—A material that picks up and retains a liquid distributed throughout its molecular structure, causing the solid to swell—50 percent or more. The absorbent must be at least 70 percent insoluble in excess fluid.
- Absorbent materials for organic liquid releases include rubbers and cross-linked products such as imbibing polymers.

Sorbents can be classified as either mineral products, natural (organic or agricultural) products, or manufactured (synthetic) products.

Sorbents are used widely to clean up small terrestrial or marine spills and for completing the cleanup of a large spill. Their use is generally more costly than conventional mechanical procedures except for small or thin-layer oil spills. Sorbents usually must be spread and recovered by hand, thus limiting the area that can be adequately cleaned by this process. The selection of sorbent materials for storage and use will be influenced by the local exposure to oil spills and the type of hydrocarbon that might be spilled. The following may assist in this selection.

Mineral Products

Several commercially available minerals have a high affinity for oil, including volcanic ash, diatomaceous earth, vermiculite, perlite, and some chalks. For oil spill cleanup work, these materials need to be ground into a very fine-grain form. This leaves much of the material as dust, one of its greatest disadvantages. The materials do adsorb certain oils to acceptable ratios—three to six times their weight—but are very expensive and thus are not commonly used for oil-on-water cleanup. Also, the oil spill recovery process may be complicated because these materials may:

- Be too fine grain to permit removal by conventional means such as nets and sieves
- Be abrasive to mechanical pumps
- Require specialized equipment to spread and recover
- Not burn, eliminating burning as a disposal process.

Natural or Agricultural Products

Many agricultural products are available for use in adsorbing oil from water. Most leaf-like plants contain some natural oils, giving them a greater affinity for oil than water. When dry, they are lightweight enough to float on water. All these products will become water-wet and sink, carrying the oil with them. Straws with hollow stems will float for longer periods than grass or hay. These sorbents are plentiful in agricultural communities and usually are available within a short distance.

Agricultural products are relatively inexpensive but are bulky. If needed in sizable quantities, they will require large protected storage areas. Rain-wet straw or hay loses a great deal of its affinity for oil, is more difficult to spread, and will sink more readily. The method of packaging or baling is important. Baling wire will quickly rust out in humid climates, rendering the bale useless for transport. A plastic baling line for the storage of hay or straw is preferable.

Spreading an agricultural product on the water or along a beach can be a costly and time-consuming operation unless a mechanical spreader can be used. Such mechanical units usually are available in agricultural communities and are used by highway construction contractors.

Some of the natural products that have been tested and used as oil spill sorbents include

- Rice straw
- Oat straw
- Wheat straw
- Flax straw
- Johnson grass (hay)

- Coastal Bermuda (hay)
- Bagasse (sugar cane)
- Buffel grass (hay)
- Red top cane
- Cottonseed hulls
- Corn cobs (ground or unground)
- Peat moss
- Sawdust

Straws are the most common and widely used natural sorbent materials. Straws can be oat, wheat, rice, or flax. These are available to most communities. They are the most adsorbent of agricultural products. Straws will float for longer periods because of their hollow or fibrous stems. Straw is the least expensive of the natural products and, if baled properly, can be stored for many years. Tests have shown that straws have a 30 percent greater oil adsorbing capacity than hays, 40 percent more than canes, and 100 percent more than cottonseed hulls. Straws have been known to adsorb between 8 times and 30 times their weight in oil.

Grass or hay makes a good sorbent. It is generally available as feed for livestock, but since it is a feed, it costs more than straw. This is principally a leafy material that has a high oil-adsorbing capacity. However, it can and will become water-wet and sink with the oil. Its use in shore-side or beach operations may be justified. It can be removed from the water with fine screens and easily raked into piles on a beach.

Bagasse and red top cane are regional products. Bagasse has a high affinity to oil but will readily become water-wet and sink. Red top cane, like bagasse, quickly becomes water-wet and sinks. Also, it has a relatively low oil sorption capability.

Peat moss is expensive for oil spill cleanup work. Like cottonseed hulls and corncobs, it will readily become water-wet and sink. These products can be used on land and on beaches, but their cost may preclude their use.

Sawdust quickly becomes water-wet, reducing its oil-absorbing capacity, and it tends to sink quite readily. Sawdust is also easily churned at the beach by breakers and dispersed in the water column, adding to the problem. On the beach, sawdust readily mixes with the sand during raking, making it impossible to remove.

Synthetic Products

Synthetic products are widely used and are available from manufacturers under various trade names. The adsorbent types are manufactured from high molecular weight polymers such as polypropylene, which has higher adsorbing capacities than mineral and cellulosic products.

Polyurethane, for example, can theoretically adsorb up to 90 percent of its volume. It may, in some forms, collect several times its own weight in oil—more than the mineral or cellulosic products. Adsorbents cannot sorb more than their own volume. The viscosity or thickness of the liquid being adsorbed will impact upon the adsorption capacity, and the amount of oil the material will retain on its surfaces. Some of the adsorbed oil can be rereleased from the adsorbent during retrieval operations if the viscosity is insufficient to cause the oil to adhere to the material's surfaces. This may impact the material's overall effectiveness for certain oil recovery operations.

The absorbent type of synthetic products is also available from manufacturers. These products include cross-linked polymers and rubber materials, which absorb liquids into their solid structure, causing the sorbent material to swell. It is the swelling of the absorbent that distinguishes it from adsorbents. The capacity of absorbents is generally measured in volume/volume ratios as the swelling characteristic of absorbents allows these materials to pick up many times their volume in spilled liquid. Viscosity also will impact on the effectiveness and the absorption capacity. The temperature may impact on the absorption rate, with lower temperatures tending to significantly slow the rate. As liquids are integrated into the absorbent material, the liquid cannot be rereleased, which virtually eliminates secondary contamination of the environment and response personnel.

The performance characteristics of both absorbents and adsorbents should be considered when considering the overall cost-effectiveness of a product for use in oil and organic chemical spills. Oil types and their viscosities are important factors to consider at ambient temperatures.

The adsorbent synthetic

1. As a relatively fine powder
2. As a medium-coarse powder
3. As pads one-quarter to one-half square foot in size; 12 to 24 inches
4. As particulate balls
5. In rolled sheets 3 to 6 feet wide
6. In various pillow-shaped forms
7. As sorbent booms;
8. As a mop like a household mop
9. As a tangled mass of fibers
10. In liquid component form to be chopped and

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