Using Geosynthetics for Oil Containment

Oil is oil, whether consumed or used as fuel. So says the USEPA. All oils have the same effect on the environment when allowed to enter the sub-soil or, worse, the water table. Anything that behaves like oil floating on water is considered to be oil.

No site wants to have an oil spill, into the waterway, or groundwater, especially in a residential area. Publicity following a spill will hurt the company's image, not to mention the fines and remediation costs associated with a spill.

Geosynthetics consist of the following polymeric materials used in environmental, geotechnical, transportation and hydraulic engineering applications:

- **Geotextiles** - porous textiles;
- **Geomembranes** - impermeable liners;
- **Geogrids** - reinforcement grids;
- **Geonets** - drainage nets;
- **Geosynthetic Clay Liners** - rolls of bentonite in/on geosynthetics;
- **Geocomposites** - various assemblages of geosynthetic and, sometimes, soil materials.

Geosynthetics, being a man-made synthetic material, can be modified, or combined with various other geosynthetics materials, to give the final results required when building in geotechnical applications.

There is a broad ranges of geosynthetic materials available, with more coming on stream each year to solve problems in civil engineering.

Some products which are quite common and have been in use for many years are products such as geotextiles. Geotextiles can either be a woven product for lateral flow or liquids or a fibrous product (nonwovens) for filtering and separation of soils. Geotextiles can weigh from as little as 100 g/m - to 1000 g/m - depending on the application.

Geotextiles were first developed in commercial use about 35 years ago for use on railroad beds for stabilization. Today they are commonly used in such areas as residential gardens, acting as weed control around plants.

A geomembrane is used in containment applications. It is an impervious sheet, typically made of plastic. The plastic will be polypropylene; HDPE; LLPE; PVC, among other types of resins. These sheets of plastic will range in thickness from 0.25mm to 3.5mm. Geomembranes are manufactured by machinery very similar to that which manufactures a garbage bag, however widths can be up to 15 meters. Geomembranes will block the mitigation of fluids.

Another product is a Geosynthetic Clay Liner. This product encapsulates sodium bentonite between two porous sheets of geotextiles. The sheet on the top, the bentonite and the sheet on the bottom are bonded together using a special machine that will take fibers from one sheet of geotextiles and interlock it together with another sheet. Geosynthetic Clay Liners, when saturated with water under a confining stress, will, like the geomembrane, become impervious. This 6 mm thick composite will have the same permeability characteristics as 1 meter of compacted clay.

All of these geosynthetics working in conjunction with each other have been used for many years in containment applications, such as municipal solid waste landfills to prevent

the seepage of leachates from the waste entering into the groundwater. The geosynthetics will also be used to cap the waste once the cell is full, preventing precipitation from entering the waste. The geosynthetics are also used for remediation sites when one wants to prevent the precipitation entering contaminated soils and further contaminating an area down stream.

As these geosynthetics are buried where there is little oxygen and are not subjected to ultra-voilet rays, their half-life has been estimated to be up to 400 years.

The geomembranes and the Geosynthetic Clay Liner contain all liquids whether they are water or hydrocarbons. The task was to design a system using geosynthetics which would allow precipitation whether in the form of rain or snow melt to pass through - and, at the same time, contain hydrocarbons while not allowing them to escape.

A product known as Rubberizer, also known as a co-polymer, had been on the market for a considerable period of time. The co-polymer is basically a type of hydrocarbon which will absorb other hydrocarbons. These co-polymers can be designed to absorb hydrocarbons and still be porous and are typically spread over the surface of the water to absorb oil which may be floating on the surface. The co-polymer can also be designed to absorb the hydrocarbons and congeal, becoming impermeable.

Trials with various co-polymers showed that a product that absorbed and congealed would prove very useful. With a product that totally sealed on full saturation of hydrocarbons any migration of hydrocarbons

from the containment area would be prevented.

Using the principal developed to manufacture Geosynthetic Clay Liners, the sodium bentonite was removed from the equation. A co-polymer was then substituted between the two porous geotextiles. Trials and laboratory testing were conducted to assure the correct amount of co-polymer was installed in the center of the two geotextiles. A correct amount of co-polymer is required to assure its effectiveness. By spreading the co-polymer mechanically in a production situation, it can be assured that the correct amount of co-polymer is applied to the composite as with the bentonite for the Geosynthetic Clay Liner.

Hence, another Geosynthetic is born - The Geosynthetic Oil Mat.

As with other containment systems, various types of geosynthetics are used for specific reasons. In the SorbWeb Plus system to contain hydrocarbons, various geosynthetics are also used.

On the bottom of the system, the Geosyntheitc Oil Mat is placed over porous soul to allow for drainage of the precipitation, water from outside sources and snow melt. The Geosynthetic Oil Mat is only active once hydrocarbons come into contact with it.

The sidewalls around the perimeter of the system are lined with a geomembrane which is impervious, directing the flow of any liquids to the bottom of the system, and preventing any liquid from leaving the containment area through lateral movement.

Above the Geosynthetic Oil Mat is placed a number of drainage layers with woven geotextiles between the drainage layers. Woven geotextiles give a lateral flow so that in the event of an oil spill, the oil will not flow immediately down to the Geosynthetic Oil Mat, allowing for dispersion of the oil and other liquids. This dispersion also gives dwell time for the co-polymer to fully absorb any hydrocarbons that come in contact with it.

The system is topped with fire quenching stone which will be the reservoir for both the oil and water in case of a catastrophe. There are also, within the containment system, additional hydrocarbon absorption layers.

If, by some means, the system becomes damaged due to in situ digging or other unknown reasons, the system is repairable.

A case study of the **SorbWeb™Plus** system proving that it works was the successful containment of a 4,000 liter spill following an accident at a site located along the Don River in Toronto, Ontario Canada.

In another instance, in 2005 there was a fire and catastrophic failure of a Main Output Transformer (MOT) at a nuclear generating station that resulted in an oil spill. Some oil was ultimately discharged into a large local lake. As a result, the client commissioned installation of a secondary oil containment system to protect against damage by any potential future incidents.

The **SorbWeb™Plus** oil containment system was selected from several competing systems for this project. One of the major reasons was that there would be no disruption of service from the installation of the containment system.

This turnkey project was divided into phases. Each phase involved three main tasks:

1. SorbWeb™Plus system design and material procurement;

2. Construction, including excavation, soil disposal and **SorbWeb™Plus** installation;

3. Environmental engineering, including soil sampling and testing.

Kinectrics acted as the general contractor for the entire project. The containment system is designed to contain 3,600,000 liters of transformer oil.

Stones and soil were removed from around and behind the MOT units. Rebar with concrete sloping towards the containment system areas was installed in some areas where placing **SorbWeb™Plus** would have been impractical. Additional excavation was performed using Gradall scraping, carried out 15 cm at a time.

Pre-cast cement blocks formed the exterior and sides of the below-grade dike of the system. Sand, the initial layer of the **SorbWeb™Plus**, was spread, followed by oil resistant plastic around the entire cement perimeter and interior obstructions to direct any oil or water down through the **SorbWeb™Plus**. Proprietary layers of the **SorbWeb™Plus** were then installed. Finally, additional materials and fire-quenching stones completed the system installation.

SorbWeb™Plus solution is an effective and reliable passive system that provides continuous protection against oil spills from transformers. It is a smart system that allows water to drain through a containment area without accumulating, while retaining any oil that might leak from the transformer. **SorbWeb™Plus** provides reliable secondary oil containment of spills from transformers over a long period of time.