

CONCEPTUAL DESIGN FOR SPILL CONTROL AND CONTAINMENT

Introduction

Recent changes to regulatory requirements for the control and containment of potential spills of oils associated with transformers and generators have led to the development of alternative designs for spill control and containment systems. The purpose of this document is to provide a conceptual design for an innovative spill control and containment system utilizing an impermeable underliner and a reactive treatment zone.

Background

Traditional secondary containment measures for spill control include a concrete apron surrounded by a low wall. This type of system is typically designed to provide adequate storage capacity in the case of a catastrophic spill of oil. Spill control systems of this type have several deficiencies. First, these systems require maintenance in the form of periodic inspection in the event of rain. These systems typically have a drain. After rainfall, the system must be checked to ensure that the wall was not overtopped, and drained to prevent storage of stagnant water. Secondly, these systems provide harsh contrast to naturally landscaped environments. And finally costs associated with building these systems are generally high.

Design Concept

An innovative approach to spill control and containment has been devised through the use of an impermeable under-liner and a permeable treatment zone. By incorporating a low permeability Geosynthetic Clay Liner (GCL) with an overlying Geocomposite Drainage Composite a designer can provide a barrier to prevent the spill from entering the groundwater. The Geocomposite acts as a preferential flow path, directing the infiltration and associated spilled oil toward a permeable treatment zone. The treatment zone acts to either treat or sequester the contaminate.

A variety of media can be incorporated into the treatment zone. Treatment media should be selected based on its effective treatment capacity. As an example a reactive media may have the adsorptive capacity of .5 pounds of contaminate per pound of media. From that the designer would calculate the required volume of media that would be required, based on the media's bulk density. For example a media with a bulk density of 48 pounds per cubic foot, and an adsorptive capacity of .5 pounds per pound could theoretically treat or adsorb 24 pounds of contaminates. Assuming a weight of 6 pounds per gallon, that would equate to 4 gallons of contaminate. The calculation can be described as in the equation below.

V_m = Volume of media required (in ft³)

V_c = Volume of contaminate (in gal)

D = Bulk density of the media

W = Weight of contaminate in pound per gallon

A = adsorptive capacity of the media

$$V_m = \frac{V_c * W}{A * D} = \frac{24 \text{ (gal)} * 6 \text{ (gal/lb)}}{.5 \text{ (lbs/lb)} * 48 \text{ (lbs/ft}^3\text{)}} = 6 \text{ ft}^3$$

In this example, using these variables, it would require 6 cubic feet of reactive media to effectively adsorb the 24 gallons of oil. It should be recognized that 100% effectiveness of any reactive media is probably not realistic and a reduction factor should be utilized to account for this. Although the reduction factor should be design and material specific, a typical assumption might be 80% effectiveness for the media, a 20% reduction in performance.

CETCO manufactures a variety of reactive media for use in water filtration applications. Organoclay, a modified bentonite has been used in permeable reactive zone applications. For more information on the properties of Organoclay refer to CETCO technical references TR 801 and TR 802.

The size of the impermeable underliner and geocomposite drainage layer is site specific. The aerial extent of the liner must be adequate to provide protection from a spill. GCLs are typically a width of 15' and come in rolls 150' long. Practical design would be made with the underliner in multiples of the GCL's 15' width.

The configuration of the treatment zone is also design specific. Although as a practical matter, the treatment zone length must be equivalent to the width of the sloped underliner. As materials flow across the underliner they would contact the treatment zone in such a fashion that they would easily flow into the treatment zone. The width and depth of the treatment zone must be adequate to hold the required volume of reactive media. It should also be configured in a way as to maximize the contact time of the flow as it passes through the zone. It is important that the design require that the underliner GCL be carried across the bottom of the treatment zone.

A typical detail for this design concept is included on page 3 of this document. This detail illustrates this design concept. It should be noted that site specific conditions will vary the dimensions as noted in the detail. Also of note is that this detail illustrates a vegetative layer placed over the impermeable sloped underliner and geocomposite drainage layer. It should be noted that this vegetative layer is optional and the design could be completed using a granular fill material.

Summary

In summary an innovative design concept utilizing a sloped underliner, drainage layer and treatment zone has been presented. This design can be easily constructed and allow for a more cost effective, aesthetically pleasing, low maintenance system for containment of spills.

