SorbWeb™Plus Reactive Barrier Fabric (includes SorbWeb™Plus with SAM)

Performance in Subzero Conditions

SorbWeb™Plus Containment System is built of several layers of different materials that interact to intercept and contain a spill of liquid hydrocarbons, in particular transformer oil.

During its use, the spill containment site may be exposed to temperatures below the freezing point and questions are often asked about how the containment system would perform is such conditions. It is important to understand that various scenarios are possible, when trying to answer these questions.

The following initial conditions should be taken under consideration:

a) State of the containment (fully dry, wet, fully flooded),
b) Temperature of the oil when the spill occurs (cold (ambient), hot),
c) Remediation response scenario (immediate response, spill unnoticed).

The spill containment system can be in different states, when it becomes exposed to freezing conditions and the following conditions are possible:

a) The containment is all dry,
b) All layers of the containment are saturated with water but no water layer in the containment ,
c) All layers of the containment are saturated and a layer of water is present in the containment.

Condition (a) “all dry” can only occur when containment is installed in a location where rainfalls are very rare, the water table is low and/or the containment was subject to a prolonged draught. Those conditions are very unlikely to be occurring in areas prone to prolonged freezing seasons.

Laboratory tests done on the dry reactive barrier fabric have shown that it was not affected by multiple cycles of freezing down to -18°C and thawing. All other components of the system, when in dry state, are also not affected by repeated freezing and thawing cycles.

Condition (b), all layers of the containment are saturated with water, but no layer of liquid water present above layers, is what is to be expected in most installation conditions.

When temperature drops below 0°C and layers of the containment system are all saturated with water, the containment will begin to freeze gradually. The speed of freezing will be a function of the temperature gradient in the containment. When the containment becomes all frozen, the containment will become fully sealed due to ice formation inside the containment. Ice has about 9% bigger volume and it expands and seals all possible voids.

Condition (c) “containment layers are saturated and a layer of water is present” can most likely occur only after a heavy rainfall, when the containment is still draining collected water. After all water is drained, the containment will remain in the state (b) “all components wet”. In case the saturated containment becomes exposed to freezing temperatures, the containment and all water in it will freeze and the containment will be sealed and impermeable. The frozen and sealed by ice formation containment is fully impermeable and will contain oil.

The oil can spill from a transformer under different conditions, and the following scenarios are possible:

a) Oil that spills out is at ambient temperature, e.g. the spill is from a tanker when the transformer is filled with oil,
b) A localized, small spill; oil that spills out is hot but only a limited quantity of the oil spills,
c) A large catastrophic spill; oil that spills out is hot (when an operating transformer blows up, cracks open and hot oil spill out),
d) A large, catastrophic spill, the transformer is on fire and the oil burns in the containment.

In case of a large, catastrophic, hot oil discharge, all ice inside the containment may melt but then the oil will be stopped by the barrier fabric. This specific scenario has been investigated in details by Kinectrics and their report is available as a separate document entitled "Response Under Severe Winter Conditions"

In case of a smaller oil leak of hot oil or a discharge of the oil at ambient temperature, the ice in the containment may not melt and the containment will remain sealed. If such oil leak remains unnoticed, it may happen that the containment will remain in such condition until the surrounding temperature rises and the ice in the containment begins to thaw.

An experiment was setup to confirm the performance of the containment under such specific conditions.

A small model containment was built. The containment consisted of an impermeable plastic liner and a layer of the spill control barrier fabric that was bonded to the impermeable liner using a typical installation sealant. The containment was filled with water and excess of water was allowed to drain. The containment was then filled with dry ice pellets (temperature -33°C) and left for several hours until it was all frozen. The dry ice was removed from the containment and the containment was then filled with Hyvolt II transformer oil. After about an hour, water began to drip from the containment and it soon stopped. This was the water layer that was trapped inside the fabric layer and was displaced by the transformer oil. The containment was then left for 6 days (144 hrs). There was no oil penetration through the barrier fabric after 144 hrs.

The experiment confirmed that is it safe to allow the containment to freeze, be then flooded with oil and later allowed to thaw.

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