Oil Containment Pro’s and Con’s of Different Methodologies

Oil containment has been used for many years for containment of large oil tanks in tanks farms, after the creation of the Oil Pollution Act of 1990. Spill Prevention Control and Countermeasure (SPCC) regulations were enacted in August 2002 to prevent discharge of oil into navigable water that includes storm drains, ponds, lakes and rivers. Reclassification of transformers from operating pieces of equipment to oil storage tanks brought a new requirement for Electric Utilities and industry. Facilities that store more than 1320 gallons of oil must prepare an SPCC plan. A licensed professional engineer must certify the plan, although in some cases depending on spill history the facility may be allowed to self certify.

Since SPCC regulations were enacted there have been many changes as to exactly what needs containment and what oils are exempt. EPA’s regulatory definition (40 C.F.R. § 112.2) of oil states:

*Oil means any kind or in any form including, but not limiting to: fats, oils, or greases of animal, fish, or marine mammal origin, vegetable oils, including oils from seeds, nuts, fruits or kernels; and, other oils and greases, including petroleum, fuel oil, sludge, synthetic oils, mineral oils, oil refuse, or oil mixed other than dredged spoil.*

SPCC regulations created a new environment for electric utilities to deal with transformers in substations that now require oil containment. This is a relatively new approach that many utility companies have implemented. There are still utilities that have still not adapted to the new regulations and or have only taken small approach.

Since 2002 different methods for oil containment have been implemented throughout the United States. Engineering companies designing substations were an obvious choice for the utility industry since they were hired as outside consultants to design the substation. The PE from the engineering company would recommend what type of oil containment should be used and have a PE sign off on the containment. It was a good approach initially but when we flash forward, all of the different types of containments and ideas had many unforeseen challenges. Like many new industries and approaches there are many companies that provide conceptual products that have never been proved but implemented.
This has led to many containments that were installed that functionally do not work. There were and still are claims that after installing containment systems or products that they work forever and never need to be updated or replaced. Unfortunately this is not the case. The biggest obstacle for oil containment is how to handle rainwater and ensure any oil sheen or large oil release is fully contained. That is why Oil Containment Is Like The Wild West. Many technologies sound good but are unproved and do not work as sold. Do we really know the oil containment installed is going to work when there is a large-scale spill or fire? The answer in many cases is no and then the end user is liable for the clean up and any fines associated with the discharge.

Who are the experts? In many cases there are no experts; these technologies are found on the internet or devised on site. How long are the systems reliable? Every containment is different, including environmental factors that will determine how effective and how long the system or product works. Everything requires maintenance and replacement. Different conditions such as temperature, rainfall, dirt loading, along with snow and ice are all factors as to what will work best in your substation.

**Methods of oil containment**

**Pool & Pump**

The Pool and Pump method for oil containment works very well to contain the contents of transformers. Typically these pits or pools are made out of concrete and provide a minimum of 100% for the oil content plus 10% for rainfall. A problem with pool & pump containments is the rainwater needs to be pumped on a regular basis. Unfortunately many companies do not have the manpower to check all the containments after a rainstorm. This leads to non-pumping and now the capacity of these pits does not have enough volume to accommodate a full oil discharge. This also allows a breeding area for mosquitos and algae if not pumped.
Oil Water Separators

There are many different types of Oil Water Separators (OWS) but all work similar on the scientific basis that Oil is lighter than water. OWS must be designed to accommodate maximum flow rates as well as storm water runoff to ensure that the flow does not exceed the designed capacity calculations.

As seen in the picture, the water flow is slowed down as it enters the OWS and is directed into different chambers with coalescing plates or filters. The biggest misconception to the OWS is that it does not need to be maintained. However, without proper maintenance and inspections operational and mechanical failures may cause leaks or accidental discharge of oil into water. OWS also require a good amount of area depending on how large the volume of oil is that need to be contained and unfortunately many substations do not have any extra room. With new Synthetic Ester fluids starting to be used in large power transformers the use of an OWS is even less effective as these fluids have a very similar formulation and or specific gravity to water.

Oil Float Valves

Different types of oil float valves are used in various oil containment areas. The advantage is based on achieving high flow rates with one central discharge point. The valves work on the principle of specific gravity between oil and water. If rainwater is exiting through the valve it remains open and remains open until the specific gravity changes from an oil spill. In an oil spill the valve detects the change and closes which shuts down all flow. These valves require maintenance and in most cases it is not performed. It is like many things, if it’s working don’t worry about it. The challenge however is that if the float is dirty or damaged it may not work when required.
**Oil Sensing Pumps**

There are many oil detection pumping systems that work like automatic sump pumps. Oil sensing pumps allow water to be pumped using a float. Once the water level gets to a certain height the pump turns on and will pump until the level shuts the float off. These systems also use oil detection sensors that will detect oil on the surface of water. If oil is detected, an alarm goes off notifying there is a problem and the pump shuts down. Maintenance is also required with this type of system. The sensors should be recalibrated every year to ensure they work correctly. The floats should also be inspected annually to ensure they are working properly. Oil Sensor Pumps also can provide a good flow rate if maintained on a regular basis.

**Retention Ponds**

Retention Ponds are used in areas that have the required area. Most substations do not have a large enough area to use a retention pond. Rain water from the containment area is directed to the holding ponds and in the event of an oil spill the oil is directed to the pond. The ponds usually always have water in them so the oil rises to the surface of the pond. The ponds are constructed similar to a large oil water separator with a series of weirs and baffles to keep the water on the surface and allow the water to discharge at one specific point. Potential problems include wildlife from establishing living areas in these ponds that also could be exposed to an oil release.
Earthened, stone Berms or fiberglass walls

There are many earthened, stoned or fiberglassed wall berms. These systems are installed by compacting the soil and allow the berm to contain any spilled oil. This type of system allows the water to slowly drain. In an oil spill, this type of system is suppose to hold back the oil. There are also many cases where companies have used a fabric in the stoned berms that is suppose to allow water to drain and hold back oil. However, in many cases these fabric windows get slited up quickly and allow very limited water drainage.

Drainage Ball Valves

Ball valves are installed in many types of oil containment basins to manually drain containment areas. When properly used, this type of system requires adequate personnel that is assigned to visually check the water in each containment following a rainstorm. If there is no visible sheen, the valves can be opened. Unfortunately, many valves were installed years ago and have become inoperable. In those cases, pumping and or manually removal of the water would be required. The primary challenge with this type of systems is the availability of personnel needed to go to the stations to physically open the valves and most important remember to close them when they leave.
Passive System Pump-Filter-Contain

A passive system that pumps the water and filters dirt while removing oil sheen and seals in the event of an oil spill. This is a widely used type of system for containment areas that are pool and pump.

Passive Oil Containment

Passive oil containment has been used for over 20 years successfully for many types of applications in oil containment. These types of passive products can be used in combination with many of the current technologies to make systems work better. Passive filtration uses a combination of polymer and absorption technology to filter rainwater while having the unique ability to filter out any oil sheen but shut completely shut down in large oil release.

Passive technology has been scrutinized and thoroughly tested to be an environmental equivalence listed in the SPCC guidance for Regional EPA Inspectors. When used in accordance to the manufactures guidelines they are acceptable to be used on oil containment systems for rainwater drainage without any ball valve or other protective measures. These passive filters provide water filtration and removal of oil sheen from a containment area and in a full oil spill the oil is absorbed into the media and dissolves called tackifying forming a total seal and total Shut down of all water flow is 10 -30 seconds. In a Petro-Pipe or Plug a Pump-Thru-Barrier it will continue to flow and release water for up to 1 hour. Zero oil is released in any of the products.

Blue Media in Tube allows rainwater to drain 24/7/365. Technology allows rainwater to drain and seals with and overload of oil preventing any oil from escaping. After Oil has stopped bottom Media is removed a total seal is made NO OIL IS RELEASED
There are many different passive filters in use today. Concrete basins have a few options for water drainage but using a passive flanged Pipe with a housing that is cast into the concrete on a 25° slope to allow the filter to slide into place and be attached with screws. This provides water head pressure to allow the water to exit the containment basin at up to 3 gallons per minute.

In the pictures to the left there are passive filters installed in every corner to allow for an even water drainage in the basin. The concrete floor is cut out in front of the installed pipes this is done to allow all the water in the basin to drain off floor while providing positive head pressure on the filter media.

Typical useful life for the filter pipes is 3 to 5 years depending on the climate. To replace the pipes 5 screws are removed and the pipe can slide out and a new one into place. Dirt filter basket are always used on the inside on the concrete basin for dirt and debris control. These products are always quoted with replacement dirt filter. Typically the containment areas should be checked every six months to make sure they are draining correctly.

Ball valve containment is easily solved with the use of a passive filter for ball valves. The filter pictured works best when angled up to 25° these filters do not require the valves to be opened or closed the Petro-Pipe is the valve.
Large concrete basins using passive containment drainage has been very successful over the last 20 years. When going directly into the ground it is important to make sure there is proper drainage this can be accomplished by installing crushed stone under the barrier and making sure the soil is good draining. It will always take a longer time to drain out when passively draining directly into the ground.

Lateral drains are also available for poor drainage areas as shown above. In this case the Passive Barrier is being set in place and the lateral drainage line being connected. When this containment area is complete the barrier will be backfilled with dirt and then concrete will be poured for the floor. The water will then drain through the open 24" diameter opening on the floor and filter through the media inside the containment housing. Rainwater will exit through the drainage pipe installed on the bottom of the barrier.

Each Petro-Barrier allows water drainage of 25+ gpm while having the ability to filter oil sheen to non-detectable limits. In a full oil release the oil will seal inside the barrier and back up fully containing the oil. It is recommended that every 5 years the Barrier media be replaced, this is done by removing the installed dirt filters and the removing the screws to the barrier canister and lift out and renew or replace.

Passive containment is also used with liner technology as a less expensive alternative to concrete. In the application below a liner is used with a fiberglass wall containment system the liner used is 38 oz. material that has is shipped in panels. The liner is assembled on site using heat welding guns and rollers and all penetrations are fully sealed. In this application a passive filter for water drainage is used directly into liner and the ground below. When the liner is fully installed, high pressure air is used to ensure all welded seams are completely sealed. The containment area is then backfilled with clean stone. The passive filter can always be accessed by removing the access cover to the dirt filter. To remove and replace, just undo the screws, remove the filter and replace with a new one.
Passive Pump-Thru-Barrier
Portable oil/Water Separator

The Pump-Thru-Barrier passive system has helped many companies resolve bad containment problems. This system works by pumping water into the unit from the containment area. The pumped water first goes through an external water filter and then into the unit, as the water goes through the internal filters any oil sheen is removed and the rainwater is discharged through the bottom drain. In an oil overload, the oil enters the barrier and is absorbed into the media and shut all flow down, the oil is then stopped and backs up. As the oil level rises it reaches the overflow valve and is directed back into the containment area. It is a simple yet very effective means to either treat contaminated water and or prevent a full-scale oil spill from escaping.

Passive Containment Track Record

Since 1999 my company SPI has been in the forefront of providing patented systems and products using only passive drainage. In developing this technology, testing is vital to know that the products used out in the field perform. All SPI’s products are fully tested for water drainage and long-term exposure to oil spills. This is done by running water through all of our types of products on an extended period of time to accelerated aging and then exposing the media to full-scale oil spills.

During the early years of SPI many of our customers today did not have any containment, passive filtration was a concept to them and reality for SPI. This was accomplished by working with utility customers to develop products for their specific needs and proving that our products worked as sold.
It became apparent when one of our largest customers called in after a spill occurred in a substation in 2002. We responded to find the oil level in the containment area to be 2” and the passive barrier holding all the oil back. The oil was vacuumed out and only the solidified portion was removed, the barrier was repacked with new media and the containment area was operational again.

Here are pictures of another spill and fire. This time, SPI’s passive systems were put to a more extreme test. In this incident a transformer exploded and SPI passive barriers were installed for water drainage and oil containment. The passive barriers sealed when contacted with the transformer oil and fully contained this substation.

When we were notified, we responded and went to the site. The customer advised me that “no oil escaped” even after a 3-hour fire. The concrete was badly damaged but the HDPE housing for the barrier was only slightly melted at the top 1” and was reused in the containment area.
SPI’s passive Petro-Pipes have also been put to extreme circumstances with a fire at a customer sub-station. The passive pipe was installed through a concrete wall as a retrofit where all the rainwater and oil would drain from. When the transformer exploded the oil emptied into the containment and drained to where the Petro-Pipe was installed. The fire burned for three hours putting the PVC Petro-Pipe to excessive temperatures. I was notified by the customer and arrived two day later to remove the pipe. The Petro-Pipe had flange had melted and fused together with the housing pipe flange and no oil was released.

SPI’s newest product is for Synthetic Ester fluid and is presently being used in Europe. It is import that companies are always striving to be the best by offering new products an innovation to provide our customers with the best products available.

**Oil Containment Conclusion to Pro’s and Con’s**

There are many types of oil containment, in my 30 years of working in the utility industry I have seen many attempts but unfortunately many have fallen short. Oil Containment is required now by the EPA with SPCC regulations and there are too many bad containments that don’t give the customer what they paid for. If you are redoing oil containment or just starting make sure you get the facts from different companies because the last thing needed is the system not to work and either you have a containment full of water or have an oil release from a system or product that was installed but did not do what was required.