

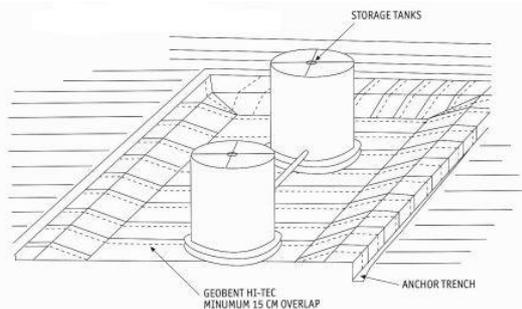
## LINING & WATERPROOFING TECHNOLOGIES Lining

### MODULO GEOBENT HC INSTALLATION GUIDELINES FOR TANK FARMING

#### OVERALL VIEW OF MODULO GEOBENT HC TANK FARM INSTALLATION

Modulo Geobent HC is a multi-layer geocomposite systems that employ two polypropylene geosynthetic encapsulating a special kind of double function bentonite that, beside to be a water barrier as standard bentonite, is able to contain simultaneously hydrocarbons and water as responsible of the major transport of contaminants in groundwater.

The secondary containment area should be designed to allow for the depth of 30 cm minimum (40-50 cm suggested) of cover material (soil or aggregate) above the MODULO GEOBENT HC liner. The prepared foundation, or subgrade, should be reasonably smooth and well contoured with all vegetation and stones larger than 2,5 cm and other protrusions removed.



The subgrade surface shall be compacted in accordance with the project specifications. At a minimum, the subgrade should be rolled with a smooth-drum compactor of sufficient weight to remove any wheel ruts, footprints, or other abrupt grade changes. Furthermore, all protrusions extending more than 12 mm

from the subgrade surface shall either be removed, crushed, or pushed into the surface with a smooth-drum compactor.

Compaction of the subgrade should be in accordance with the design specifications, or, at a minimum, to the extent that no rutting is caused by installation equipment or vehicles (grade of subgrade compaction has to be min. 90% as per Proctor Modified Test).

A good technique for difficult subgrade conditions is to water the subgrade approximately one hour in advance of GCL deployment, and then smooth-drum roll the area just before GCL deployment. The exact timing of watering, rolling and deployment depends on the site-specific soils and weather conditions.

Proper CQA procedures should include a final visual inspection of the subgrade surface to identify unacceptable surface protrusions (typically larger than 12 mm), excessive rutting (typically greater than 25 mm), abrupt vertical displacement differences, or other areas that may damage the GCL during or after installation. These areas should be eliminated by removing protruding objects, smooth-drum compaction, or the placement of a protective geotextile cushion layer (min. 500 g/sq.m.) prior to installation of the GCL.

#### Handling and Storage

The survival of the roll of GCL in good condition depends on a number of aspects, the main areas of damage appear to take place while the GCL is being unloaded stored and handled at the site where it has to be installed.

On arrival at the site the rolls will be either on a flat bed lorry, or truck, or in a container.

Unloading is best carried out by a fork lift truck equipped with a carpet boom. The carpet boom is inserted into the core of the roll and simply lifted clear of the vehicle.

However, a fork truck is not always available at the site, in which case a heavy duty steel pipe should be used. The pipe is pushed through the core of the GCL roll, leaving about 50 cm or so, protruding from each end of the roll core. The lifting slings from each end of the spreader bar are attached to the ends of the pipe and the roll lifted vertically using a front end loader or back hoe.

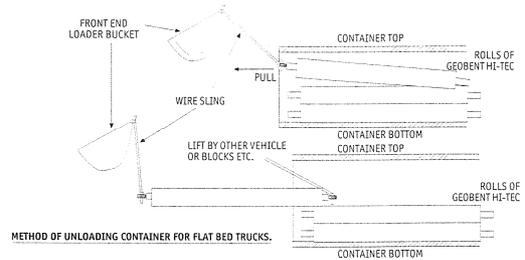


If the rolls have travelled any distance it may be that the ends of the individual rolls have moved together during the journey and the pipe at this end cannot be extended beyond the end of the core. If this is the case, or if the GCLs have been delivered by container, then the individual rolls should be offloaded, by sliding the heavy duty pipe up the centre of the core as far as possible, attach a wire rope at this end and lift the end clear of the rolls underneath, then back off the front end loader from the roll to be lifted, just half a meter or so, to slide the roll a short distance (40 cm approx) then lower the end of the roll push the pipe the rest of the way through the core so that the sling can be attached at both ends and the lift completed.

If the rolls are in a container this method must be used to move the GCL rolls to the door of the container where they can be properly lifted.

The lifting equipment must be as shown in the diagram, or similar, there are some

variations, the main objective in having a spreader bar is to keep the lifting slings clear of the end of the rolls to avoid damage. The main items of the lifting equipment are a swivel hook, or eye bolt from the bucket of the front end loader, or back hoe, to a double wire sling. The ends of each sling going from the swivel to each end of the spreader bar as shown. The spreader bar then has a short sling from each end to the ends of the pipe.



The swivel on the crane is useful in turning the roll so that it can be unrolled from the top of the roll with the stencilling uppermost so that the marks for the overlap can be used.

The forks of a fork lift should never be used, under any circumstances, to unload GCL rolls, this would incur heavy damage to the roll.

Modulo Geobent HC should be stored under covering a clean dry building if at all possible and clear of the ground, with their original wrapping left intact until ready to install. If a building is not available the rolls of GCL should be left in their original wrapping and stored off the ground on pallets or some other support and then covered with tarpaulin, or plastic sheet, to ensure that the GCLs are not subject to any inclement weather or water damage.

Modulo Geobent HC should also be carefully handled when being deployed from storage to their position around the landfill just prior to installation. Even though these liners are very forgiving of any minor damage, they should be treated with the same respect as any other liner or geotextile.

## Liner placement

As each roll is moved from storage to its location for installation, all information from the roll should be recorded and filed by the on-site CQ officer or the person in charge.

Modulo Geobent HC should be brought from storage using the lifting device and spreader bar, as previously described, so that the GCL roll is properly supported and can be easily unrolled from the supporting pipe, or bar. The GCL should be carried in this way to avoid damage. Never drag or roll into position ready for placement.

When Modulo Geobent HC is being placed on a steep slope it might be more convenient to attach the end of the GCL in the anchor trench and roll the GCL down the slope by passing a lifting pipe through the core of the roll attach a rope at each end and ease the roll down the slope by hand, instead of pulling the liner off the supporting bar, this is always difficult if the slope is too steep.

### **Tools for handling GCL**

Modulo Geobent is very easy to install and the only hand tools needed are a sharp utility knife to cut and fit the GCL around protrusions or into corners. Although the GCL can be easily moved by hand it is sometimes more comfortable when laying large areas, to use broad nosed "mole grips", as used by sheet metal workers. The liner can be held quite comfortably with these grips and the liner easily maneuvered.

GCL should first be installed on the slope section. This will accommodate water run off and drainage in case of inclement weather. It will also avoid any of the GCLs being covered by standing water and spoiling the liner. This can also be avoided by covering the GCL with backfill material or the flexible membrane as soon as possible.

The amount of Modulo Geobent laid in any one day must be limited to the amount that can be covered by the flexible membrane (HDPE liner) or cover material by the close of work. In this way there is no GCL eHCosed to the weather before the start of the next working day. At the end of each day, or close of work, the GCL must be completely covered with the exception of the leading edge which

should be covered by a light plastic sheet (the plastic cover from the rolls can be used), this plastic sheet should then be held in position by weighting it down in some way. If backfill is being used this can be placed over the plastic. The following day at commencement of work the plastic protective cover can be quickly removed to eHCose a clean dry edge so that installation of the liner can continue from this overlap.

In the case of heavy rain or other forms of inclement weather the installation of the GCL should be suspended and any eHCosed GCL should be covered immediately.

### **GCL seaming**

Once the first roll of MODULO GEOBENT HC has been placed in position, progressive liners should be placed with overlapping seam 15-20 cm longitudinally over the previous GCL; the ends of the liner should overlap at the cross seam by 30-40 cm.

These amounts of overlap can be changed to suit the situation. Sometimes on a landfill cover it may be necessary to increase the overlap to allow for differential settlements that may occur, or on a landfill liner the high surface temperatures in a hot summer may cause some slight shrinkage of the GCL.

Under normal circumstances Modulo Geobent HC should be overlapped as above and to the markings stencilled for convenience on the upper surface of the liner. At the corners of the landfill the GCL should be trimmed to fit, always ensuring that the overlapping seams are parallel to the slope.

It is imperative that all overlapping seams are clean and that a good contact is made between the two overlapping seams of the GCL.

No additional bentonite is requested for overlap seaming whenever confining pressure acting on GCL is 10 kPa minimum. If not, suggested amount of bentonite is one 25 kg bag every 2-3 rolls.

### **GCL damages handling**

Modulo Geobent HC is forgiving in the way of minor faults and damage; however, great care should be taken in the handling and

deployment of these GCLs to ensure that no damage will occur.

If there is any damage due to unforeseen circumstances the damage is very easy to repair and should be carried immediately. On the flat surfaces of the Landfill the GCL can be repaired by placing a patch of good GCL material over the damaged area, the patch should extend for about 40-50 cm all round the damage.

The patch should be held in position by carefully placing a substantial amount of backfill material by hand over the patch to ensure the patch will not be disturbed.

If the GCL is under an HDPE liner or some other flexible membrane the repair patch should be placed under the GCL by passing the patch through the liner's damaged portion and opening the patch under the GCL. This method should also be used on landfill side slopes loose bentonite can also be used on this type of repair for further advantage. If the damage is excessive the liner should be replaced.

### GCL covering

All GCLs should be covered as soon as possible in the construction of a landfill liner, either by the flexible membrane and then the backfill material, or working cover. However on steep slopes this cannot always be done right away. The steep side slopes are difficult to cover with loose material depending on the angle and the type of material being used to cover the liner.

The needle-punching system used for the production of Modulo Geobent HC helps to confine the sodium bentonite by restricting the swelling of the bentonite clay and acting as a form of confining stress, improving the hydraulic conductivity of the liner without loss or movement of the bentonite.



The GCL can therefore stand in place with the only cover being the flexible membrane. During construction of the landfill liner the GCL should not remain uncovered by the flexible membrane for any longer than is necessary, and should not be laid too far ahead of the flexible membrane.

When the product is used on a landfill cap as a single liner great care must be taken covering the GCL with the required amount of cover soil or backfill material. If possible the cover material must be placed by the bulldozer or front end loader and spread in the direction of the overlapping GCL.

### Pipe penetrations

Any pipes or vents that have to pass through the landfill composite liner, and therefore the GCL must be properly sealed around the GCL prior to the installation of the flexible membrane.

The method is to wrap a short collar of GCL around the pipe and sliding it into the subgrade and then covering the area round the pipe with sodium bentonite in powder or granules the whole is then covered by a patch fitted round the pipe.

This type of methods used on any penetration or protrusion through the liner.

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