

GEOSYNTHETICS

Geotextile Reinforced Sludge Pond Closures



Sludge Ponds

Sludge ponds are formed when particles are mixed with water and are deposited in depressions in the ground or in earthen containment facilities. Sludge ponds may be the result of natural processes where soil sediments combine with surface water run-off or may result from industrial (man-made) processes where industrial (waste) by-products are combined with process water. Typical industrial processes that utilize sludge ponds are:

- Industrial manufacturing, e.g. sludge ponds arising from chemical processes;
- Mining, e.g. tailings dams;
- Utilities operations, e.g. coal ash dams;
- Public health processes, e.g. sewage treatment ponds.

Closing and reclaiming sludge ponds

When sludge ponds become full then a decision must be made whether to extend their lives or close and reclaim them.

If the industrial process is to continue, then the full sludge pond capacity may be expanded by dredging the sludge and dewatering it, thus providing additional capacity to the sludge pond.

Alternatively, if the industrial process has reached the end of its life the decision is normally made to close the sludge pond and reclaim it in a way to meet acceptable long term environmental standards.

Closing and reclaiming sludge ponds can be difficult because of their very low shear strengths which can continue for years. This limits the techniques that can



Full sludge pond with very low shear strength

be used successfully to place fill over sludge ponds. Even if the sludge ponds have a dry surface crust this may not support the construction equipment required to construct the fill closure.

Closure techniques

Conventional sludge pond closure techniques normally involve waiting for the pond to dry out to support construction equipment (which can take a long time) or to dewater the sludge insitu to reduce its water content (which may be ineffective if the sludge has low hydraulic conductivity).

An alternative technique that doesn't require pre-treatment of the contained sludge is to use a multi-functional geotextile reinforcement layer across the sludge pond surface prior to placement of the fill closure.



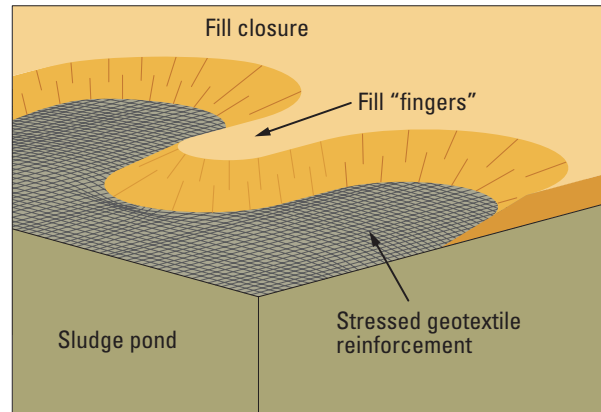
Mirafi® Geotextile Reinforced Sludge Pond Closures

Mirafi® geotextile reinforcement can be placed across the surface of sludge ponds to enable the fill closure to be placed on top. Here, the geotextile reinforcement is utilized to improve the effective bearing capacity of the very soft sludge and to prevent fill loss into the sludge.

Mirafi® PP woven polypropylene and Mirafi® PET woven polyester geotextiles are used to provide stability across the surface of soft sludge ponds because of their tensile strength, tensile stiffness and relative ease of deployment. They are normally fabricated into large panels utilizing sewn seams prior to installation so they can effectively cover the large surface areas of soft sludge sites in an efficient manner.

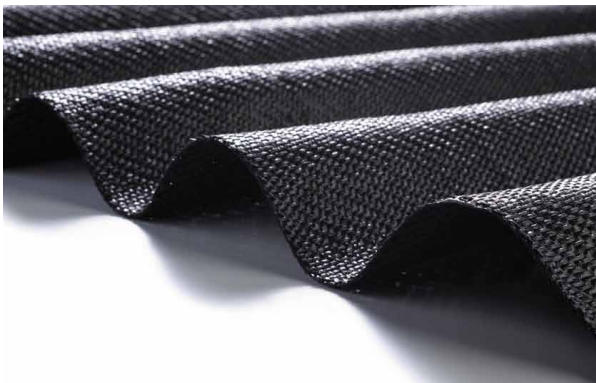
Once the geotextile panel has been placed, it is anchored around the periphery of the sludge pond to provide tensile restraint during placement of the fill closure.

During cover fill placement, the Mirafi® geotextile reinforcement is stressed in a planned manner by first

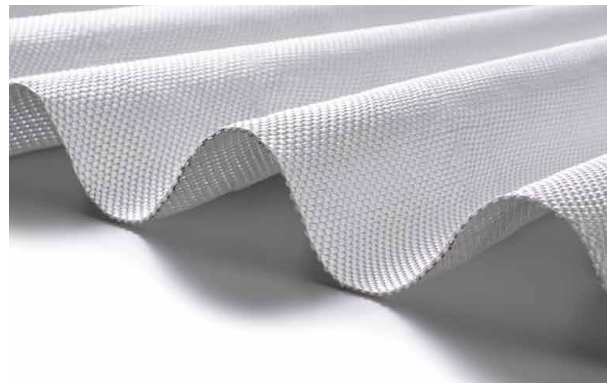


Stressing geotextile reinforcement by constructing parallel fill "fingers" across sludge pond surface

constructing parallel fill "fingers" across the surface of the geotextile prior to infilling with the remaining fill to complete the fill closure.



Mirafi® PP woven polypropylene geotextile



Mirafi® PET woven polyester geotextile



Installation of the Mirafi® Geotextile Reinforcement

Providing a continuous cover

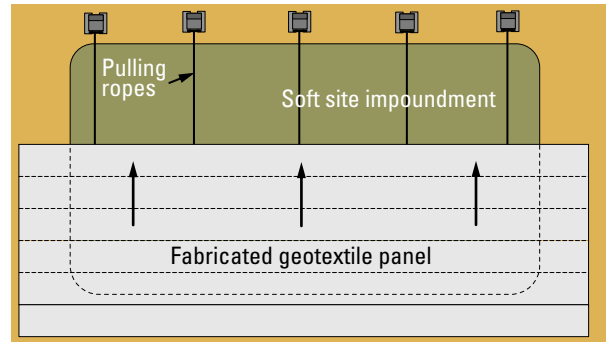
It is important that the Mirafi® geotextile reinforcement provides a continuous cover over the sludge surface in order to support the fill cover over the top. This is to ensure that the geotextile reinforcement maintains a continuous separation, filtration and reinforcement layer between the sludge and the fill cover.

The tensile loads generated in the Mirafi® geotextile reinforcement layer must be transferred in all directions, even across any geotextile joins. To accomplish this normally requires either two layers of geotextile reinforcement placed at right angles to each other or the use of a single layer that has been judiciously seamed to form a large panel unit.

The use of seamed geotextile panels is attractive from the perspective of requiring only a single geotextile reinforcement layer and efficient geotextile usage where minimal overlaps are required throughout the site.

Mirafi® geotextile reinforcement seaming and fabrication

Mirafi® geotextile reinforcement can be seamed into panels either in the factory or onsite. Factory panel fabrication has the advantage of using best sewn seam technology and consequently relatively high seam capacities. The disadvantage of factory panel fabrication is that panels of only a certain size can be practically manufactured as the panels have to be rolled up and transported to the job site.



Pulling Mirafi® geotextile reinforcement panel across surface of sludge pond

Onsite panel fabrication enables large panels to be manufactured to suit the job site geometry, but this may be done at lower seam capacities (compared with factory fabrication). Also, the manufacture of onsite fabricated panels should be done at a scale that ensures they can be launched across the surface of the sludge pond.



Installation procedure

For the installation of single panel layers, normally seaming of the panels occurs in the cross direction of the geotextile reinforcement. Here, the fabricated panels are laid out in concertina fashion at the edge of the sludge pond and pulled across the pond by winches, cables, etc.

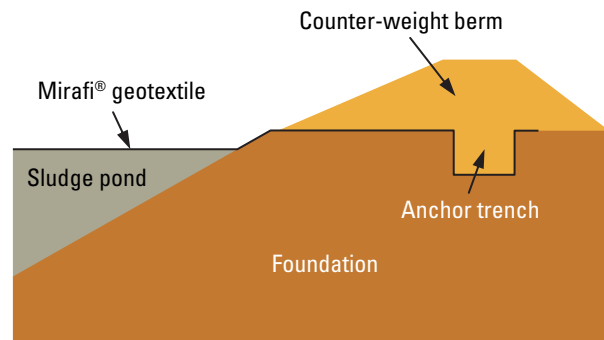
Other installation approaches may require the Mirafi® geotextile reinforcement rolls to be placed across the surface of the sludge pond and then seamed insitu. For this to be successful it is necessary for seaming to be carried out over the surface of the sludge pond and will depend on the shear strength of the sludge pond surface to support the seaming operation, and any presence of surface water, etc.

In some instances, it may be worthwhile to flood the surface of the sludge pond in order to float the Mirafi® geotextile reinforcement panels across the surface of the sludge pond.

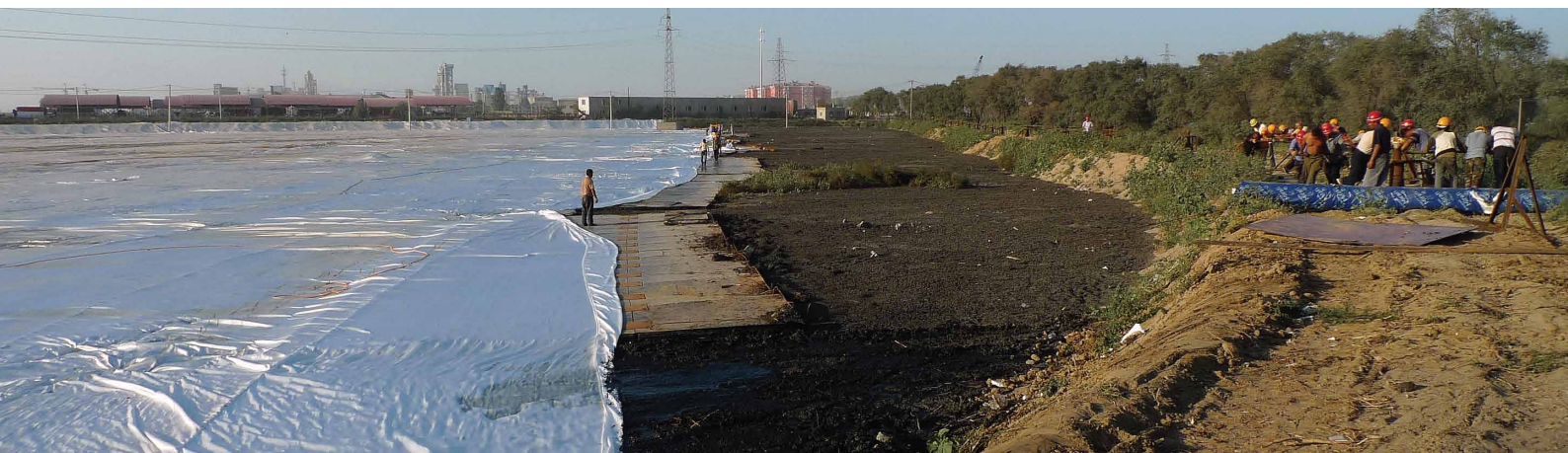
Periphery anchorage

If the sludge pond surface is very soft, the Mirafi® geotextile reinforcement panel should be anchored at the periphery of the sludge pond to prevent the edges being pulled into the sludge pond during fill coverage.

Anchorage can be provided by the construction of an anchor trench around the periphery, or alternatively, by simply covering the extremities of the Mirafi® geotextile reinforcement with a counterweight berm of fill.



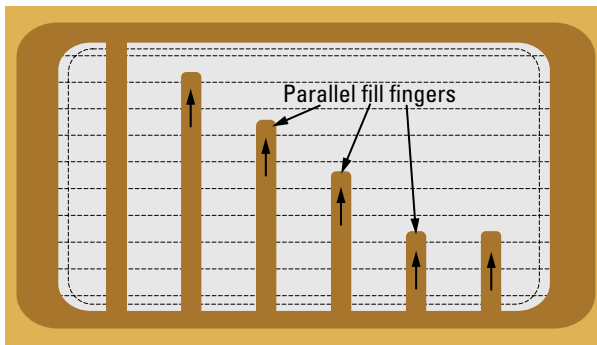
Anchorage of Mirafi® geotextile panel around periphery of sludge pond



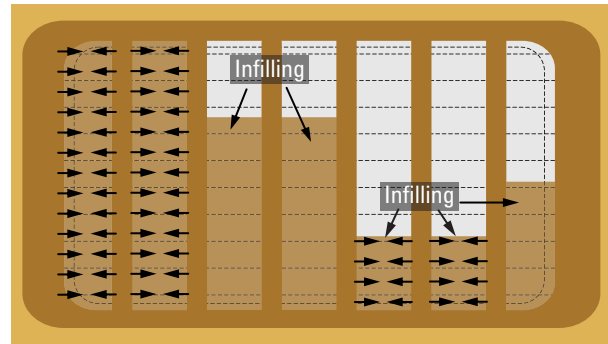
Placement of Fill Closure

The fill closure should be constructed in such a way to ensure bearing and shear failures do not occur in the sludge pond while closure filling.

If the sludge pond material can support the fill closure placement, then the fill material should be placed evenly over a wide front. However, if the sludge pond material is very soft then a different fill placement procedure is warranted to preserve stability during closure construction.



Constructing parallel fill fingers to stress Mirafi® geotextile reinforcement panel



Infilling between parallel fill fingers to complete fill closure

For very soft sludge ponds, the fill closure is normally carried out in two stages over the Mirafi® geotextile reinforcement.

Stage 1 : Construction of parallel fill "fingers"

The parallel fill fingers are constructed in the transverse direction across the Mirafi® geotextile reinforcement in a thickness ranging between 0.4 m to 0.8 m depending on the strength of the sludge material below, with the fingers normally between 8 m and 12 m spacings. The goal of the fill fingers is to



deform the surface of the very soft sludge material and stress the geotextile reinforcement, thereby improving the effective bearing capacity of the sludge material.

Stage 2 : Infilling between fill fingers

Once the Mirafi® geotextile reinforcement has been stressed by the construction of the parallel fill fingers, infilling to complete the initial closure can be carried out. The infilling should be done by pushing closure fill from the surface of the existing finger bunds using low ground pressure dozers. It is important that any stockpiling of closure fill does not overstress the sludge material.

It should be recognised that during this infilling process appreciable deformations may occur at the surface of the sludge material and therefore it is important to have good seam strengths in the Mirafi® geotextile reinforcement so that local geotextile separations can't occur.



Completion of fill closure

Case Study: Iron pyrite tailings dam reclamation, Huelva, Spain



Following completion of mining operations in the area, the reclamation and closure of the 35 ha iron pyrite tailings dam was also decided. An engineered closure cap was designed to prevent any future acid mine run-off pollution entering nearby streams and rivers.

Due to the extensive area to be reclaimed, and large volumes of fill to be moved, relatively large earth moving equipment had to be used. This posed a major technical problem as the equipment had to traffic over the very soft tailings extending to a depth of approximately 18 m.

The solution was to construct a 1 m thick granular working platform supported by Mirafi® geotextile reinforcement placed over the surface of the soft tailings. The stone fill was placed over the geotextile reinforcement in a planned manner to ensure there was little disturbance of the soft tailings below. Once the working platform had been constructed, an engineering barrier was then constructed over the top.



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