



GEOSYNTHETIC
TECHNOLOGY LTD

Liners for Lakes, Ponds and Water Features





The GT Difference

Typical straight bankment

Because all liners AREN'T the same!

At Geosynthetic Technology Limited (GT), we pride ourselves on offering only the best quality lining systems for your project.

For the majority of applications we recommend our Excelastic range of liners. Excelastic is a modified Polyethylene product offering clear advantages in terms of flexibility and mechanical performance in comparison with products manufactured from synthetic Rubbers (EPDM & Butyl) and Polyvinyl Chloride (PVC). Typically, Excelastic has twice the strength characteristics (tear, stretch, tensile etc) of Rubber and PVC Liners of the same thickness. Similarly, Excelastic displays much better resistance to ultraviolet light and remains inert in all soil conditions. These differences make Excelastic the choice for the majority of lakes, ponds and water features.

For some highly geometric applications Excelastic may not be the most suitable product. In these cases we offer tailor-made and/or box-welded liners manufactured from alternative geomembrane products.

All our liners are offered with various grades of needle punched non-woven Geotextiles. These underlays and overlays help protect the liner from damage from above and below.

The Benefits of Excelastic

- Typically twice the strength of Butyl Rubber liners
- Excellent flexibility, therefore easy to install
- Excellent resistance to cracking
- 20-year warranty
- Completely fish-friendly, unlike PVC liners
- In excess of 1,000,000m² used for pond schemes
- Installation services available for larger projects

GT - Offering Quality as Standard

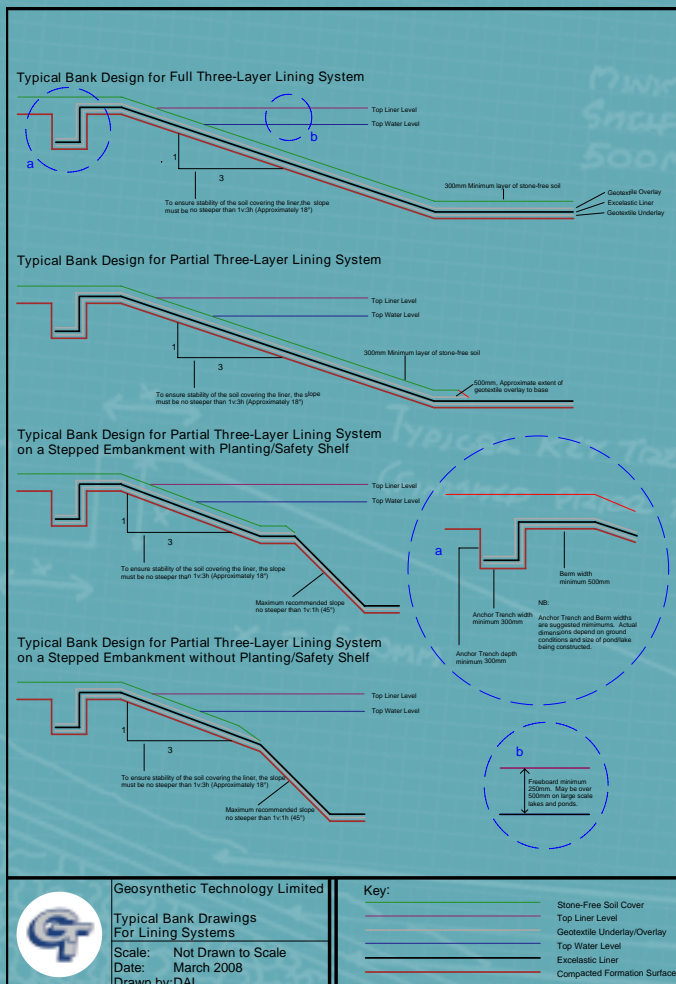




Liners for Self-Installation

GT offers a wide range of lining systems for self-installation. Our liners do not sit on shelves waiting to be ordered; each one is fabricated individually to meet our Customer's exact requirements. Our liners are fully packaged for safe delivery and come with comprehensive installation instructions, ensuring trouble-free installation.

We are pleased to work with you to determine the specification, type and size of liner you require. This helps ensure your finished water area meets your expectations and will remain watertight and aesthetically pleasing for many years to come.





Supply and Installation

At GT we understand that, for many people, the idea of installing a pond or lake lining system can be very daunting and in many cases the proposed pond is too large for self-installation to be an option. To ensure our Customers achieve a high quality completed project GT offers a full design, supply and installation service.

Our installation services provide you with complete peace of mind. We will work with you throughout the design and build process. Where required we will meet you and your Earthworks/Groundworks Contractor to discuss and agree the earthworks required for your project. Once the excavation is complete and ready for lining our fully-trained Site Installation Crews will carry out the installation in such a manner that disruption and fuss is kept to a minimum.

Our installation services are backed up with long-term Warranties and comprehensive Product Liability Insurance. All site works are carried out in full compliance with the Company's ISO 9001 Quality Assured Operating Procedures.

GT - Quality Guaranteed

Contact us

We welcome enquiries from all those concerned with the design and construction of water areas.

For a no cost/obligation quotation please contact us.



WORLDWIDE GEOMEMBRANE ENGINEERING



Lining systems supplied and installed throughout the world



Lined Reservoirs, Lagoons and Storm Ponds

Lined Reservoirs, Lagoons and Storm Ponds

Water is a most precious resource. Increasingly, to meet irrigation requirements, storage reservoirs are recognised as the key to water self-sufficiency.

The management of waste liquids and effluents is subject to stringent legal requirements meaning that lagoons and ponds are required to avoid their discharge into rivers and other watercourses prior to treatment.

Synthetic liners – Geomembranes – provide a cost effective and assured method of waterproofing these in-ground / earth-built structures.

This brochure details the substantial experience of Geosynthetic Technology Limited (GT) and the benefits of employing the service and materials of the company in the construction of lined reservoirs, lagoons and ponds.

GT offer a wide-range of high performance liner products manufactured from Polyethylene (PE) and Polypropylene (PP) and specific formulations to meet every requirement. Our liners and installation services are recognised internationally as 1st Quality Standard giving optimum service life.

Front cover photos, top to bottom

Effluent Lagoon *Somerset*

Irrigation Lagoon *Lancashire*

Industrial Cooling Lagoon *Yorkshire*

Farm Irrigation Reservoir *Norfolk*

Storm Water Pond *Finland*

Farm Irrigation Reservoir Lining *Suffolk*



About GT

- GT is a specialist contractor in the provision and installation of high performance lining systems for reservoirs, lagoons and storm ponds. Our customers include farmers, industrial corporations, oil companies and water companies.
- GT provides an international service having undertaken lining contracts in more than thirty countries on five continents.
- GT can provide prefabricated liner panels for smaller projects, allowing our Clients to undertake their own installation.

Quality Assurance

- All site works undertaken by GT are carried out in full compliance with the company's ISO 9001 Quality Assured Operating Procedures.
- All liners installed by GT are covered by a bona fide twenty-year warranty.



The Lining Installation Process

1

Preparatory earthworks in progress. The area is cleared of large stones, debris and tree roots and is compacted to give a firm, dry surface on which to lay the lining system.



2

Geotextile underlay is installed. This provides a puncture-resistant layer onto which the geomembrane lining can be laid.



3

Geomembrane lining is laid. All joints are welded on site to ensure full waterproof integrity.



4

Fully lined earth structure awaiting filling. If required a geotextile overlay can be added to allow landscaping / soil covering.



Photo references, top to bottom
Settlement Lagoon *Isle of Wight*
Lagoon *West Sussex*
Slurry lagoon *Wiltshire*
Irrigation Reservoir *Suffolk*

Examples of our work

Left
Lechgate Lagoon
Norfolk



Right
Irrigation Reservoir
Kent



Left
Waste Water Lagoon
Herefordshire



Right
Irrigation Reservoir
Norfolk



Left
Irrigation Reservoir
Oxfordshire



Right
Slurry Reservoir
Hampshire



Left
Irrigation Reservoir
Hampshire



Right
Slurry Lagoon
Somerset



Left
Irrigation Reservoir
West Sussex

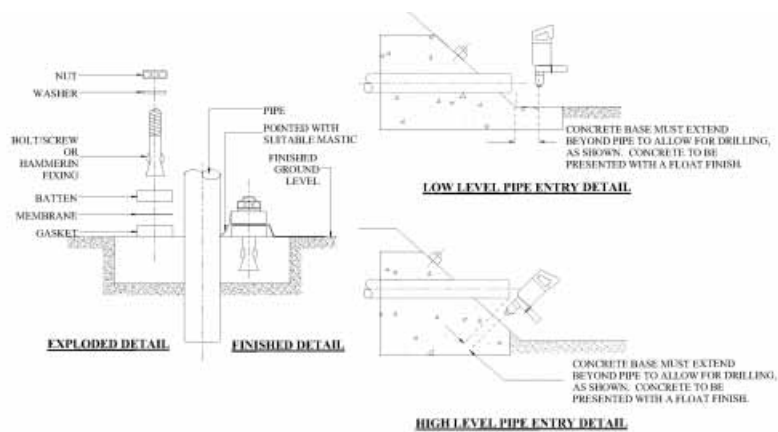


Right
Irrigation Reservoir
Worcestershire



Technical Support

- GT will provide input into the design of reservoirs and lagoons and prepare Method Statements detailing the necessary construction earthworks required.
- GT will, if required, work with suitably qualified Contractors to provide a complete service for the building of the reservoir or lagoon
- GT will assist other contractors working on the scheme by providing appropriate technical drawings to ensure the overall design meets the Client's requirements.
- GT has installed many millions of square metres of lining systems. This experience can prove invaluable for your project.



Examples of our International Work

Left
Irrigation Lagoon
Bahamas



Right
Storage Reservoirs
China



Left
Treatment Lagoons
Ireland



Right
Tank Bund Lining
Kazakhstan



Left
Fire Fighting Lagoon
Papua New Guinea



Right
Irrigation Lake
Portugal



Left
Sewerage Pond
Saudia Arabia



Right
Toxic Waste Lagoon
Spain



Left
Solar Evaporation Lagoon
Oman



Right
Secondary Containment Lining
Ascension Island



WORLDWIDE GEOMEMBRANE ENGINEERING



Irrigation Reservoir *East Anglia*



Lined Lakes,
Ponds &
Irrigation
Reservoirs for
Golf Courses



Lined Lakes, Ponds & Irrigation Reservoirs for Golf Courses

Ponds, lakes and reservoirs on Golf Courses provide numerous practical and aesthetic benefits.

Synthetic liners – Geomembranes – provide a cost effective and assured method of waterproofing these in-ground / earth-built water areas.

Geomembranes are increasingly being used in the refurbishment of leaking, typically clay-lined, lakes.

This brochure details the substantial experience of Geosynthetic Technology Limited (GT) and the benefits of employing the services and materials of the company in the construction of lined lakes, ponds and water storage reservoirs.

Front cover photos, top to bottom

La Moye Golf Club *Jersey*

Heritage Golf & Country Club *Ireland*

Dun Laoghaire Golf Course *Ireland*

Kirtlington Golf Course *Oxfordshire*

Bom Sucesso Golf Project *Portugal*

Fota Island Golf Club *Ireland*



About GT

- GT is a specialist contractor in the provision and installation of high performance lining systems for golf course lakes, ponds, lagoons and irrigation reservoirs.
- GT provides an international service having undertaken lining contracts in more than thirty countries on five continents.
- GT can provide prefabricated liner panels for smaller projects, allowing our Clients to undertake their own installation.

Quality Assurance

- All site works undertaken by GT are carried out in full compliance with the company's ISO 9001 Quality Assured Operating Procedures.
- All liners installed by GT are covered by a bona fide twenty-year warranty.



The Lining Installation Process

Badgemoor Park Golf Club

1

Excavated lake ready to receive lining system. The excavated area is cleared of large stones, debris and tree roots and is compacted to give a firm, dry surface on which to lay the lining system.



2

Geotextile underlay is installed to provide a puncture-resistant layer onto which the geomembrane lining can be laid. Any joints in the geomembrane are welded on site to ensure full waterproof integrity.



3

Lake lined with geomembrane liner, geotextile overlay being added.



4

Fully lined lake awaiting filling and final landscaping.



Lakes, Ponds & Water Features

Examples of our work in the UK

Left
Brett Vale Golf Club
Suffolk



Right
Celtic Manor Resort
South Wales



Left
Enville Golf Club
Staffordshire



Right
High Legh Park Golf Club
Cheshire



Water Storage Reservoirs

Left
Aroeira East Golf Course
Portugal



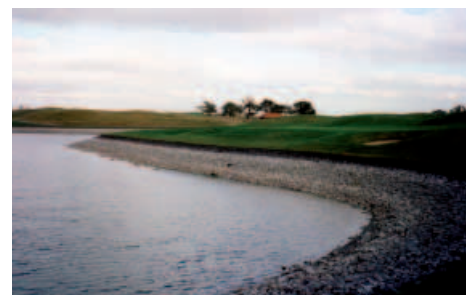
Right
Frilford Heath Golf Club
Oxfordshire



Left
Moatlands Golf Club
Kent

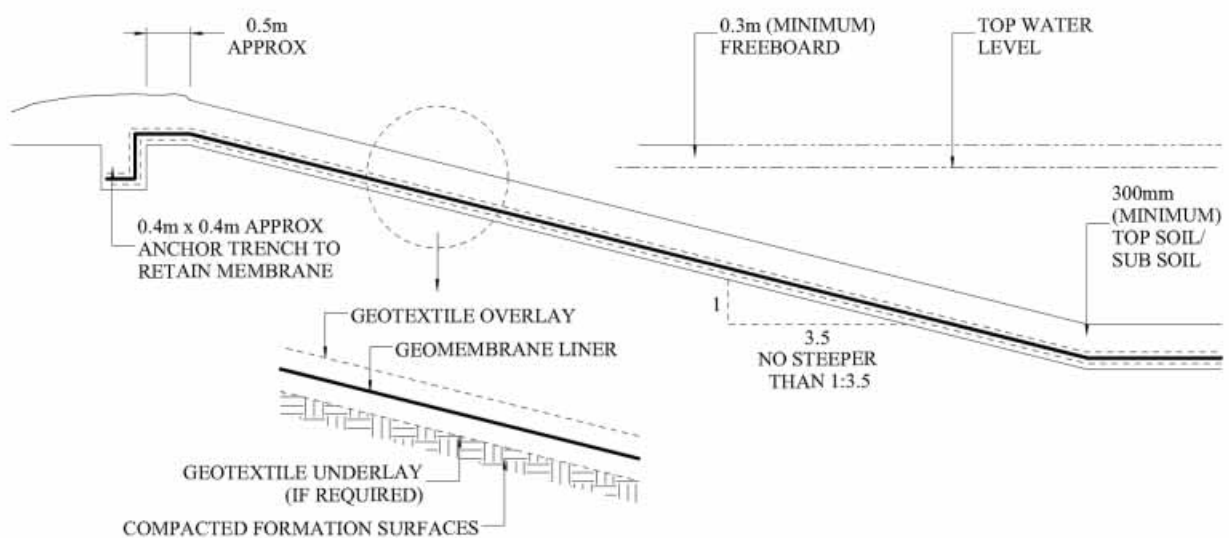


Right
The Oxfordshire Golf Club
Oxfordshire



Technical Support

- GT will provide practical input into the design of lakes, reservoirs and ponds, and prepare Method Statements detailing the necessary construction earthworks required.
- GT will design water storage reservoirs against an understanding of site parameters to ensure that golf course irrigation requirements are met.
- GT will work with suitably qualified Contractors to provide a complete service for the building of the lake, pond or reservoir.
- GT will assist other contractors working on the scheme by providing appropriate technical drawings to ensure the overall design meets the Client requirements.



TYPICAL SECTION OF A BURIED LINING SYSTEM TO A POND/LAKE AREA

Examples of our International Working

GT is proud to have completed golf projects throughout the world.

Left
Nofa Farm Golf Project
Saudi Arabia



Right
Brunnthal Golf Course
Germany



Left
Abaco Golf Project
Bahamas



Right
Discovery Bay Golf Club
China



Left
Dun Laoghaire Golf Course
Ireland



Right
Killarney Golf & Fishing Club
Ireland



GT Client List

Abaco Golf Project *Bahamas*

Abbey Hill Golf Club

Airlinks Golf Club

Amberley Castle Project

Aroeira East Golf Course *Portugal*

Ashdown Park Golf Course

Austin Lodge Golf Course

Aylesbury Park Golf Course

Badgemoor Park Golf Club

Batchworth Park Golf Club

Bicester Golf Club

Birchwood Park Golf Course

Bird Hills Golf Club

Blankney Golf Course

Bletchingley Golf Club

Bom Sucesso Golf Project *Portugal*

Botley Park Golf Club

Boughton Golf Club

Bradley Park Golf Course

Bramley Golf Club

Brett Vale Golf Club

Brickhampton Court Golf Club

Bristol Golf Club

Broadwater Park Golf Club

Brocket Hall Golf Course

Broke Hill Golf Club

Brooklands Golf Course

Brunnthal Golf Course *Germany*

Buckingham Golf Club

Burhill Golf Club

Bushy Hall Golf Club

Cambs Hall Golf Course

Castle Park Golf Course

Castle Royal Golf Club

Celtic Manor Resort

Chalfont Park Golf Club

Chartridge Park Golf Club

Cherry Lodge Golf Club

Chobham Golf Club

Cottesmore Golf Club

Craythorne Golf Club

Dainton Park Golf Club

Darlands Golf Club

Deanwood Park Golf Club

Denton Golf Club

Dinas Powis Golf Club

Discovery Bay Golf Club

Donnington Grove Golf Club

Donnington Valley Golf Course

China

Dukes Meadows Golf Club

Dunston Hall Golf Club

Enville Golf Club

Etchinghill Golf Club

Eyhurst Golf Club

Farleigh Golf Course

Fawkham Valley Golf Club

Forest Pines Golf Club

Fota Island Golf Club *Ireland*

Foxhills Golf Club

Frilford Heath Golf Club

Fynn Valley Golf Centre

Godstone Golf Club

Gort Golf Club *Ireland*

Grims Dyke Golf Club

Grove Golf Centre

Grove Golf Course

Halesworth Golf Club

Halifax Bradley Hall Golf Club

Hanbury Manor Golf Club

Hartley Wintney Golf Club

Hassocks Golf Club

Henley Golf & Country Club

Hennerton Golf Club

Heritage Golf & Country Club *Ireland*

Hesketh Golf Club

Hewitts Golf Centre

Heydon Grange Golf & Country Club

High Legh Park Golf Club

Kendleshire Golf & Country Club

Killarney Golf & Fishing Club *Ireland*

Kings Acre Golf Centre

Kingshill Golf Course

Kingstand Golf Course

Kingsway Golf Centre

Kington Golf Club

Kirtlington Golf Course

Kirton Holme Golf Club

La Moye Golf Club *Jersey*

Lensbury Golf Course

Links Hotel and Golf Club

London Golf Club

Luton Hoo Golf Development

Manor at Groves Golf Club

Matlock Golf Club

Merlin Golf Course

Milford Golf Course

Minchinhampton Golf Club

Moatlands Golf Club

Moore Place Golf Club

Muddy Lane Golf Course

Murrayshall Golf & Country Club

New Dun Laoghaire Golf Course *Ireland*

New Weston Golf Course

Nofa Farm Golf Project *Saudi Arabia*

Oxfordshire Golf Club

Panshanger Golf Course

Paphos Golf Course *Cyprus*

Parklands Golf Club

Parkwood Golf Club

Pedham Place Golf Centre

Penrhos Golf Club

Princes Golf Club

Princes Risborough Golf Club

Ramsdale Park Golf Course

Redlibbets Golf Club

Richings Park Golf Course

Ridge Golf Club

Rowlands Castle Golf Club

Royal Cinque Ports Golf Club

Ryburn Golf Club

Sandford Springs Golf Club

Searles Leisure Park

Southern Gailes Golf Club

Spalding Golf Club

St Andrews Golf Course

St Enodoc Golf Club

St Georges Golf Club

Sunbury Golf Club

Suffolk Golf & Country Club

Sutton Green Golf Club

Swinley Forest Golf Club

The Kent National Golf & Country Club

Tudor Park Hotel Golf Complex

Turnberry Golf Club

Tydney Park Golf Club

Ufford Park Golf Course

Wakefield Golf Club

Waldringfield Golf Club

Walton Heath Golf Club

Welcombe Golf Course

West Malling Golf Club

Westerham Golf Club

Weston Super Mare Golf Club

Wharton Park Golf Club

Whitchurch Golf Club

Woodbridge Golf Club





Geomembrane Lining Systems for Civil Engineering and Construction



GEOSYNTHETIC
TECHNOLOGY LTD

Lining Applications for Civil Engineering and Construction

There are a multitude of applications for GT's lining systems within the Civil Engineering and Construction Industries.

From the sealing and capping of contaminated ground to the waterproofing of attenuation tanks, GT's range of geomembranes and geotextiles provides a cost-effective and assured method of providing impermeable barriers.

This brochure details the substantial experience of Geosynthetic Technology Limited (GT) and the benefits of employing the service and materials of the company within the Civil Engineering and Construction Industries.

GT offers a wide range of high performance geomembrane products manufactured from Polyethylene (PE) and Polypropylene (PP) meeting every requirement. Our PE and PP geomembranes are recognised as superior materials giving long life service.

Front cover photos, top to bottom

Attenuation Tank *West Midlands*

Lining for A13 Road Project *London*

Landfill Cell Lining *Wrexham*

On-Site Welding *Hertfordshire*

Liner Deployment *Ireland*

Secondary Containment Lining *Kazakhstan*



About GT

- GT is a specialist contractor in the provision and installation of high-performance lining systems for a multitude of applications within the Civil Engineering and Construction Industries.
- GT provides an international service having undertaken lining contracts in more than thirty countries on five continents.
- GT can provide prefabricated liner panels for smaller projects, allowing our Clients to undertake their own installation.

Quality Assurance

- All site works undertaken by GT are carried out in full compliance with the company's ISO 9001 Quality Assured Operating Procedures.
- All liners installed by GT are covered by a bona fide twenty-year warranty.



Applications

Geosynthetic Technology has an impressive portfolio of completed projects within the Civil Engineering and Construction Industries. The following pages detail some of the applications completed to date.

Left
Attenuation Tank
Wiltshire



Right
Attenuation Tank
Hertfordshire



Left
Contaminated Land Capping
Berkshire



Right
Contaminated Land Capping
Kent



Left
Cooling Lagoon
Yorkshire



Right
Evaporation Lagoon
Australia



Left
Evaporation Lagoon
Saudi Arabia



Right
Fire Fighting Lagoon
Papua New Guinea



Applications

Left
Gas Barrier Membrane
Gwent



Right
Gas Barrier Membrane
Cumbria



Left
Industrial Lagoon
Hampshire



Right
Industrial Lagoon
Norfolk



Left
Lake Lining
Surrey



Right
Landfill Capping
Essex



Left
Landfill Cell Lining
Belgium



Right
Reed Bed Lining
Northamptonshire



Applications

Left
Reed Bed Lining
Yorkshire



Right
Reservoir Lining
Gwent



Left
Reservoir Roof Lining
Devon



Right
Secondary Containment
Ascension Island



Left
Secondary Treatment
Ireland



Right
Settlement Lagoon
Australia



Left
Sewage Treatment Lagoon
Portugal

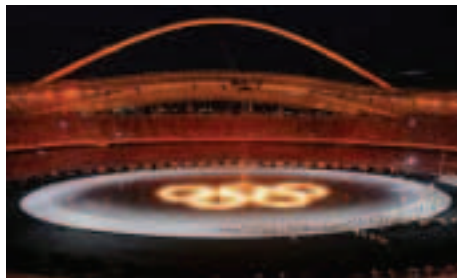


Right
Slurry Lagoon
Hampshire

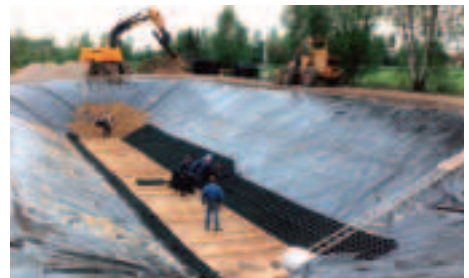


Applications

Left
Special Commission
Athens Olympics



Right
Storm Water Pond
Finland



Left
SUDS Lining
Devon



Right
Structural Waterproofing
Kent



Left
Toxic Waste Lagoon
Tyne and Wear



Right
Waste Storage Lagoon
Spain



Left
Waste Water Treatment Lagoon
Yorkshire



Right
Waste Water Treatment Lagoon
Staffordshire



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Drainage Lagoon *Yorkshire*



Attenuation Tank Lining Case Study

Chelsea Football Club Youth Academy

The construction of Chelsea Football Club's Youth Academy required an attenuation tank of 117 cubic metres. The attenuation tank was formed from plastic blocks each @ 0.84m x 0.81m x 0.4m to form a finished tank of 34.83m x 8.40m x 0.40m.

This choice of Sustainable Urban Drainage System (SUDS) is now commonplace in the UK. Our company has been at the forefront of developing effective lining techniques.



The construction sequence was as follows:

- 1) Excavation of the area to site the tank (by others).
- 2) Installation of a geotextile underlay and an impermeable PE liner.
- 3) Placement of the blocks (by Geosynthetic Technology Staff)
- 4) Pulling of the lining up the sides of the tank, and undertaking pipe seals.
- 5) Placing of a PE liner and geotextile layer over the top of the tank.
- 6) Backfilling the tank (by others).



The lining system benefits from a bona fide 20-year Warranty and our Professional Indemnity insurance. The lining system has a working life in excess of 100-years.

Materials used: 300g/m² Geotextile / 0.50mm Excelastic PE Liner

Geosynthetic Technology Ltd lines attenuation 'block' tanks from all Manufacturers & Suppliers.

We also offer to prefabricate liners for installation by Groundworks Contractors.



Attenuation Tank Lining Case Study

New Housing Site, Stowupland, Suffolk

The tank was 6m x 5.5m x 1.2m providing a gross volume of 39.6 cubic metres.

The attenuation blocks of 1m x 0.5m x 0.4m high were orientated 6 blocks x 11 blocks x 3 blocks high, ie 198 blocks @ 0.20 cubic metres each = 39.60 cubic metres.



The construction sequence was as follows:

- 1) Placement of the geotextile layer.
- 2) Installation of the prefabricated 1.00mm liner.
- 3) Placement of the 198 No blocks.
- 4) Sealing the liner to pipe inflow/outflow stub end penetrations. Sealing of the vent.
- 5) Placement of the prefabricated lid liner across the top of the tank, and its extrusion welding to the previously installed liner. This created a fully welded liner encasing all six sides of the tank area.
- 6) Completion of the installation of the remaining geotextile overlay to the outside of the tank.



Our work on site was completed in one day. This included installation of the (Contractor supplied) attenuation blocks. The Contractor subsequently joined the pipework runs to the sealed stub ends prepared by our company.

Materials used: 300g/m² Geotextile / 1.00mm Polypropylene Liner

Geosynthetic Technology Ltd lines attenuation 'block' tanks from all Manufacturers & Suppliers.

We also offer to prefabricate liners for installation by Groundworks Contractors.



World's Largest Lagoon Liner



***GEOSYNTHETIC
TECHNOLOGY LTD***



1,400,000 sq. metres

350 acres - Installed in 7 months!

World's Largest Lagoon Liner

Considered to be the World's largest lagoon lining, more than 1.4 million square metres (350 acres) of continuous polypropylene geomembrane lining was recently installed on a project in Kazakhstan.

A giant lagoon facility in Kazakhstan, of some 1,400,000 square metres (350 acres), designed to contain process liquid waste for an oil company, was lined in 7 months site work. This remarkable fast track programme was achieved by British company, Geosynthetic Technology Ltd, (GT) which was appointed to manage all aspects of the lining project.

GT, based in Colchester England, has more than 40 years experience of Geomembrane Engineering and specialises in high quality lining project management on an international basis. In preparation for the fast track plan, considerable time was spent by GT on project planning particularly in:

- The evaluation and testing of various geomembrane lining materials
- reviewing manufacturing resources
- international transport logistics
- training and certifying unskilled labour
- geomembrane installation planning
- quality assurance procedures

GT Chairman, John Alexander, said that the original planning by the oil company client foresaw the lining being installed in phases over a three-year period. The harsh winters from November to March meant that lining installation work was only possible from April to October. Based upon the clients past experience of lining works by other companies working on the same site, this indicated a three year installation programme for the 1.4million square metre (350 acre) project.



(Fig 1)



(Fig 2)

GT commenced the installation in August 2010 (Fig 2) with the objective of testing their rapid installation plan over about 10% of the total lagoon design area. GT literally 'hit the ground running'. Everything worked perfectly and, despite very hot weather, (up to 38°C) the trial area was completed ahead of schedule. The client noted the rapid progress and authorised the whole of the remaining area to be installed on the same fast track basis from April to October during 2011. In fact, despite severe dust storms and occasional flooding, the work was completed by the end of August 2011. Every seam was tested and all quality procedures completed. GT Chairman, John Alexander said, "I have been working in Geomembrane Engineering for nearly 40 years and have never seen a geomembrane installation more professionally performed. The pace was breathtaking!"

Geomembrane Material Evaluation

The key design requirements, which had to be considered in the selection of a suitable geomembrane material, are set out in the table (Fig 3). In the final review, two materials were considered and compared in detail; High Density Polyethylene (HDPE) and Polypropylene (PP-Ex). Although HDPE has been widely used for geomembrane lining for many years, it is known to have serious limitations, particularly in relation to its very slow seam welding speed as well as its stiffness and poor thermal properties - all of which could be exacerbated by the design requirements.

Comparative Review – HDPE v PP-Ex (Fig 3)

Fast welding speed was crucial with 240km (160 miles) of liner seams to be undertaken. PP-Ex can be seam welded up to 5 times faster than HDPE.

Geomembrane must remain thermally stable and weldable across an ambient temperature range of 0°C + 40°C (black sheet temperature up to 70°C) HDPE thermal expansion is 2 times PP-Ex which combined with its stiffness, can lead to the HDPE sheet buckling and induce severe stress on seams following cooling and contraction from day to night. HDPE installation often necessitates night working in hot climates. PP-Ex remains flat and weldable at high ambient temperature. (Fig 4)

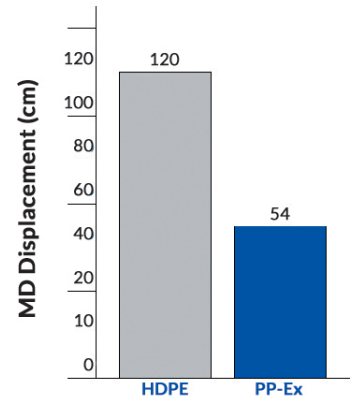
Liner flexibility was considered essential for safe deployment in windy conditions on the exposed site. Flexible PP-Ex flops over whereas HDPE stiffness acts like a sail and sometimes cannot be restrained by any number of men! (Fig 5)

Extreme low winter temperature performance down to -50°C was important. HDPE seams can be susceptible to brittleness and cracking failure at - 40°C. PP-Ex remains flexible.

Liner resistance to incoming effluent at 85°C was examined. PP-Ex has much higher temperature resistance than HDPE, which softens and expands causing stress around effluent pipe liner fixings.

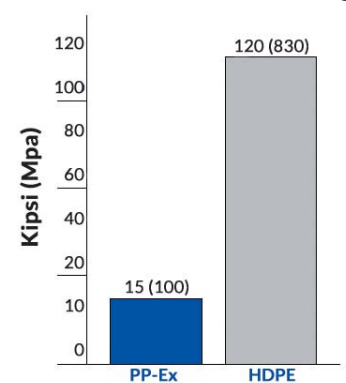
Liner to have outstanding puncture resistance The Test Method ASTM D5514 (Fig 6) which simulates field service by pressurising the liner over steel cones, revealed that PP-Ex has 4 times the puncture resistance of HDPE, enabling thinner (lower cost) PP-Ex sheet to be used. (Fig 7)

Geomembrane Displacement Due To A Typical Temperature Change. (Fig 4)

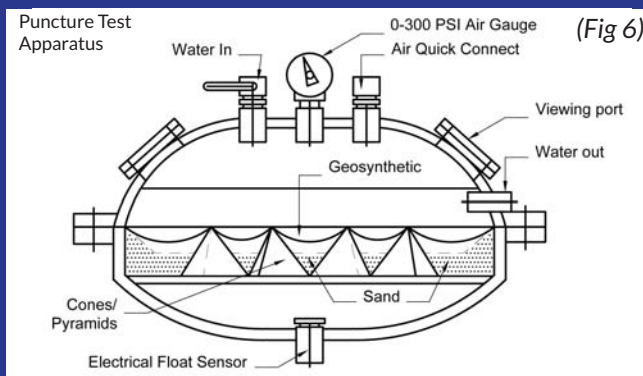
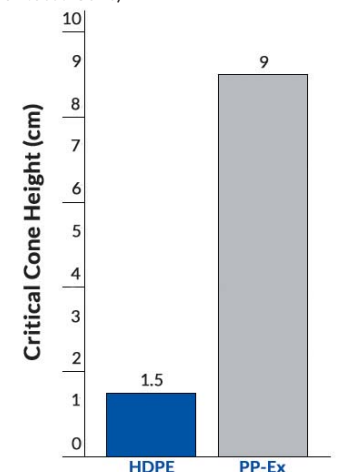


MD displacement per 100m length of geomembrane when exposed to a 50°C temperature change (20°C - 70°C)

Relative Stiffness of PP-Ex and HDPE (Fig 5)



Large Scale Point Stress (Truncated Cone) (Fig 7)



Cost Benefit

The Geomembrane Material Evaluation clearly indicated that key factors such as maintaining programme in hot weather conditions and / or moderate winds, distinctly favoured PP-Ex over HDPE. Moreover, using PP-Ex would eliminate the need for night working throughout summer months. On a 1,400,000 square metre (350 acre) project employing several people in a 'fast track' liner installation, these factors had major cost implications. In addition, whilst on a same gauge thickness basis, PP-Ex sheet material costs more than HDPE, the much higher puncture resistance of PP-Ex enabled PP-Ex 1.00mm (40mil) gauge (for the lagoon bases) and PP-Ex 1.5mm gauge (60mil) (for the lagoon embankments) to be proposed.

HDPE would need to be at least 2mm (80mil) gauge to be equivalent on this basis and, as such, the basic material - cost advantage of HDPE over PP-Ex is insignificant in the final cost calculations. Overall, taking into account other beneficial factors including much faster welding speeds; installation programme reliability; and fewer quality and rectification problems the total cost benefit of using PP-Ex on the project as opposed to HDPE was calculated to be considerable. This, together with the clear technical limitations of HDPE, led to HDPE being expressly banned from use on the project by the client's Engineers.

Manufacturing Quality Assurance

A "right first time" failsafe approach was taken by Geosynthetic Technology Limited (GT) to manufacturing quality. The distance of more than 2000 miles from the liner manufacturing plant to the job site, and the tight installation programme, could not tolerate manufacturing faults on delivered materials.

Raw material tests certificates were provided and checked for each batch of polymer used and rolls of sheet manufactured from each polymer batch were allocated a unique reference number. Every roll was tested at the production plant for compliance with particular contract specification basic physical properties.

A sample of each thickness from every batch was selected at random by GT and submitted to an Independent Laboratory for repeat conformance testing of basic physical properties. GT also arranged for various Reference Tests, such as surface friction, multi-axial elongation, and coefficient of thermal expansion to be conducted in an Independent Laboratory in the USA, using specially developed apparatus. The results of all testing were incorporated into a Quality Assurance Report for the client to archive. (Fig 8)



(Fig 8)

Freight

The two most important factors considered for container freight were size of the rolls, to enable best use of container volume and the method of loading/unloading without damage occurring.

It was determined that rolls of 1.00mm (40mil) gauge in a sheet size of 5.8m (19ft) x 200m (656ft), and rolls of 1.5m (60mil) in a sheet size of 5.8m (19ft) x 135m (443ft) would enable 16 rolls to be packed per container in each case, a symmetrical 4 x 4 formation, without risk of crushing or becoming loose during the 2000 mile journey. (Fig 10)

A purpose made 'spike' was bolted to a forklift truck. The spike was inserted through the central core of the rolls for loading/unloading. (Fig 11). Each roll was fitted with slings to facilitate site lifting by excavators. (Fig 9)



Geomembrane Installation

Prior to start up, an inventory of specialist equipment, welding machines, spare parts, lifting frames and quality control equipment was assembled by GT and shipped out to the job site. An air-conditioned site laboratory and workshop was established. GT calculated it would be necessary to operate with 3 welding crews each day on 12 hour shifts, 7 days a week, for continuous sessions of 30 days on / 30 days off per rotation crew, in order to achieve the output target.

It was foreseen by GT that it would be necessary for at least one of their skilled and experienced Senior Technicians to be on site on a rotation basis throughout the entire works. To facilitate a smooth start up and communication, two Kazakhstan personnel were selected who travelled to GT's Head Office near Colchester in England, where they underwent intensive training including much site work in all weathers for some three months. Training included learning job-specific English words: weld; deploy; quality control etc. At the completion of training, they were issued with Certificates of Competence in Welding signed by GT's Chairman, John Alexander, a professionally qualified Chartered Engineer.

The availability of the trained Kazakhstan personnel (Fig 12) under the management and organisation of the GT Technician enabled GT to make an efficient start and within days of commencement, output of 20,000m² (215280 ft²) per day was being consistently achieved when weather conditions permitted (Fig 13).



(Fig 12)



(Fig 13)

Over the 7 month installation period, the work crews (Fig 14) experienced two flash floods, numerous dust storms (Fig 15), frosty mornings and high temperatures exceeding 40°C. On many days no installation was possible, which made it even more imperative to achieve high output during good weather to accomplish the overall programme.



(Fig 14)



(Fig 15)

Installation Quality Control

Every seam was tested qualitatively by an air pressure method. Each seam weld actually comprised two parallel welds with a gap between them. The end of the seam run, (up to 200m in length), is clamped, and air is pumped in to the weld gap to inflate it to a predetermined pressure, which is read from a gauge. If this pressure is maintained for a specified time, the seam is verified as airtight. In the event of a drop in pressure, the leaking air is easily located by sound, and the leak can be patched by welding. (Fig 16)

At the start of each shift or change of welding machine setting, a sample seam tab is submitted to the site laboratory for destructive testing. It is pulled to destruction on a Tensiometer and the values for strength and elongation at break are noted. The mode of failure of the seam is also examined. Detailed records are maintained and the location of all rolls and seams are noted on an As Built drawing. The site based quality control function was performed by an English-speaking person to ensure nothing became “lost in translation”! (Fig 17)



Overview

“This Geomembrane Lining Project was groundbreaking in many respects” says John Alexander, GT’s Chairman, seen shaking hands with the President of the Kazakhstan Main Contractors (Fig 18).

“Its sheer scale of 1,400,000 square metres (350 acres) is awesome and is, by any standards, the largest lagoon lining ever undertaken anywhere in the world. The speed of liner installation together with the high quality standards maintained throughout the work has set new standards in geomembrane engineering”.

This project clearly demonstrated the value of employing the Project Management Services of a company highly experienced in Geomembrane Engineering but independent of liner manufacturer’s influence. “Liner material manufacturers promote their particular liner material on a, ‘one size fits all basis’ with strong influence on lowest price per square metre” says John Alexander. “They are generally not qualified (or concerned) to consider the much more important cost benefit factors or to involve themselves fully in the client’s design and operating requirements for the facility concerned. These are the key benefits that GT brings to bear on lining projects and which make our projects so successful”.





About Geosynthetic Technology Ltd. (GT)

GT has more than 40 years experience in geomembrane engineering and provides its services internationally. It has carried out installations in more than 30 countries on 5 continents including: most of Europe; Middle East; USA; Canada; Australia; and China. Some 9 billion people saw an example of GT's work on television in 2004, being the artificial lake inside the stadium at the opening ceremony of the Athens Olympics.

GT welcomes enquiries on any aspect of geomembrane engineering where the opportunity to participate in projects involving linings is at any stage of development. GT's advice is provided free of charge and without obligation.



**GEOSYNTHETIC
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