

Geotube[®] **Dewatering Technology**
For Mining and Mineral



One Total Solution For Mining And Mineral Processing

TenCate Geotube® dewatering technology provides a simple and cost effective way of dewatering large and small volumes of Mining and Mineral wastes. This proven technology can accommodate dewatering and containment in one, cost-effective operation. Utilizing TenCate Geotube® containers is an effective alternative to mechanical processing that enables the capture of precious metals and the efficient management of mine tailings, coal sludge, and other mine waste streams. With volume reduction as high as 90%, high solids levels make removal and disposal easy.

TenCate Geotube® containers can be custom-sized to fit available space and be easily removed when dewatering is complete. Dewatered solids can be safely stored on site, re-utilized to build dykes and berms, or disposed of in a landfill without expensive dredging or transportation.



Sludge before (left) and after (right) treatment with Geotube® dewatering technology.



Simple, Versatile TenCate Geotube® Dewatering Technology Is Ideal For:

- **Pond and Lagoon Maintenance**
(polishing ponds)
- **Tailings Management**
- **Water Resource Management**
(water reclamation and reuse)
- **Beneficial Reuse**
(dyke and berm construction)
- **Precious Metals Recovery**
- **Emergency and Disaster Management**
(uninterrupted mining operations)
- **Acid Mine Drainage**
(for active or inactive mines)
- **Specialty Applications**



1. Filling

Material is pumped into the Geotube® container. Environmentally safe polymers are added, which make the solids bind together and water separate.



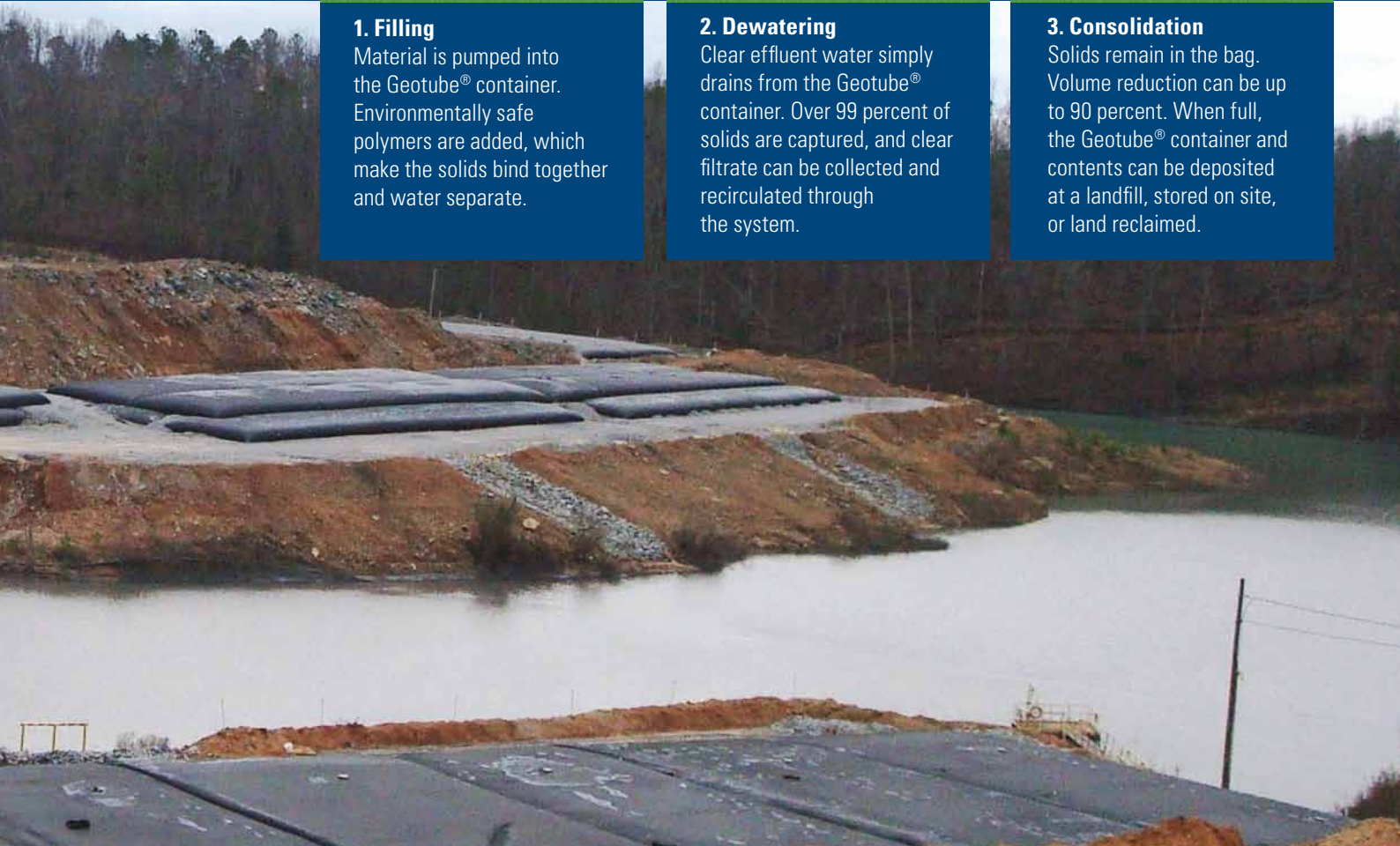
2. Dewatering

Clear effluent water simply drains from the Geotube® container. Over 99 percent of solids are captured, and clear filtrate can be collected and recirculated through the system.



3. Consolidation

Solids remain in the bag. Volume reduction can be up to 90 percent. When full, the Geotube® container and contents can be deposited at a landfill, stored on site, or land reclaimed.



Case Study

application	Pond & Lagoon Maintenance
location	Malaysia

A processing plant needed to clean an oil sludge pond in order to complete repairs to the damaged HDPE lining of the pond. The sludge had to be removed in order to perform the maintenance work. The original proposed plan involved pumping the sludge into tanks and transporting to a waste water treatment plant, but this solution was too costly. TenCate Geotube® dewatering technology was successfully introduced to contain and dewater the oil sludge in order to empty the pond and repair the leaking HDPE liner.

Suspended solids from the ponds was chemically conditioned and captured in the Geotube® containers. The associated costs of pumping the sludge into tanks and transporting it several kilometers away for processing and disposal were eliminated.

Pond & Lagoon Maintenance

Maintaining key water quality discharge parameters and sufficient free board for continuous operation is of the highest priority at all mining operations. The major environmental concern with wastewater lagoons is the potential leakage to groundwater. Wastewater can contain a range of pollutants (e.g. organics, nutrients, salts, metals) either acidic, or alkaline. Often hazardous substances require the highest level of care. Overtopping of a full lagoon or compromised pond liners can lead to leakage and environmental concerns.

Through continuous or event driven pond maintenance dewatering programs to insure sufficient capacity, TenCate Geotube® dewatering and containment technology provides a simple, low cost solution. Easy to set up, even in remote locations, TenCate Geotube® dewatering technology can quickly be deployed to reduce lagoon levels or be used to contain the full volume of dewatered waste material for a complete cleanout.



Dewatering of oil sludge



Pond empty for HDPE liner repair



Tailings Management

“Tailings” refer to the end of the mining process, constituting what is left over after the substances of economic value have been removed. They generally consist of ground rock and process effluents that are generated in a mine processing plant. Tailings are commonly stored in an impoundment – an engineered structure – used as a settling basin/storage container. Management of these storage basins is critical to a mining operation to insure there is sufficient capacity to keep the mine running.

Adding additional capacity is often done by raising the perimeter of the basins, or removing and dewatering the built up sediments in the storage ponds. TenCate Geotube® dewatering technology delivers a high volume, low cost solution reducing disposal costs by consolidating higher solids with very little maintenance. Dewatered solids can be safely stored on site, within the container, eliminating the spread of airborne particles or mechanically removed and transported to an approved location. In many cases, dewatered tailings contained inside the Geotube® units can be used as a structure within the pond or placed on top of the perimeter of the berm to provide additional capacity.



Case Study

application	Tailings Management
location	Finland

Europe’s largest nickel mine faced an overwhelming challenge of full water-storage basins after record rainfall caused a halt to mining operations and the potential environmental issues associated with a leaking tailings pond. Unprecedented rainfall required the mine to store millions of cubic meters of excess water in basins across the 60 km² site. The rainwater had become contaminated with water high in sulphates coming from mining operations.

After several months, the mine was forced to halt mining ore due to water building up in the deepest section of the open-cast mine. This situation was further aggravated when the tailings pond containing gypsum sediment began leaking. The majority of the water that leaked from the tailings pond contained both metals and sulphate compounds. This combination of challenges meant that the mine’s environmental and water-management specialists needed an effective solution capable of delivering sufficient treatment capacity without being excessively expensive to implement.

TenCate Geotube® dewatering technology was implemented to dewater and capture the heavy metals for the massive water purification operation. Concentrations of heavy metals fell well below the threshold limits set by the local environmental authorities. As a result of the successful treatment of sludge and mining effluent, the nickel mine was able to start up ore-mining and crushing operations again.

Case Study

application | **Water Resource Management**
location | **Quebec, Canada**

A zinc mine at an isolated site faced a challenge to provide a water supply to its drilling operation. As drilling holes are spread over the mine site, there was no available water. The mine required a solution for treatment of drilling water to an adequate level to be recirculated in the drilling process.

TenCate Geotube® dewatering technology provided a customized solution to implement a closed loop system to manage on site drill water, even in winter conditions. TenCate Geotube® containers, in combination with a continuous, monitored treatment system, provided the filtration of the contaminated drilling water, where solids were captured and clean water could be reused in the drilling process. This solution eliminated the requirement for the installation of a water supply at this isolated site.

Water Resource Management

Water is often limited in supply in mining applications making it a precious commodity that needs to be reclaimed and recycled through the process. TenCate Geotube® dewatering technology, in combination with proper coagulant or polymer conditioning, will begin releasing water from the suspended solids the moment they enter the tube.

The specially engineered TenCate Geotube® textile retains the solids while releasing the clear water through the pores of the fabric. The effluent is typically of a quality that can be reused for mine processing operations, making this an economical and sustainable technology for mine water management.



Closed loop process for drilling water management



Dewatering under winter conditions



Beneficial Reuse

Beneficial reuse of mining by-products to create structures can positively impact the environment by preserving limited landfill space that otherwise would be consumed by normal tailings disposal. Using TenCate Geotube® dewatering and containment technology and a proper chemical conditioning regimen, a high solids content can be achieved with dewatered mine waste to create stable structures including raising embankments, creation of dams, diversion dykes, and levees. This effort helps drive sustainability initiatives in the industry.

From an economic perspective, the use of TenCate Geotube® containers can eliminate costly disposal of semi-liquid or paste waste by-products to the extent that waste streams can be diverted into useful and safe products. These uses can include good quality, economically attractive alternative structural fill materials for use in construction projects. In many cases, mine waste will dewater without the need for polymer conditioning offering even greater savings.



Case Study

application	Beneficial Reuse
location	Central America

A new tailings storage facility (TSF) was constructed to contain tailings and extend the lifetime of a mine located in a steep, mountainous region subject to severe erosion. Geotube® containers were chosen to build debris detention structures within the TSF impoundment in the event of a catastrophic water-related event from high intensity rainfall.

The traditional engineering solution would be to build a gabion wall, however this would require the transport of rock to the site and the removal of sections of the LLDPE liner system. This posed a considerable risk of allowing storm water to get under the lining system leading to erosion, risking future liner failure, and could interrupt mine operations.

Geotube® dewatering and containment technology allowed the mine to use existing on-site materials to fill the Geotube® containers. Coarse mine tailing slurry was pumped into custom fabricated tubes which fit into narrow areas of the TSF channel. Two debris detention structures were constructed with culvert systems underneath to limit the water table behind the stacked Geotube® structure to increase stability.

Case Study

application | **Precious Metals Recovery**

location | **Nevada, USA**

During routine pond liner inspection of this gold mine's barren pond (a pond containing a chemical solution waste from which the gold has been removed) and pregnant pond (a pond containing solution which has percolated through the ore on a heap leach where the solution is impregnated with the gold and silver removed from the ore), it was discovered the sludge had high gold content. Geotube® technology was chosen to contain and dewater the sludge, while capturing the gold ore for reprocessing.

The metals recovery operation involved using a submersible slurry pump to remove the sludge from the barren and pregnant ponds, pumping the sludge over the leach pad to the dewatering cell. The Geotube® containers were placed within the lined heap leach pad drainage channel to capture sediment and gold ore present in the leach pad drainage solution. The sludge was chemically conditioned to aid in capturing suspended solids and released clean filtrate to be used as dilution water for the polymer solution. The Geotube® recovery process allowed the mine to capture the dewatered gold ore for reprocessing prior to the solution being discharged to the combination pregnant/barren solution pond.

Precious Metals Recovery

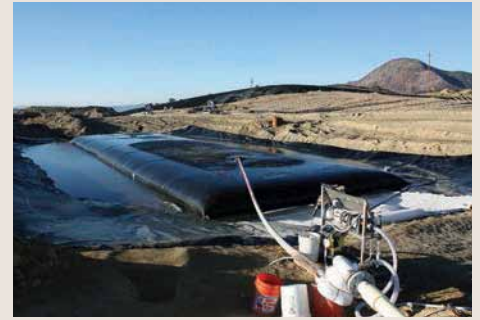
Precious metal recovery through heap leaching is an industrial mining process to extract precious metals, copper, uranium, and other compounds from ore via a series of chemical reactions that absorb specific minerals and then re-separates them after their division from other earth materials. Inherent in this process is the creation of slurries that need to be dewatered.

TenCate Geotube® dewatering and containment technology is well suited for 1) dewatering the waste stream from the precious metals recovery process such as barren solution ponds and 2) capturing of dewatered slurries that still contain precious metals so they can be reintroduced into the ore processing system.

By capturing and containing valuable metals using TenCate Geotube® containers, the expense of treating mine waste can be offset and become a valuable income stream.



Barren and pregnant ponds



Capture of gold ore for reprocessing



Emergency and Disaster Management

When emergency situations or disaster strikes a mining operation, causing disruption of normal tailings management, the economic impact can be severe. Having a simple, proven, effective solution at hand is paramount. Utilizing TenCate Geotube® containment and dewatering technology to allow for continuous operation of mining activities, in a situation when traditional methods are not viable, is often the preferred choice.

Whether it be a natural disaster, a catastrophic event affecting tailing ponds, permit restrictions, interruptions of mechanical dewatering processes, above or underground capacity limitations, or sudden increase in slurry production that strains the existing dewatering facility, TenCate Geotube® containers, in a variety of sizes to fit almost all situations, are readily available to restore tailings operations.



Dewatering of waste slurry



Reclaimed site after dewatering



Case Study

application | Emergencies
location | Alabama, USA

Waste slurry from raw coal processing is normally disposed of via surface impoundments or injection into abandoned underground mine workings.

Due to new regulatory restrictions, available area, and construction scheduling, a coal mine was facing possible interruption of its primary disposal method of underground injection. The daily refuse was estimated at 1.5 million gallons of slurry per day. The mine needed to continue operations, but conventional disposal methods were not possible.

In order to maintain capacity in the surface impoundment and continue operation, the coal mine implemented Geotube® containers to dewater the waste slurry in this emergency situation. An additional benefit of Geotube® technology during this project was the reclamation of land used as the dewatering cells. Once dewatering and consolidation of 200,000 cubic yards was completed, the stacked Geotube® containers were covered and the reclaimed site was prepared for seed and mulch.

Case Study

application | Acid Mine Drainage

location | Pennsylvania, USA

During highway construction for I-99, over 700,000 cubic yards of excavated material was found to contain pyritic rock. Acid runoff from the pyritic rock endangered local streams and groundwater from the drainage of the contaminated materials. The slurry material was concentrated in several holding areas or storage lagoons.

Although other methods of handling the AMD slurry were considered, TenCate Geotube® dewatering technology was selected based on its simplicity of operation, cost, and lower consolidated volume when the material needed transport off-site. The dewatering process using TenCate Geotube® containers was optimized and designed to handle the large volume of runoff, and involved collecting and neutralizing the acid runoff in sediment ponds. Proper chemical conditioning allowed the Geotube® containers to filter the acid runoff (iron oxide) and effluent was collected and used for dilution water for polymer injection.

TenCate Geotube® dewatering technology allowed for dewatering and containment of the acid runoff, thus avoiding the need to stockpile the AMD liquid slurry on-site.

Acid Mine Drainage

During the mining process sulfides can be exposed which, when they come in contact with water and air, can form sulfuric acid. This acid can and often does dissolve other harmful metals and metalloids in the surrounding rock. Acid mine drainage can occur anywhere on the mine where sulfides are exposed to air and water -- including waste rock piles, tailings, open pits, underground tunnels, and leach pads which can endanger local streams and groundwater. This can be a problem at both active and abandoned mines.

The treatment process of an AMD waste with TenCate Geotube® dewatering technology is accomplished through the containment and dewatering of the precipitated solids. The dewatered solids can then be safely and economically disposed in an approved landfill site thus eliminating an environmental problem.



AMD sediment pond



Geotube® dewatering cell



Specialty Applications

The very nature of mining and mineral processing operations are that no two locations are exactly alike. Location, weather, topography, mining conditions, local and state regulations related to water quality and tailings management are but a few of the challenges that operators must face. This requires a dewatering technology that is uniquely flexible to adapt to individual site requirements to meet specific needs.

TenCate Geotube® dewatering and containment technology is a simple, low tech solution ideal for remote or highly industrialized locations. TenCate Geotube® containers can be customized in size and shape to meet almost any need. Whether an individual Geotube® unit is required to fit into an underground gallery, or multiple, large tubes need to be stacked above ground to accommodate large volumes within a specific footprint; whatever the situation, TenCate can customize a dewatering solution right for you



Geotube® Mobile Dewatering System



Geotube® V-bag



Case Study

application	Specialty Applications
location	Quebec, Canada

A gold mine was in search for a unique solution to improve the treatment of mine water containing highly abrasive sediments. Mine water is collected underground in a sump and the solids at the bottom were removed daily by a scoop tram. The abrasive nature of the mine sediments created a high maintenance cost to keep pumps operational.

Custom fabricated Geotube® containers were implemented and sized to fit within existing mine galleries to allow the underground application of a mine water treatment system. Mine water with a high level of TSS was pumped from the sump to a Geotube® treatment system. This dewatering process allowed the mining operation to replace the former slurry pumps with lower maintenance water pumps, and the clear water is reused for mine operations. The Geotube® treatment system replaced a full time scoop tram with driver and after consolidation, the dewatered solids are reintroduced in the ore treatment system. The mine water management costs utilizing Geotube® dewatering technology were reduced by more than 50% when compared to the previous operation.

TenCate develops and produces quality products that increase performance, reduce cost, and deliver measurable results by working with our customers to provide advanced solutions.

TenCate Geosynthetics Asia Sdn Bhd

14 Jalan Sementa 27/91 Seksyen 27
40400 Shah Alam
Selangor Darul Ehsan
Malaysia

Tel: +60 3 5192 8568
Fax: +60 3 5192 8575
Email: info.asia@tencate.com

TenCate Geosynthetics North America

365 South Holland Drive
Pendergrass
Georgia 30567
United States of America

Tel: +1 706 693 2226
Fax: +1 706 693 4400
Email: marketing.info@tencate.com

TenCate Geosynthetics Netherlands bv

Hoge Dijkje 2
P.O. Box 9
7440 AA Nijverdal
The Netherlands

Tel: +31 546 544475
Fax: +31 546 544490
Email: geotube@tencate.com

www.tencategeosynthetics.com



TenCate Geotube® is a registered trademark of Royal Ten Cate. The information contained herein is to the best of our knowledge accurate, but since the circumstances and conditions in which it may be used are beyond our control, we do not accept any liability for any loss or damage, however arising, which results directly or indirectly from use of such information nor do we offer any warranty or immunity against patent infringement.

© 2013 TenCate Geosynthetics Asia Sdn. Bhd. All Rights Reserved.