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Authorized Dealer

TITANTube™

Dewatering Operating Manual

FLINT
Technical Geosolutions

1. Receiving and Storage

All dewatering components delivered must be thoroughly checked for flaws and/or visible damage and with any flaws noted reported to FLINT to determine if the damage can be repaired and to determine the cause of the damage. TITANTube™ containers should be kept in their original packing until ready for use.

The TITANTube™ containers shall be unloaded and stored in accordance with the manufacturer's specifications and industry standard practice. No hooks, tongs, or other sharp instruments should be used for handling TITANTube™ containers and the tube should not be dragged along the ground.

In the transportation and handling of these dewatering containers, extreme care must be exercised to avoid damage such as tears and/or punctures, which can jeopardize the future performance of the equipment and safety of the workers.

All TITANTube™ containers should always be stored in a safe, elevated, location where water cannot accumulate, and protected from conditions that will affect the properties or performance of the container. TITANTube™ containers should never be exposed to extremely high temperatures (in excess of 180º C / 356º F). TITANTube™ containers should be unrolled into position when ready for use.

WARNING!
Do not use a sharp knife or box cutter to cut and remove the TitanTube™ packaging material. Scissors are recommended. Care should be taken so as not to cut or puncture the TitanTube™ unit when removing the packaging.

2. TitanTube™ Dewatering Technology Site Preparation

Before the installation of the TITANTube™ container, the site should be prepared as follows:

Inspect the area where the TITANTube™ dewatering cell will be constructed. The site must be level in all directions and all obstructions that could damage the TITANTube™ containers (such as roots and projecting stones) should be removed.

A trench should be constructed inside the perimeter of the cell to control the flow of the effluent away from the TITANTube™ container to a sump or a gravity discharge location (flume).

A perimeter containment berm should be built around the cell in order to contain potential release of sludge or effluent into the surrounding environment.

After the base of the cell is leveled, the TitanTube™ impermeable membrane should be installed over the entire floor of the cell, the berm, and embedded in the surrounding soil outside the berm. This membrane should further limit effluent and other fluids from leaking into the ground.

NOTE!
As an option, if the terrain is already leveled, the exterior berm could be constructed using sand bags, concrete highway barriers, railroad crossties, or hay bales.

After the TitanTube™ membrane has been installed, a Flint non-woven textile may be installed over the entire surface to protect the membrane against heavy machinery traffic.

Additionally, the floor of the cell may be covered with some type of drainage media such as a layer of drainage stone or a drainage net in order to improve the flow of the effluent from underneath TitanTube™ container to the interior trench.

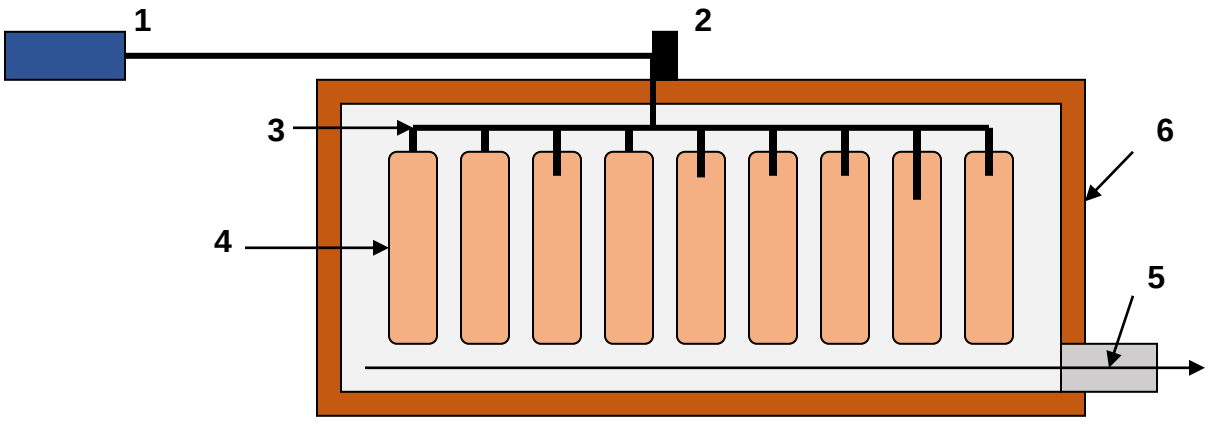
Other dewatering cell constructions have been used successfully. These include drying beds and concrete or asphalt slabs. Contact Flint for more detains on these constructions if you believe they are more appropriate for your project.

3. TitanTube™ Deployment and Connection Details

Once the drainage media has been installed, the site is ready for the TitanTube™ unit deployment. Measure the width of the TitanTube™ dewatering cell and mark the location of the center of each TitanTube™ unit. Position the first TitanTube™ unit such that the center of the TitanTube™ roll is centered at the designated mark.

WARNING!
The loops that are attached to the ends and sides of the TitanTube™ unit are to be used for unrolling and positioning the unit during deployment and to secure the unit before filling. These loops are not to be used to support, secure, or anchor the TitanTube™ container during the filling operation.

NOTE!
To prevent the unrolled TitanTube™ unit from being blown about by a strong wind, sand bags or the loops can be used to temporarily secure the unit until the start of the filling operation. As soon as the filling starts, the sand bags should be removed and the loops secured.



1 – Dredge 2 – Polymer System 3 – Manifold 4 – Tube
5 – Discharge Flume 6 - Berm

Small TitanTube™ containers (less than 45' circumference) can easily be unrolled by two workers. Straps and square tubing for unrolling large TitanTube™ containers (45' circumference

and greater) are installed at the factory. These can be attached to a piece of machinery to aid in transporting or deploying the container.

Discharge lines coming from a dredge or pump should be sized so that the flow inside of the line is at a velocity to keep the pipe full and prevent settlement of solids. Four inch (4") lines are generally used for a small diameter TitanTube™ unit while 6" to 8" lines are generally used on TitanTube™ units 45' and greater in circumference. The lines should be laid straight whenever possible and have few elbows and T's to prevent clogging inside the discharge line. All connections should be equal to the diameter of the discharge line. The pressure in the discharge line should not exceed 6 psi when the flow is going into the one or multiple TitanTube™ units.

Polymers are recommended on most TitanTube™ dewatering applications not involving high percentages of sand in order to facilitate rapid dewatering, to improve effluent quality, and to achieve higher dewatered solids. They can be generally classified in two categories, coagulants and flocculants, and can be injected inline and mixed by a number of methods. The polymer should be injected into the discharge line as close to the TitanTube™ unit as possible, but at a distance to insure that the polymer is thoroughly mixed into the sludge to allow for the formation of a floc. One recommended method of creating the inline mixing is to inject the polymer into the discharge line and allow the mixture to go through a series of elbows creating an “S” shape. After the inline mixing, a sample port on the line to the TitanTube™ units should be installed from which to periodically take samples. The samples should be examined to insure that proper polymer mixing is occurring and that the proper dosage is being injected.

Note!
In many cases, it is recommended that a return line be installed before the sludge goes into the TitanTube™ unit. This line can divert sludge to a reserve TitanTube™ unit or be returned to the source to insure that proper polymer dosage is being well mixed and a proper floc is being formed before the mixed slurry is injected into the TitanTube™ unit. This prevents improperly flocculated sludge from being pumped into the TitanTube™ containers.

When multiple TitanTube™ units are deployed on a project at one time, a manifold system may be used to distribute the sludge to fill one unit at a time or multiple units at a time. The manifold should be constructed using either “T’s” or “Y’s” fittings and valves.

To control the filling of one or multiple tubes at a time, pinch valves are recommended to be installed on a flexible line between the fitting at the manifold and the line connected to the fill port. Gate valves or ball valves can also be used, but the preferred valve is the pinch valve. As one TitanTube™ unit is filled, the pinch valve for the next TitanTube™ container can be opened and the pinch valve for the first TitanTube™ unit can be closed completely, or partially closed to maintain a flow into this unit that balances the inflow to the dewatering rate of the TitanTube™ unit.

4. Polymer and Conditioner Systems

As detailed in section 3, polymers are essential for most projects to achieve optimal dewatering efficiencies and economics. Polymers come in two forms, emulsions and dry formula. Both formulas must be mixed and diluted into a low concentration before being injected into the sludge slurry. Below are the details of the methodologies that can be employed to dilute and inject the polymers to achieve the optimal dewatered results with TitanTube™ Dewatering System.

One polymer system that has been used successively is the Direct System. With this system, neat emulsion polymer is pumped direct from the container and metered into a water stream and inverted in an inline static mixer. From the static mixer, the inverted polymer is injected into the discharge line at the point before the inline mixer.

Another successively utilized polymer system is when the neat emulsion or dry polymer is "Made Down" diluted and mixed with water and inverted in a tank or series of tanks. After being inverted in the tank, the polymer solution is pumped and injected into the discharge line at the point before the inline mixer.

Aging is a term that refers to the time allowed for the polymer to fully invert after being diluted in water and before it is injected into the sludge slurry stream. In either system, again of the polymer is important and will sometimes improve the performance of the polymer to create a tight flocculation of the sludge. Contact your polymer supplier for the recommended aging time.

Before the start up of the project, create a start up and daily checklist to follow throughout the operation. A thorough check for leaks in the piping and connections should be made. Verify the working condition of the pumping system, the polymer mixing system, and the injection system for acceptable performance. Inspect the site to insure that there are no abnormal situations and that all safety precautions are in place to avoid accidents. If everything is considered to be working as planned, the equipment can be put in operation.

WARNING! Verify the maximum filling height for each size of a TitanTube™ unit. This is printed on a tag attached to each tube. Install a spring line set to the design height of the TitanTube™ unit above the unit. Do not exceed this fill height.

START UP & DAILY CHECK LIST

1). Prepare the polymer injection system. If the polymer make down method is being used, be sure that an adequate volume of polymer has been inverted, aged, and prepared for pumping.

2). Start up the sludge pumping system and insure that it is working properly. Circulate the pumped sludge through the piping system and re-circulate the Sludge back into the source through the return line.

NOTE: *In some projects, a return source is not allowed. In this case, it is recommended that a small TitanTube® unit be used to receive the first flow of material until the polymer has been adjusted to an acceptable performance as detailed in the two following steps.)*

3). Start the injection of the polymer into the flowing sludge and take samples at the sample port to insure proper mixing and the formation of the desired floc.

4). Once the proper polymer mixing and flocculation has been achieved, open the valve to the first TitanTube™ unit and close the valve on the return line.

5). Fill the first TitanTube™ unit up to the re commended fill height for the specific TitanTube™ circumference.

6). Once a TitanTube™ unit has been filled to the recommended fill height, the

flow to this unit should be closed or adjusted to match the discharge rate of the effluent to maintain this unit at a level that does not exceed the recommended fill height.

7). Open the valve to the next TitanTube™ unit and begin the filling process. Repeat steps 5 and 6 until all of the first layer of TitanTube™ units have been filled. Units can be filed multiple times until the recommended is filled with fully dewatered material.

5. Container Stacking

On Many projects with large volumes of sludge to dewater and/or with a limited footprint to build the dewatering cell, it is desirable to stack TitanTube™units in layers. TitanTube™ container stacking requires the owner, engineer, and the operator to consider issues that will be a challenge with stacking, and to follow steps that contribute to a safe and successful operation.

The lower layer of TitanTube™ units must be completely filled and dewatered sufficiently to support the next layer. This also applies for all subsequent layers. All units on a supporting layer must be dewatered to the same level.

The "V-Notch" or void space between each TitanTube™ unit must be filled with suitable material, such as hay bales, to level the surface before the next layer of TitanTube™ units can be placed or “nested”, and to prevent the next layer from collapsing into the space between the lower TitanTube™ units.

. Each subsequent layer must be centered directly over the "V-Notch" of the lower layer of TitanTube™ containers.

Each subsequent layer must be a minimum of 16 feet shorter than the lower layer and centered on the lower layer, so that each end is positioned a minimum of 8 feet in from the ends of the lower layer.

When filling each layer, any individual TitanTube™ unit must not exceed the recommended filling height. The maximum height must be measured from the lowest point of a TitanTube™ unit to the maximum upper surface of the unit.

The outer TitanTube™ unit on any stacked layer must not be placed any closer to the edge of the stack than the second "V-Notch" from the outer edge.

***NOTE!**: When stacking tubes, the following should be considered:*

1). TitanTube™ unit's dimensions (offset from lower tier)
2). Layers of TitanTube™ units
3). Site stability
4). TitanTube™ manifold feed system
5). Dewatering time between layers (solids percentage of preceding layer)
6). Placement of second and subsequent layers
7). Effluent flow and control
8). Solids removal

6. Maintenance

For a TitanTube™ dewatering project to perform at an optimum level, routine preventative maintenance should be performed. The most usual type of maintenance is to clean the TitanTube™ unit surface. A power or push broom can be utilized during the filling operation. This will insure solids that may seep through the pores of the TitanTube™ engineered textile during filling will be removed to prevent any solids build up that may dry and potentially clog the pores.

Another method of maintenance is to use a high pressure water spry to remove dried solids that were not removed by sweeping, or to remove fungi that may build up over time. Care should be taken to ensure that the nozzle of the water sprayer is at a sufficient distance so that the high pressure water does not damage the TitanTube™ unit surface, but still removes the dried material.

Also, clogging or low flow of effluent may occur due to the formation of a filter cake on the inside surface of the TitanTube™ unit. To break up the filter cake, a push-behind vibrator plate can be moved over the top surface of the TitanTube™ unit. Care should be taken to keep the vibrator plate moving at all times when in operation to prevent localized abrasion. A pipe may also be used to tap the surface of the unit to break up the filter cake.

NOTE! Clogging can be caused by improper application and dosing of the flocculating agent.

From time to time, a TitanTube™ unit may be damaged in operation and a small hole may be created in the surface of TitanTube™ textile. Two repair methods are included in this guide.

A. Foam Method - For small holes up to 2"

1). Insert a tube sock into the hole in the TitanTube™ unit surface so that the closed end and approximately 1/2 of the sock is inside the hole. The open end of the sock and the remainder of its length should remain outside the TitanTube™ unit.

2). Insert the nozzle extension of a construction foam aerosol can inside the sock, as far inside the TitanTube™ unit as possible.

3). Using a rubber band, secure the open end of the tube sock to the nozzle extension.

4). While holding the nozzle extension to prevent is from backing out of the Tube sock while filling, fill the sock with construction foam. Fill the portion inside the TitanTube™ unit first, then the portion outside the unit.

5). Remove the aerosol can from the extension nozzle and allow the foam to harden. The process should close the hole and prevent leakage.

B. Plywood Method - For holes between 2” to 24"

1). Measure the hole and cut two equal, generally rectangle pieces from 1/2" plywood. The narrow dimension should be equal to the widest part of the hole. The long dimension should be equal to twice the widest part of the

hole.

2). Insert one of the plywood rectangles through the hole by the narrow dimension and rotate the plywood 90° so that it is centered under the hole.

3). Apply a construction adhesive to the upper surface of the plywood rectangle positioned inside of the TitanTube™ container so that the entire surface is sufficiently covered.

4). Apply equal amounts of construction adhesive to the other plywood rectangle and position it on the outside surface of the TitanTube™ container directly over the top of the inside plywood rectangle.

5). Press down on the plywood sandwich so the adhesive oozes through the TitanTube™ textile pores.

6). Secure the plywood sandwich together with 1/2" long wood screws in rows parallel 2" apart on 1" spaces over the entire surface of the plywood patch. When the adhesive dries, the patch should be secure.

7. Disposal

Once the dewatered material has reached the desired percent solids and where removal to an approved landfill is the chosen method of disposal, cut open the top of the TitanTube™ units with a box cutter and fold back the textile. Using a front end loader or excavator, load the dewatered material into a dump truck that can transport the material to the landfill. Care should be taken to insure that the dewatered material passes the paint filter test as this is necessary for the dewatered material to be placed in an approved landfill.

Should the dewatered material be slated for onsite disposal, remove the piping and all TitanTube™ system related equipment and cover the bags with soil grade the site. Often, an impermeable membrane cap may be required prior to spreading of topsoil, depending on the classification of the dewatered material. Once covered, seed or landscape as needed to reclaim the land.

Provide boundary markers and a permanent information panel for the property stating (as a minimum): identification of the TitanTube™ container, start and end of the operation dates, and nature of the dewatered material.

All analyses of the material must be kept by the owner for future inspection by environmental authorities.

8. Tests

There are two tests to assist the operator or chemical supplier in evaluating candidate chemical regimens:

1. Bench Test
2. Hanging Bag Test

These tests allow the operator to do the following:

- Visualize the dewatering process
- Evaluate the efficiency of the selected polymer
- Analyze the clarity of the effluent
- Predict achievable percent solids after dewatering in TitanTube™ units
- Estimate the time of the dewatering cycle.
- Analyze the quality of effluent water.

9. General Safety Issues

Be sure to read the entire TitanTube™ Operating Procedures Manual and follow the site preparation recommendations. All workers should undergo instruction on this safety section and visitors need to be accompanied by a site-approved, safety knowledgeable person.

All TitanTube™ containers are slippery due to filtrate coming through the fabric and possible surface deposits due to filtration.

Many installations contain contaminated material, check with site personnel for proper safety requirements when around TitanTube™ containers, filtrate, and sludge.

The TitanTube™ container unloading needs to be performed using lifting straps rated for the proper weight of the container. Do not use forks. The placement of units for storage need to be in secure location out of traffic flow areas. Position TitanTube™ units on flat, level surface within the dewatering cell using the unrolling straps contained in the TitanTube™ package.

Take care to not fill units over the manufacturer's maximum fill height and do not go on top of units if maximum fill heights have been exceeded. Be aware that TitanTube™ containers that are being filled, or are dewatering, will be wet and slippery. Caution should be exercised.

There are several safe ways to get on top of the TitanTube™ containers. All methods need to make sure that the item being placed on the unit has no sharp edges or they are covered. Such methods are ladders, man lifts and catwalks.

Access to units next to each other can be accomplished by placement of catwalks between the units, bales of hay filling the gap, or going to the ground and back up other unit via an appropriate system.

If the TitanTube™ container is supplied with a “shirt-sleeve” port, ensure That all fill ports are tied shut. If a fill port is temporarily left open, place a

safety cone next to it so individuals are aware of the hazard.

Extra precaution is needed near ends and sides of units that are Sloped, so stay on the level portion. Small flags may be inserted to warn personnel of slope at sides or the end. Safety cones can also be placed at the beginning of the slope (usually 15 ft. from end at seam), so personnel can take extra precaution due to the slippery nature of dewatering units.

Workers should always wear safety equipment specified by OSHA, the property owner, and/or the contractor. Do not war footwear that has cleats, spikes, or sharp objects on the soles as it will damage the tube.

WARNING! : This involves releases such as when a puncture, hole, or rupture occurs.

1). Ensure all personnel are present and accounted for.
2). If solids are on any personnel, follow site cleaning requirements based on type of solids.
3). Contain escaped solids. If large volume is present, place absorbent material (such as hay bales) around and over released solids.
4). Notify appropriate personnel as required by site and regulator personnel.
5). Repair if needed, following procedure in the Repair Guide of this manual.

10. TitanTube Construction

All TitanTube™ containers are fabricated from a specially engineered dewatering three-dimensional textile manufactured from high tenacity polypropylene or polyester yarns, which are woven into a stable network such that the yarns retain their relative position. The TitanTube™ container material is inert to biological degradation and resistant to naturally encountered chemicals, alkalis, and acids.

The TitanTube™ container is fabricated by sewing together widths of the woven engineered textile to form a tubular shape. The seams shall be parallel stitch lines sewn with a “locking” chain stitch and the thread shall be multi-ply polyester filament yarn.

The TitanTube™ should demonstrate a circumferential “Operating Strength” of 400ppi and an axial “Operating Strength” of 300ppi. An maximum AOS of 40 US sieve and flow rate of 27 gpm is provided for superior dewatering.