

CST INDUSTRIES, INC.

# BIOENERGY

storage solutions



The Complete Storage Solutions Provider  
for Anaerobic Digester Applications

Meeting the Increasing Demand for Renewable Energy Worldwide

When you need components and options for state-of-the-art BioEnergy Storage Solutions, turn to CST Industries, Inc. CST Industries (CST) is a global leader in the manufacture and erection of the finest factory coated steel storage tanks, aluminum domes and specialty covers.

CST has been designing and manufacturing digester storage tanks and covers for more than 100 years and has over 275,000 installations in more than 135 countries around the world.

Now, CST introduces BioEnergy Storage Solutions, a complete line of tanks, steel roofs, aluminum domes and flexible membrane covers for digester construction.

Our world-wide resources provide personalized service to meet our customers' needs. These include design and engineering, construction, customer service and support. CST works closely with BioEnergy customers to construct best-of-class, ultra-low maintenance digester storage structures that provide longevity and a rapid customer return on investment.



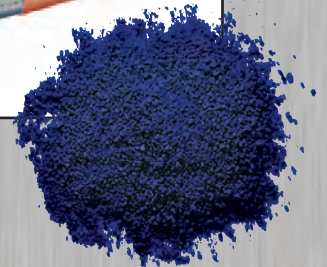
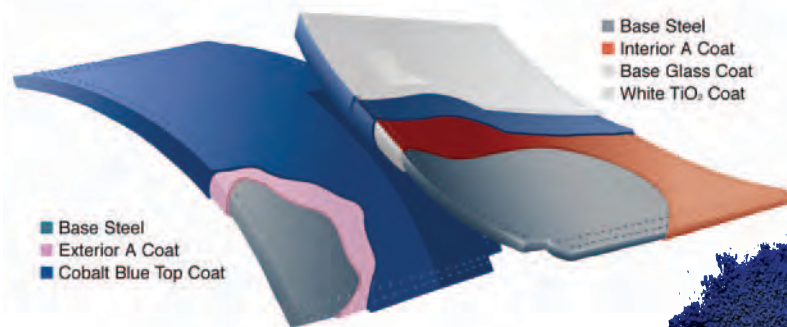
## Coating Technologies for BioEnergy Storage Solutions Tanks

CST provides its customers with the data and information they need to make the right coating technology decision for their application. The only company that designs and manufactures multiple state-of-the-art coating technologies, CST provides our customers options in selecting which coating technology is best for each application – unlike companies with only one technology to offer.

### Glass-Fused-To-Steel

CST Vitrium™ glass-fused-to-steel technology is the premium coating in the digester tank market. It is a single, strong, integrated glass and steel material fused together at 1,500°F (816°C) in a controlled process furnace. The physical properties of Vitrium, featured in Aquastore® tanks, are specially suited for digester applications. The hard, inert barrier on both the interior and exterior tank surfaces guards against corrosion. Impermeable to liquids and vapors, it controls undercutting caused by corrosion and offers excellent impact and abrasion resistance.

#### Physical Properties - CST Glass-Fused-to-Steel Vitrium Technology



CST Vitrium technology combines the outstanding chemical and physical resistant properties of titanium dioxide-enhanced (TiO<sub>2</sub>) glass with a highly engineered, ultra-fine glass bubble structure for durability and flexibility. Our glass-fused-to-steel coatings range from 7-15 mils (175-380 microns) on the exterior and 10-18 (260-460 microns) on the interior. Interior sidewalls are tested to be holiday free using 1,100 volt dry testing method that exceeds the industry standard low voltage wet sponge testing method.

BioEnergy Storage Solutions tanks made with glass-fused-to-steel outperform other digester tanks, making them the best choice to contain the aggressive liquids found in today's BioEnergy facilities. CST Vitrium glass-fused-to-steel technology meets or exceeds all of the standards outlined in ISO 28765 – The design of bolted steel tanks for the storage or treatment of water or municipal or industrial effluents and sludges.

### Anaerobic Digester Tank Design

| ITEM                          | TYPICAL                 | OPTIONAL                             |
|-------------------------------|-------------------------|--------------------------------------|
| Diameter/Height Ratio         | 1.0:1.0/1.2             | 1.0:1.0 thru 7.0:1.0                 |
| Pressure                      | 5-37 mbar (2"-15" WC)   | Up to 60 mbar (24" WC)               |
| Vacuum                        | 2.5-7.5 mbar (1"-3" WC) | Up to 20 mbar (8" WC)                |
| Specific Gravity              | 1.05                    | Up to 1.8                            |
| Temperature                   | (35°-40°C) 95°-105°F    | (60°C) 140°F                         |
| External Supported Roof Slope | 15°                     | 10°-20°                              |
| Mixers                        | Top Mount/Sidewall      | Jet Mix / Liquid Recirculation / Gas |
| Baffles                       | Yes                     | Yes                                  |
| Ladder, Walkways, Platforms   | Standard-Straight       | Wrap Around                          |
| Concrete Floor                | Flat                    | Conical                              |
| Steel Floor                   | Flat                    | Glass/Epoxy                          |

**AQUASTORE®**



Glass is fused to steel at 1500°F (816°C) in a state of the art furnace.



## OptiBond™ Epoxy Coating System



Our proprietary OptiBond™ Epoxy Coating System, featured in HydroTec™ tanks, provides excellent corrosion resistance and long tank life for the finest epoxy coating available in the liquid tank industry. In the process, parts are degreased and rinsed, hot air dried and pre-heated at an optimum temperature.

Part surfaces are then blasted with engineered grit material. This creates a rugged 3-D surface topography ideally suited for better powder coating adherence, increased durability and long-term coating performance. Then they are powder coated in a proprietary electrostatic booth with precise environmental controls, and cured at a tightly regulated temperature to maximize the cross-link bonding of the epoxy materials.

A uniquely engineered polyurethane topcoat is applied on exterior surfaces. This provides added UV protection and extends the coating life in tough outdoor conditions. A final curing stage through the oven is the last step in the OptiBond Epoxy Coating System before our stringent quality control inspection – a high voltage defect testing procedure to identify any holidays, inclusions and thin areas in the coating.



## Hybrid Tanks and Other Options

The unique design of CST's bolted tanks easily adapts for hybrid tank designs that utilize the strengths of multiple state-of-the-art coating systems. We can design tanks with different coating systems for the gas and liquid zones of a digester that create a unique storage solution that cannot be accommodated by concrete or field welded designs. CST also offers tanks constructed of stainless steel and uncoated steel when design specifications demand these options.



## Component Comparison

| PANEL TYPE                        | DIGESTER ZONE | DESCRIPTION   |
|-----------------------------------|---------------|---|
| Vitrium™<br>Glass-Fused-to-Steel  | Liquid<br>Gas | - High Specification 3-coat Glass Coating<br>- Exceptional Performance<br>- Low Maintenance<br>- Sidewall, Covers, Floors |
| OptiBond™ Epoxy<br>Coating System | Liquid<br>Gas | - Proprietary Thermoset Coating<br>- High Performance<br>- Sidewall, Covers, Floors, Manway,<br>Flanges, Baffles          |
| Stainless Steel                   | Liquid<br>Gas | - Grade 316 or 304<br>- Excellent Resistance Gas Zone<br>- Sidewall, Covers, Manway, Flanges, Baffles                     |
| Uncoated Steel                    | Liquid        | - Can be used as sidewall in non-corrosive liquid zones   |

## Bolted Tank Technology

Bolted Tank Technology offered in CST BioEnergy Storage Solutions tanks have numerous advantages over competitive tanks.

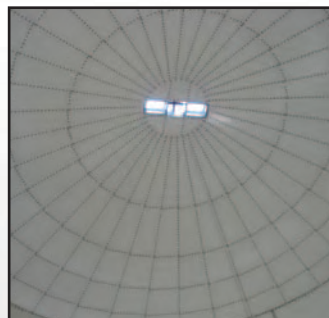
- All tank parts are factory coated for maximum protection and are easily transported to the job site.
- Bolted tanks can be erected in 1/3 of the time required to build a field-welded or concrete tank on-site.
- Tanks can be assembled in even the most remote sites, without large staging areas, and in every season of the year.
- Bolted tank construction is very conservation-friendly with little disturbance to the surrounding environment.
- CST bolted tanks are factory coated, so there is no in-field painting required which can expose the environment to harmful silica from sand blasting or paint overspray.
- Tanks are assembled at ground level using a unique jacking system that progressively elevates the structure to install the panels without the need for expensive cranes or staged scaffolding.

## Choose Between Floor Options

CST understands the complexity that can exist when providing floor designs for digester tanks. That is why we offer options for our customers depending on their digester need. The customer can select from Coated Steel (Vitrium Glass or OptiBond Epoxy Coating System), or reinforced concrete. Concrete digester floors can vary from flat up to a 45° conical shape. Utilizing our worldwide regional offices we can work with the customer to provide the most economical floor design and installation that is required for the project.

## Accessories – Optional Equipment:

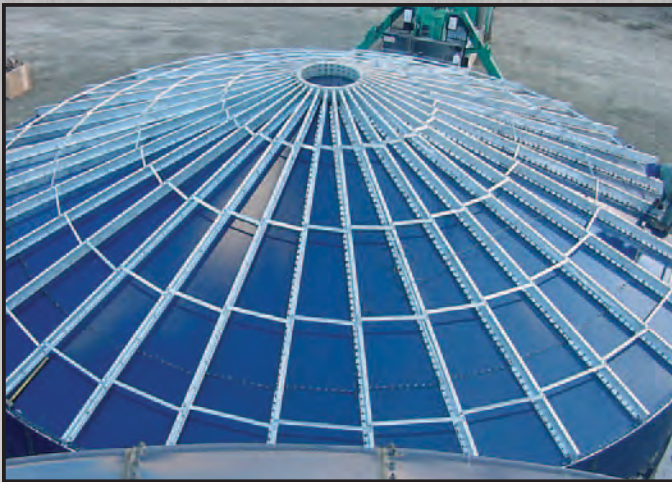
- Nozzles
- Baffles
- Site glasses
- Roof walkways and railings
- Caged ladders and platforms
- Cross walks
- Sidewall manway ports
- Insulation
- Passive & active cathodic protection





## Multiple Tank Cover Options

BioEnergy Storage Solutions from CST include the industry's best cover options for digester applications. The gas zone of a digester is the most corrosive area and requires appropriate design. Along with this corrosiveness, there are many other factors (environmental, mixer loads, pressure, vacuums, ancillary equipment loads, etc.) that need to be considered in cover selection. CST can design and engineer the right solution from the multiple cover types in its portfolio.



### ESR – Externally Supported Roof:

The most common roof design in the industry with a smooth internal roof surface and no rafters. Used when moderate to high pressure or vacuum design limits are anticipated. It is also preferred when there are heavy load conditions expected from mixers and/or other ancillary equipment is installed in the cover. Roof panels can be designed with Vitrium glass-fused-to-steel coating, OptiBond Epoxy Coating System or stainless steel.

### PD - Pressure Dome:

Geodesic dome design can be utilized in moderate pressure and vacuum designs and can accommodate light load conditions. All-aluminum design is lightweight, free-span and resists corrosion better than many other alloys.



### KR - Knuckle Roof:

An option for smaller diameter storage tanks, a knuckle roof is best suited for lighter pressure and vacuum applications with no load bearing requirements. Fabricated from stainless steel to provide excellent gas zone longevity.



### GSM - GeoFrame Supported Membrane Cover:

Unique proprietary design incorporating a geodesic aluminum strut support frame that provides a clear-span, obstruction-free cover which removes the need for center post and strap designs to support the membrane. Can be used in single and dual membrane configurations for low-medium pressure applications.



### DMF - Dual Membrane - Foil Covers:

Designed to operate in applications with low to moderate gas pressures where there is not a design requirement for a fixed steel or aluminum cover. Multiple layers and optional center support structures are utilized depending on design considerations.

## Roof and Membrane Options and Specifications

| Roof Type                               | Max. Design Pressure | Max. Design Vacuum | Max. Diameter        | External Loads   | Coatings/ Material            |
|---|----------------------|--------------------|----------------------|--|-------------------------------|
| ESR - External Supported Roof           | 45 mbar<br>18" WC    | 5 mbar<br>2" WC    | 28 (m)<br>92 (ft)    | Accommodate heavy loads (including roof mounted mixers)            | Glass, Stainless Steel, Epoxy |
| PD - Pressure Dome                      | 60 mbar<br>24" WC    | 15 mbar<br>6" WC   | 36.6 (m)<br>120 (ft) | Accommodate medium to light loads (other than roof mounted mixers) | Aluminum                      |
| KR - Knuckle Roof                       | 20 mbar<br>8" WC     | 5 mbar<br>2" WC    | 9.5 (m)<br>31 (ft)   | Limited  | Stainless Steel               |
| GSM - GeoFrame Supported Membrane Cover | 10 mbar<br>4" WC     | 5 mbar<br>2" WC    | 30.8 (m)<br>101 (ft) | None   | EPDM                          |
| DMF - Dual Membrane - Foil Covers       | 10 mbar<br>4" WC     | 5 mbar<br>2" WC    | 36.6 (m)<br>120 (ft) | None   | Various Polymers              |

Note: Higher pressure dual membrane foil covers (DMF) and higher pressure/vacuum external supported roofs( ESR) need to be reviewed as special requests.



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## The Complete Storage Solutions Provider for Anaerobic Digester Applications

Meeting the Increasing Demand for Renewable Energy Worldwide

### Worldwide Network of Support

Bid and quotation services for BioEnergy Storage Solutions are available worldwide. Factory-Trained Builders are located on every continent, providing construction and after-installation services.



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