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DESIGN, FABRICATION, AND ON-SITE ASSEMBLY OF A 350,000 GALLON FIBERGLASS POTABLE WATER TANK

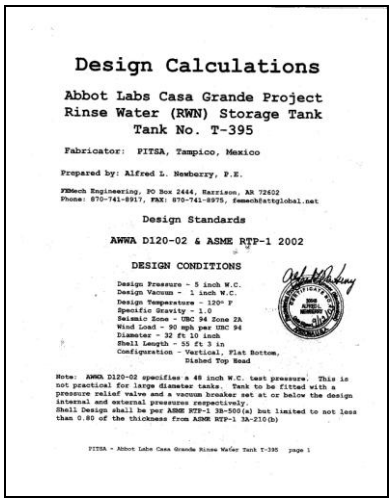
In August of 2003, Plasticos Industriales of Tampico, S.A. (PITSA) was contracted by Abbott Laboratories of Casa Grande, Arizona, to design and fabricate a 350,000 gallon capacity fiberglass rinse water tank that would be capable of handling over 1,000,000 gallons of potable water daily. Because of the size of the vessel (32'10"Ø x 55'3" side) wall in a seismic zone 2A and the requirement for the vessel to meet ASME RTP-1 and AWWA D120-02 design standards, detailed design calculations were required. The vessel also had to comply with FDA regulation 21CFR177.2420. The decision to use fiberglass as opposed to other construction materials was based on the understanding that the complete vessel would be made of non-corrosive materials, FDA-approved materials, and there would be no potential of contamination by rust as would be the case in coated mild steel vessels. The cost of a fiberglass vessel was less than that of a stainless steel vessel while still providing the FDA compliance required.

PITSA has been building industrial fiberglass equipment since 1965 and had built many large fiberglass vessels with capacities of up to 240,000 gallons, as well as many vessels for food grade service. However, fabricating this large of a vessel in sections in Tampico, Mexico, 1,500 miles from the job site, and assembling the vessel in Casa Grande, Arizona was a new challenge. The standard procedure used by PITSA for large diameter vessels is to oblate the walls so that they could be shipped over the highways, and ship the top and bottom in sections for field bonding.

The first step was to select a resin system that would provide both the FDA compliance, as well as be flexible enough to withstand the compression of the rings for shipping as well as the constant demands of processing 1,000,000 gallons a day. PITSA has always been conservative in its equipment design and decided on using an FDA-approved vinyl ester resin in the corrosion barrier (Dow Derakane 411), and an FDA-approved isophthalic polyester resin in the structural layers (Owen Corning 737).

Once the resin was selected, detailed engineering was prepared by Al Newberry of FEMech Engineering who specializes in composite design, is on the ASME RTP-1 design committee, and who provided stamped design calculations for the vessel fabrication, assembly, and post cure procedures. Mr. Newberry was also contracted to provide in-plant and on-site third-party

inspection to ensure that all fabrication and assembly was carried out in accordance with the design calculations. Based on the design calculations AutoCad drawings were prepared and approved, and production was begun.



Design Calculations

Abbot Labs Casa Grande Project
Rinse Water (RWN) Storage Tank
Tank No. T-395

Fabricator: PITSA, Tampico, Mexico

Prepared by: Alfred L. Newberry, P.E.

FEMech Engineering, PO Box 2444, Harrison, AR 72602
Phone: 870-741-8917, FAX: 870-741-8975, femech@attglobal.net

Design Standards

AWWA D120-02 & ASME RTP-1 2002

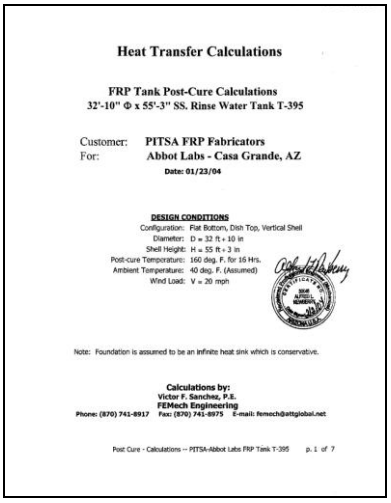
DESIGN CONDITIONS

Design Pressure - 5 inch W.C.
Design Vacuum - 1 inch W.C.
Design Temperature - 120° F
Specific Gravity - 1.0
Seismic Zone - UBC 94 Zone 2A
Wind Load - 90 mph per UBC 94
Diameter - 32 ft 10 inch
Shell Length - 55 ft 3 in
Configuration - Vertical, Flat Bottom, Dished Top Head

Note: AWWA D120-02 specifies a 48 inch W.C. test pressure. This is not practical for large diameter tanks. Tank to be fitted with a pressure relief valve and a vacuum breaker set at or below the design internal and external pressures respectively. Shell Design shall be per ASME RTP-1 3B-500(a) but limited to not less than 0.80 of the thickness from ASME RTP-1 3A-210(b)

PITSA - Abbot Labs Casa Grande Rinse Water Tank T-395 page 1

Stamped Design Calculations



Heat Transfer Calculations

FRP Tank Post-Cure Calculations
32'-10" Φ x 55'-3" SS. Rinse Water Tank T-395

Customer: PITSA FRP Fabricators
For: Abbot Labs - Casa Grande, AZ
Date: 01/23/04

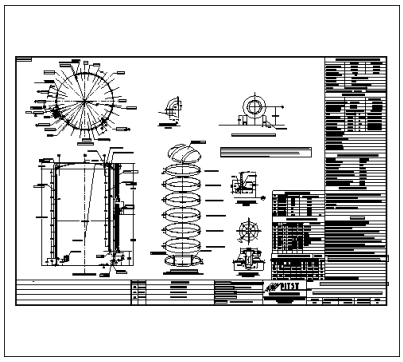
DESIGN CONDITIONS
Configuration: Flat Bottom, Dish Top, Vertical Shell
Diameter: D = 32 ft + 10 in
Shell Height: H = 55 ft + 3 in
Post-cure Temperature: 160 deg. F. for 16 Hrs.
Ambient Temperature: 40 deg. F. (Assumed)
Wind Load: V = 20 mph

Note: Foundation is assumed to be an infinite heat sink which is conservative.

Calculations by:
Victor F. Sanchez, P.E.
FEMech Engineering
Phone: (870) 741-8917 Fax: (870) 741-8975 E-mail: femech@attglobal.net

Post Cure - Calculations -- PITSA-Abbot Labs FRP Tank T-395 p. 1 of 7

Stamped Steam Cure Calculations



AutoCad Drawings

One of the advantages of fiberglass is that material thicknesses can be varied based on the loading required. Since higher stresses are seen toward the bottom wall of the tank and around vessel penetrations, the wall thickness started at 2.11" at the bottom knuckle and tapered down to .39" at the top of the vessel wall. All tie down, fabrication, and field assembly calculations were prepared based on the seismic loading requirements in conjunction with the ASME RTP-1 and AWWA D120-02 standards.

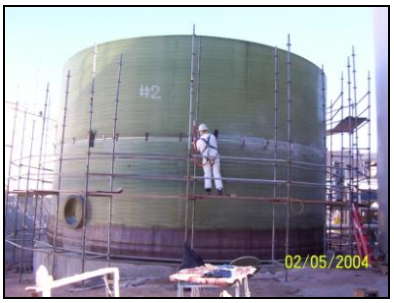
Shop fabrication of floor and wall sections of 350,000 gallon FRP tank

As the vessel sections were completed at the plant, the sections were post-cured with dry heat at 200°F for two hours. Final steam cure of the completed vessel would be performed on site. Extensive testing of raw materials was carried out, and records were maintained of all raw materials and in process fabrication inspections in accordance with ASME RTP-1 standards.

Walls are oblated and the vessel sections are shipped to Casa Grande, Arizona

Once the sections were offloaded, the process of field assembly was begun by C&E Industrial Services out of El Paso, Texas under the supervision of PITSA personnel. With the bottom knuckle being 2.11" thick and the bond between the bottom knuckle and the first wall section being 2.4" thick, bonding of the vessel sections was time consuming. Care had to be taken to ensure that there was no air entrapment in the layers, and that the laminates were allowed to exotherm slowly to avoid damage to the bond.

Bottom knuckle

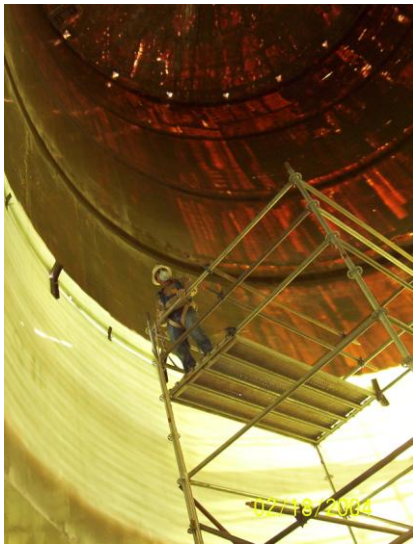


Assembly of lower sections

Setting top section with handrail

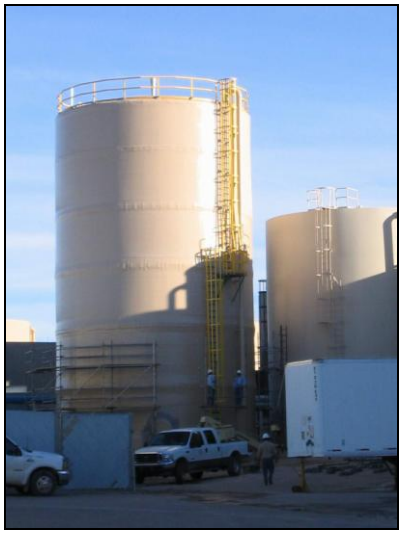
As the exterior bonds were being made and rings assembled, the internal corrosion barrier at the seams was also applied and inspected.

Setting upper sections on lower sections



Interior seams applied & inspected

When the lamination was complete, the walls were washed with a high pressure washer, and a final inspection of the laminates and accessories was carried out. The next step was to perform the final steam cure which required raising the interior temperature of the vessel to a minimum of 160°F for a period of 16 hours using high pressure steam. With a vessel of this size, special steam distributors needed to be constructed, with care to ensure the safety of personnel carrying out the post cure.



Completed 350,000 gallon tank

Checking temperature during steam cure

16 hour steam cure at 160-180°F

Throughout the project, PITSA had two dedicated quality control inspectors on-site to oversee the preparation of materials, wet out of the laminates, assembly of the sections, locations of accessories, bonding of the seams, final steam cure procedures, and the hydro test. Upon completion, water samples were sent to an independent laboratory for testing to ensure that there were no contaminants that might affect the quality of the water. Because of the care that had been taken during the fabrication and post cure procedures, the results came back with no detectable contaminants and the tank was put into service.

If you have any questions about the project or the products and services offered by Plasticos Industriales de Tampico (PITSA) please do not hesitate to contact Roger Beman at rbeman@pitsausa.com.