

**LDS Church Camp Concrete Storage Tank
50% Report
Project ID: CEEEn_2017CPST_012**

by

**Genesis Engineering
Jeremy Fowler
Seth Richardson
Michael Reynolds
Kyler Ashby**

A Capstone project submitted to

**Roy McDaniel
The Church of Jesus Christ of Latter Day Saints**

**Department of Civil and Environmental Engineering
Brigham Young University**

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Introduction

There are currently two concrete water tanks in use on a campground operated by The Church of Jesus Christ of Latter-Day Saints. One tank is a raw water tank, where water from two spring sources and one domestic source is stored. The other tank stores the water treated from the raw water tank to be used throughout the campground. Currently, the raw water tank can only accommodate having one source open at a time to fill the tank. The client wishes to determine what changes need to be made in order to have multiple sources open at a time, in order to be more efficient in water usage.

Also, due to the tanks having been in operation for an extended period, an evaluation of the tanks is to be performed to determine what needs to be done. Specifically, the evaluation is to determine whether the tanks need to be replaced, refurbished, or are acceptable for the immediate future. Said evaluation is to be done to ensure that water needs for the campground are met, while at the same time helping the client avoid any unnecessary expenditures.

Based on the findings, a cost analysis will be generated in order to help the client to determine the best course of action for this project

Report

Observations

Last October, we performed a preliminary site visit to observe the general condition of the two water tanks. This visit was quite helpful for us to better understand the scope of the project, and better understand the needs of the tanks. From our site visit we could easily see that the tanks were rather worn. The south tank was especially worn, and had a lot of exposed aggregate, and even some exposed rebar on the top of the tank. There were some signs of past leakage through cracks on the sides of the tanks as well. Included below are pictures of the north tank, and south tank respectively.





As can be seen from the pictures, the tanks are built partially into a hillside. Signs of leakage are visible on both tanks. It also appears that the tanks were built at different times, or in different manners. This is evident from small differences in lids, tank tops, color, and general condition. The north tanks appears to be newer than the south tank. This could potentially have an effect on the final decision, with the possibility of replacing only one tank.

Possible Solutions

To address the issue of the deteriorating tanks, we have explored several options. The main solutions we have explored are tank replacement and tank refurbishment. The majority of work has been spent researching the details of either replacing the tanks, or doing some repairs and preventative maintenance. Other potential solutions will also be mentioned later on.

Option 1 - Tank Replacement

The first option we have for improving the water tank system is to replace the existing tanks with new 25,000 fiberglass tanks. The main benefits of this approach are that it is the most effective way to increase the longevity and reliability of the water system . The existing concrete tanks appeared to be intact, but the risk of a failure of some kind increases with time.

During our site visit a few months ago, we observed several signs of wear that could result in tank failure at some point. The first thing that we observed was significant spalling on the South tank. The top of the tank had significant amounts of concrete worn off, exposing the aggregate on top (see picture below).



Another related sign of wear was that of exposed rebar on the South tank (see picture below).



We do not know if these defects will directly lead to the failure of the tank, but it is cause for concern.

The principal disadvantage to the tank replacement approach is the high costs of replacement compared to refurbishment. The estimated total cost to replace both tanks is shown

in the table below. Estimates were made using a combination of RSMeans Light Industrial 2017 costs estimation book (See Appendix) and fiberglass tank prices from supplier websites.

Tanks Replacement Costs

(Estimated shipping and installation costs not included).

	Unit Cost	No. of Units	Total Cost
25000 Underground Fiberglass Tank	\$72,775.22	2	\$145,550.44
25000 NSF Grade Fiberglass Tank	\$54,000.00	2	\$108,000.00
Demolition of Concrete Tank Floors (per sq.ft)	\$0.94	454	\$426.76
Demolition of Concrete Tank Walls (per sq.ft)	\$0.94	1572.8	\$1,478.43
Tank Shipping and Installation Costs	?	?	?
Concrete Removal (Cost per truckload)	\$55.00	5	\$275.00
	Underground	Fiberglass Replace	\$147,730.63
		Fiberglass Replace	\$110,180.19

Requesting quotes from local companies will be required to be able to estimate additional shipping and installation costs.

Option 2 - Tank Refurbishment

The second option for the water system improvement plan is to refurbish the existing tanks. This option is appealing because it would involve a much lower initial cost, as opposed to the tank replacement option. The main challenge to this option is determining if the concrete is strong enough to continue to be usable for a number of years to come with minimal repairs or maintenance.

The site visit was helpful in determining the general condition of the tanks. After further research though, it has been decided that an additional site visit will be useful in producing a more accurate determination of the strength and usability of the tanks. This is obviously challenging under the current weather conditions, because of several snow storms in the last few weeks. It is our hope that within the next few weeks the weather conditions will permit us to travel to the site and further evaluate the tanks. On our last site visit, we also were not able to see the inside of the tanks, because the keys to the locks could not be found. Since we do not have structural drawings, we especially feel that seeing the inside of the tanks would help us to better determine their structural integrity.

As stated earlier, the refurbishment option will be significantly cheaper than replacing the tanks. It has yet to be determined everything that would need to be done to fully refurbish the tanks, but from initial cost estimates it is obvious that those would cost much less than brand new tanks. This is especially true, because the client has requested that if replacement is the recommended option, that the new tanks be at least the same size as the existing tanks.

Refurbishment of the tanks will likely involve installing a lining on the inside of the tanks to reduce water leakage through cracks. There are several products available that are used to coat the inside of concrete tanks to prevent leaking. From our research, and by comparing different options, Xypex appears to be the most promising. Xypex would be especially effective for several reasons. For one, it is relatively cheap when compared to other products available. It is also simple to apply, and does not require a professional for application. Another reason it is an appealing option, is that after application it is considered permanent, and requires no maintenance. Included below are some tables detailing the dimensions of the existing tanks, and the estimated cost to apply Xypex to the inside of both tanks.

Approximate Tank Dimensions		
Outer Diameter	18	ft
Inner Diameter	17	ft
Inner Radius	8.5	ft
Inner Volume	25000	gal
Inner Volume	3342.0	ft ³
Inner height	14.72	ft
Inner Surface Area	1240.3	ft ²

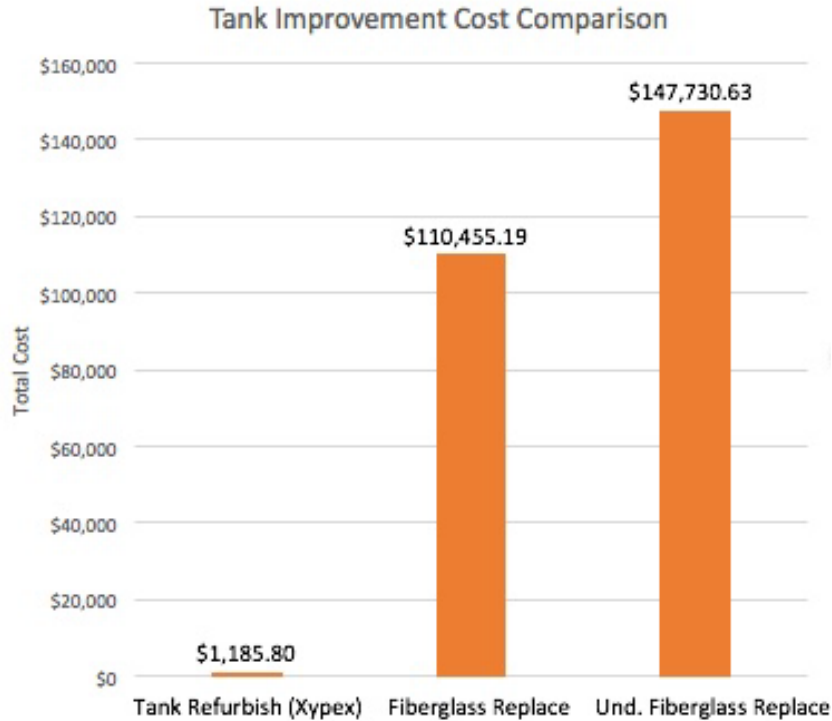
Xypex Info	
1.5	lb/yd ²
60	lbs/bucket
169.4	\$/bucket

Amount needed	Lbs	Buckets	Cost
Inner surface	206.7	4	\$677.60
Both Tanks	413.4	7	\$1,185.80

As can be seen, simply applying a lining would be much cheaper. But simply deciding upon cost will not necessarily give the best results. Lining the inside of the tank is completely dependant upon whether or not the tanks are structurally sound. If they are not, then it will be necessary to replace the tanks.

Cost Comparison

A table comparing the costs of tank replacement and refurbishment is shown below.



Other Potential Solutions

Another option that would require further research in order to justify would include refurbishment beyond the application of Xypex. This expanded refurbishment could include new piping that could accept water from multiple springs simultaneously, new mesh lining for the overflow valves, and a protective coating that would cover the exposed rebar.

The “do nothing” alternative remains on the table, but we would have to justify it with data showing that the tanks in their current state are likely to last a significant amount of time.

We also wondered if there might be a use for some of the concrete in the existing tanks if they were to be replaced. It might be possible to leave the bottom portion of the tank as a foundation or base to the new fiberglass tanks. Again, this option would need to be researched more before it would be considered a primary option.

Conclusion

We have researched two primary options in determining what is to be done with the concrete tanks, each with evidence why they should be pursued. Tank replacement, while initially costly, would ensure the tanks have an increased longevity. Refurbishment, such as using Xypex, could also improve longevity while minimizing costs. However, should the tanks not be structurally sound enough, it's unlikely Xypex would help mitigate the damage. Another option could be that the tanks are fine in their existing condition, though more evidence would have to be found to support this. Each option also details the benefits and drawbacks associated with them. For the time being it would appear that either replacing or refurbishing the tanks are the best options, though we leave it to the client to make a decision that would best suit them and their current needs and limitations.

At this time, a hydraulic analysis is yet to be performed of the water tank system, in order to determine which changes need to be made to have two water sources open into the raw water tank. Said analysis will be the focus of Genesis Engineering's future efforts for the time being, along with researching additional cost data.

The team will work to refine the concrete tank evaluation findings, to ensure they are accurate and supported, so the client can make the best possible decision regarding them.

Appendix

R.S. Means Company,. (2017). *Light commercial costs with RSMMeans data.*