Highland Tank | TechNews

Using Computational Fluid Dynamics in Tank Performance Analysis

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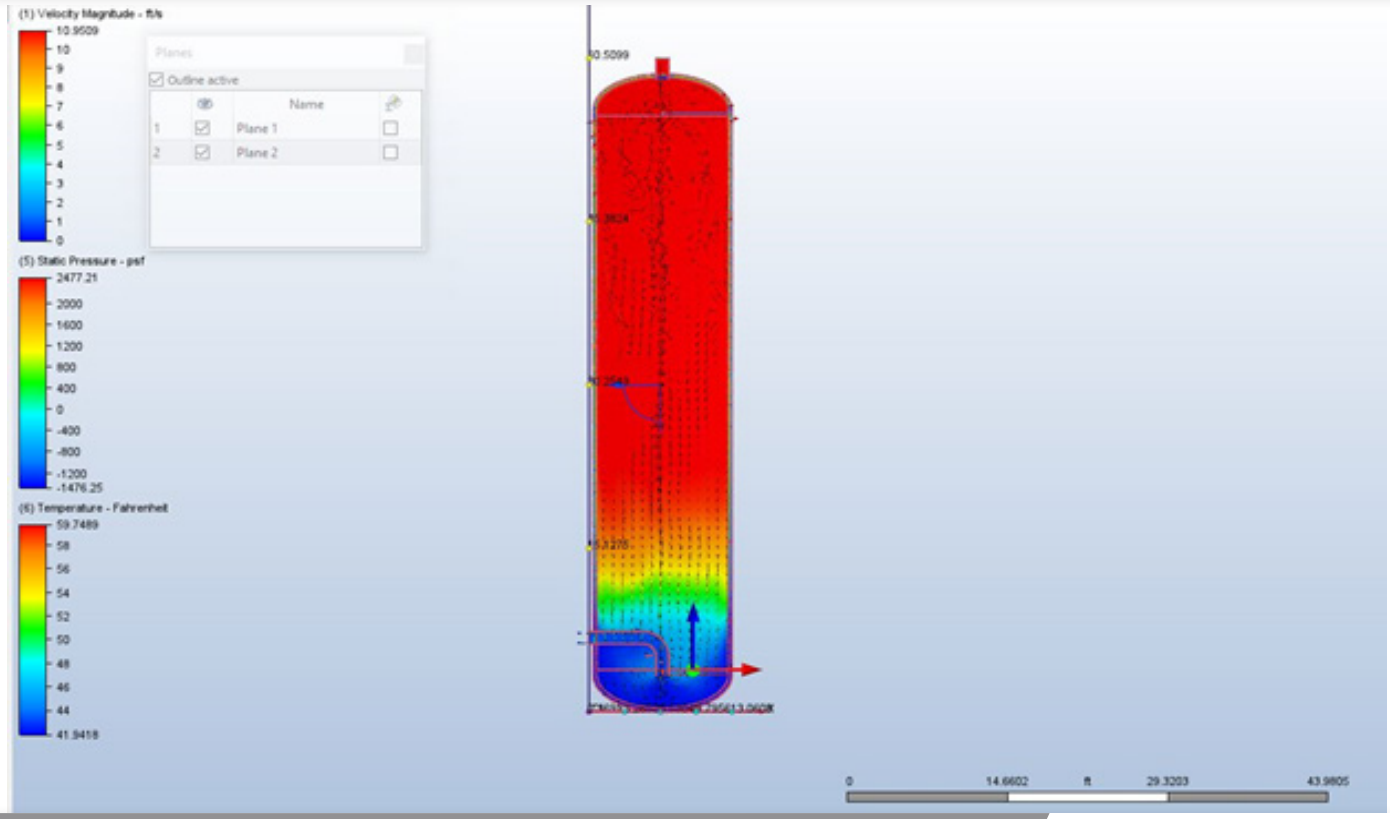

This illustration shows a snapshot of the hot water discharge in a Thermal Energy Storage tank.

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CFD SOFTWARE HELPS VISUALIZE TANK PERFORMANCE

For many years at Highland Tank, we have worked with a strategic partner to utilize empirical calculations to determine flow characteristics in our engineered systems such as Thermal Energy Storage Tanks (TES) and Chlorine Contact Tank (CCT) systems.

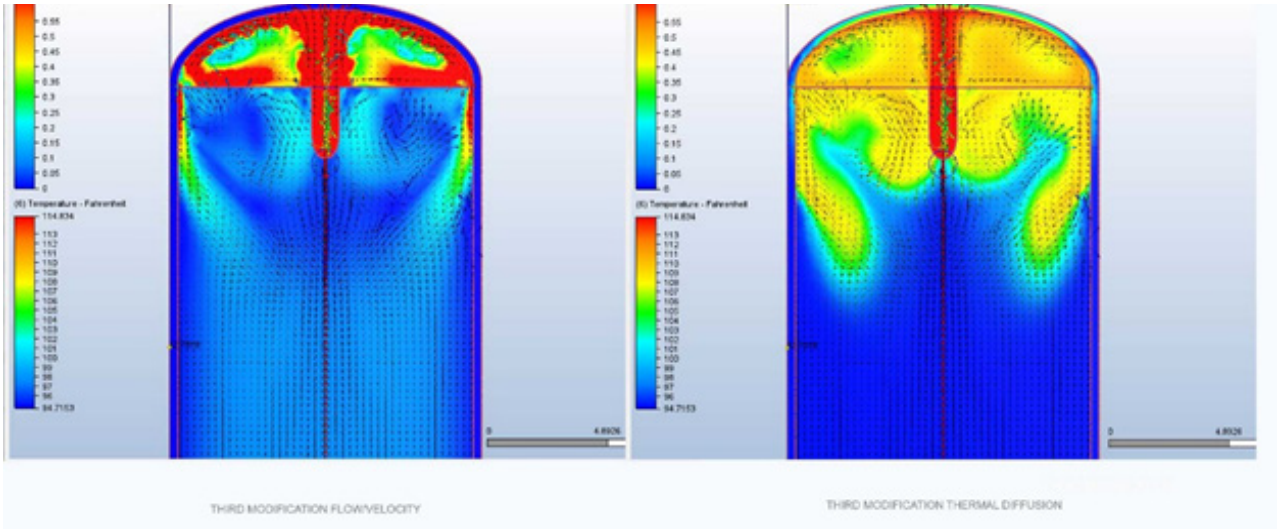
These types of systems are highly engineered due to the critical design parameters associated with their process applications. For example, a modified STAAD analysis produced required slot size for Thermal Energy Storage tank diffusers based on flow and pressure.

Although these types of calculations have been effective in proving the performance level of any given system, they couldn't predict true and/or potential areas of inefficiency in a given tank system.

With help from our partner and Computational Fluid Dynamics (CFD) software, we are able to analyze fluid flow problems in more detail, at an earlier stage in the design cycle, for less money, and with lower risk. In short, we have created a window into the engineered tank system designs.

CFD has quickly become an integral tool of the engineering design and analysis environment for our TES and CCT systems because of its ability to predict the performance of new designs or processes before they are manufactured or implemented. Computational fluid dynamics is based on the Navier-Stokes equations.

These equations describe how the velocity, pressure, temperature, and density of a moving fluid are related. In the design of TES tanks for either emergency storage and/or HVAC heating/cooling, CFD allows Highland Tank to dial in the process of stabilizing the two separate densities of water with minimal mixing and thermal conductance.



TES storage systems rely on diffusers to slow the velocity of fluid entering and exiting the vessel. The diffuser design takes into account all variables in the heating/cooling process to determine efficiency of the TES vessel or Figure of Merit (FOM). Using the empirical equations, we were typically at 90-92% efficient which is acceptable by industry standards. By using CFD, the diffusers can be optimized to increase usable thermal capacity to >95% FOM. Although only a few percentage points separate the two analysis, the cost savings for energy use and consumption is exponentially reduced using CFD.

We have also incorporated the use of CFD for our CCT systems. Similarly to the TES systems, CCT requires contact time and laminar flow to create an effective disinfection device to meet the EPA 4 log treatment. There have been many studies done to determine the optimum design for a chlorine contact tanks to maximize the treatment process and maintain safe drinking water.

The primary aim is to devise means for improving the operating conditions of the contact chamber. Physical testing of a CCT entails a tracer study to inject sodium chloride to prove the theoretical baffling factor as required by the city, county, and/or state standards. Although tracer studies are time tested methods for proving efficiency, they are a pass/fail and don't necessarily give us the feedback we want or need to make the proper adjustments to the tank design. CFD allows us the opportunity to not only adjust the efficiency but to potentially change the way CCT are designed, engineered and manufactured for each individual application

The ability to eliminate short circuiting, turbulence and dead zones within the CFD model prior to fabrication allows Highland Tank customers the benefit of knowing the CCT will meet and exceed the disinfection parameters required for the EPA's Surface Water Treatment Rule.

The use of CFD software has allowed Highland Tank to perform fewer iterations to the final design, shorter lead times, and fewer expensive prototypes.

CFD also encourages innovation because it enables cost-effective means for testing novel designs that would otherwise be too expensive and risky to investigate. With the advent of CFD, Highland Tank has opened a window into the complex workings of its engineered systems to provide our customers the ultimate in performance, sustainability, energy savings and manufacturing efficiency.

Contact Highland Tank to discuss applications for CFD software in tank or pressure vessel analysis.

Watch the CFD modeling in action.

Call 814-893-5701 today or visit us at www.highlandtank.com for more information on rainwater systems or High-LINK® systems.

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