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Chlorine Contact Tanks: How It Works

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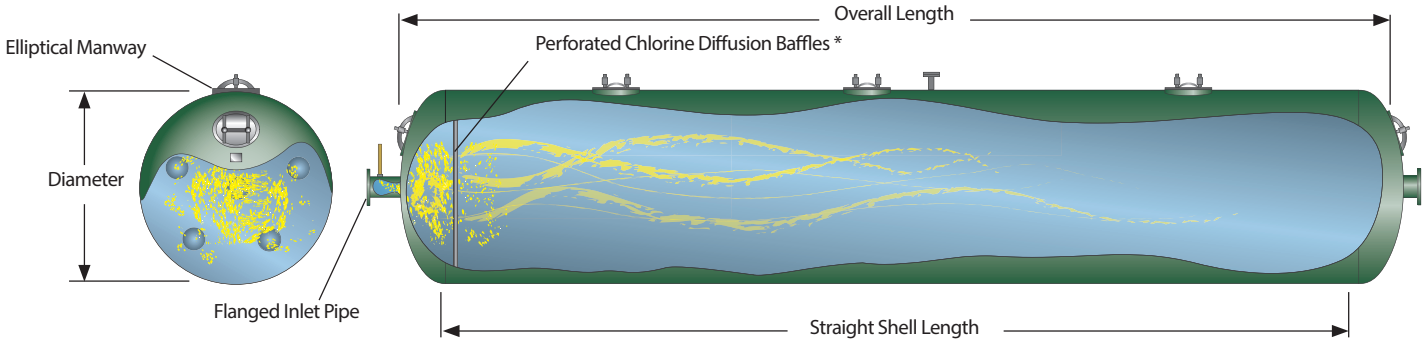
Superior Performance CCT



*Perforated Diffusion Baffles as Required

Highland Tank's Chlorine Contact Tanks are built in accordance with the latest edition of the ASME Unfired Pressure Vessel Code.

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HOW IT WORKS

Chlorine is the primary disinfectant used across the United States for surface water and ground water systems. Chlorination is the addition of chlorine (Cl_2) to water to form hypochlorous acid (HOCl). Benefits of chlorination include strong oxidizing powers, taste and odor control, prevention of algae growth, removal of iron and manganese, biofilm control, water main sterilization, and distribution system residual.

The chlorine reacts with pathogens to satisfy the chlorine demand. The chlorine remaining after the demand is the chlorine residual. The effective destruction of these pathogens by chlorination is dependent on a number of factors including water temperature, pH, chlorine contact time (CT), turbidity and concentration of chlorine available after treatment (residual).

The most important factor is the Chlorine Contact Time (CT). CT measures the effectiveness of the disinfection process. This is important in complying with the 4-log treatment of pathogens standard found in Surface Water Treatment Rules.

CT = Concentration of free chlorine x contact time. Free chlorine is measured in milligrams per liter (mg/L). Process vessels have been used for the application of chlorine in both large and small community water systems.

One of the process tanks that have evolved since the introduction of chlorine is the chlorine contact tank.

This tank was designed specifically to achieve sufficient contact time between the injected chlorine and the water that needs disinfection. The CT rule was adopted to use a more representative value of actual contact time. The effective contact time is designated T_{10} and is the time required for 10% of the water to pass through the process vessel.

The formula for T_{10} is as follows:
T_{10} = Effective Contact Time = V/Q x BF
V = Volume of process vessel
Q = flow rate
BF = Baffling Factor

As you can see from above, the process vessel relies heavily on flow and the baffling factor to determine effective contact time for disinfection.

The baffling factor will determine the actual residence time within the process vessel. By increasing the baffling factor, the overall efficiency of the process is increased. Below is a table outlining estimating baffling efficiencies for various storage and pressure vessels.

Baffling Condition	T10/T	Baffling Description
Un-baffled (mixed flow)	0.1	None, agitated basin, very low length to width ratio, high inlet and outlet flow velocities
Poor	0.3	Single or multiple un-baffled inlets and outlets, no intra-basin baffles
Average	0.5	Baffled inlet or outlet with some intra-basin baffles
Superior	0.7	Perforated inlet baffle, serpentine or perforated intra-basin baffles, outlet weir or perforated launders
Perfect (plug flow)	1.0	Very high length to width ratio (pipeline flow)

The "baffling efficiency" or circulation effectiveness of a tank is used to determine CT. If the raw water used to calculate disinfection moves through a process vessel or pipe too quickly the scenario is called short circuiting.

The CT_{10} requirements also influence tank size. An inefficient tank with a normalized T_{10} of 0.1 requires a tank 7 times the size of a normalized T_{10} of 0.7 if the same concentration is assumed. Therefore it can be stated that for the same level of disinfection, tank size can be related to tank efficiency. Tank efficiency can in turn be related to the number of baffles (and placement) in the chlorine contact tank.

There have been many studies done to determine the optimum design for chlorine contact tanks in order to maximize the treatment process and maintain safe drinking water. The primary aim of these studies was to devise a means for improving the operating conditions of the tank's contact chamber. The difficulty facing engineers and designers is how to prove the theoretical calculations compare with actual in process tank performance.

Highland Tank understands the complexity of the disinfection process as it relates to proper contact vessel design. With the aid of CFD modeling, Highland has opened a window into proper tank configuration to achieve a highly efficient process vessel based on raw water quality, disinfection parameters such as temp, pH and flow.

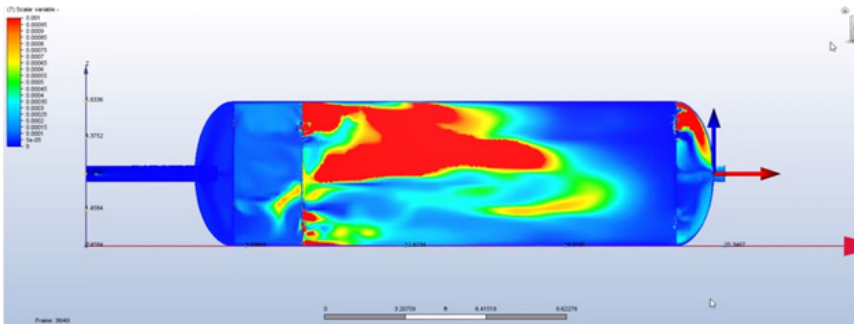
By utilizing tank diameter to length ratio and strategically placed radial slotted baffles. in lieu of perforated/half baffles, a much truer plug flow is obtained. In a CCT vessels this basically means there is no back mixing and/or dead zones that cause the vessel to short circuit and decrease the efficiency of disinfection.

The inlet and outlet structures in the CCT are designed to distribute the water flow uniformly within the cross sectional area of the contact chamber.

Strategically positioned radial diffusers within the contact chamber aid in achieving the minimum residence time requirements.

The Highland Tank CCT hydraulic flow characteristics are proven to meet or exceed industry standards by providing an efficient engineered system to meet requirements of the EPA's Surface Water Treatment Rule. The alternative to a CCT, based on table C-5, is the 1.0 baffling factor which would require hundreds of feet of transmission main to achieve a perfect plug flow. This is no longer a cost effective means of chlorination nor is it viable in today's modern treatment process.

Watch video



Call 814-893-5701 today or visit us at www.highlandtank.com for more information on chlorine contact tanks.

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