San Francisco Water Power Sewer

Services of the San Francisco Public Utilities Commission

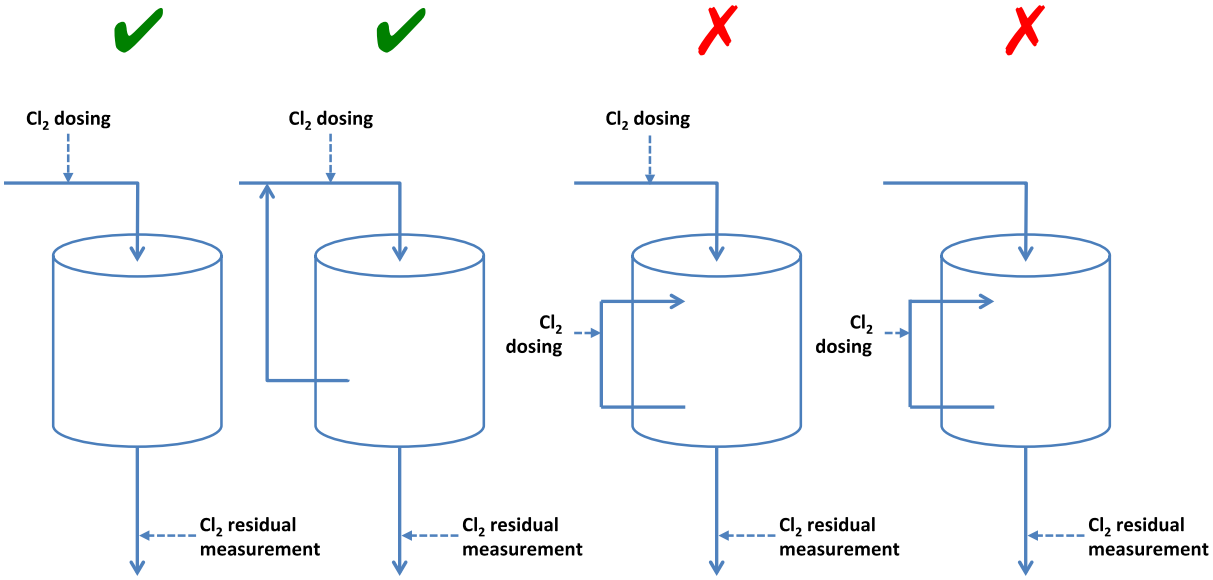
Non-potable Water Program FAQs

1. How does my project receive pathogen reduction credits for free chlorine?

To achieve pathogen reduction credits, calculations must be shown in the Engineering Report to demonstrate CT disinfection, where CT = Chlorine Residual Concentration x Contact Time. The configuration of the chlorine contact basin is an essential element in receiving CT credit. The contact basin must be able to provide both the minimum specified contact time and chlorine residual for all of the water flowing through the system. It is essential that the following criteria be met:

- All water entering the chlorine contactor must be chlorinated prior to entering the contactor.
- Chlorine can only be added before the contactor.
- Chlorine residual must be measured in the contactor effluent.

Figure 1. Examples of proper (✓) and improper (x) configurations for chlorine contactors

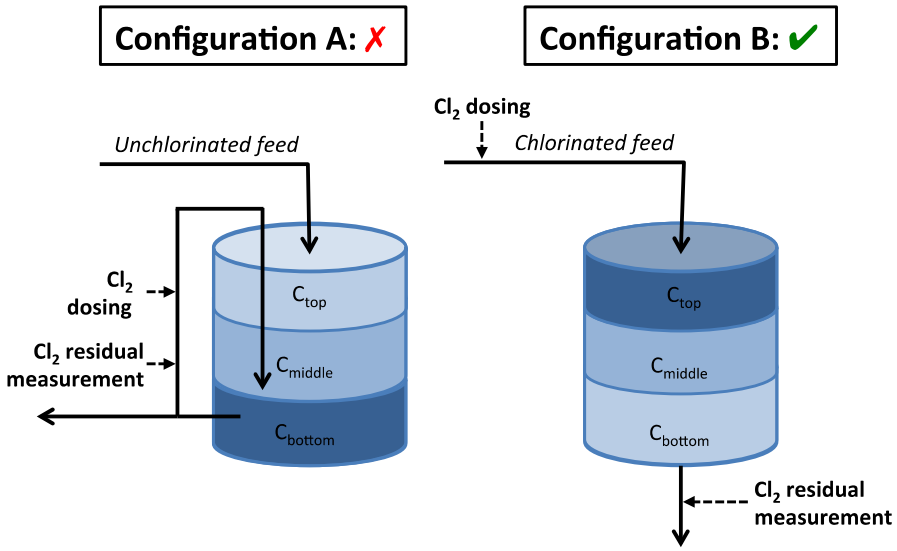


2. What is the proper design for a chlorine recirculation loop?

Refer to Figure 2 for a common design pitfalls with chlorine recirculation loops. Configuration A is problematic because water pulled for the recirculation loop is drawn out from the bottom of the contact basin and then re-injected at the bottom. With this design, achieving complete mixing in the contactor to obtain a uniform chlorine concentration is not possible. The chlorine concentration at the bottom of the contact basin is likely higher than at the top, where unchlorinated feed water enters the contactor. The chlorine residual used to calculate the CT will be higher than what is actually experienced by all the water in the contactor, leading to non-conservative estimates of the actual CT. To achieve CT credits, the design must include chlorine dosing prior to water entering the contact basin.

In Configuration B, a more typical configuration, the chlorine residual concentration measured for compliance would be the minimum concentration experienced by all of the water for the entire contact time of the reactor. This conservative approach is in line with EPA guidance on disinfection.

Figure 2. Comparison of chlorination configurations with (A) and without (B) a recirculation loop



A Continuous Stirred Tank Reactor (CSTR) is the least ideal configuration for a chlorine contact basin, but can use a baffling factor of 0.1. In a CSTR, some volume of water leaves immediately upon entering the basin and thus experiences zero contact time. The more plug flow-like your chlorine basin, the less likely that water will be discharged from the basin with little to no contact time.

3. What are other considerations for chlorine disinfection?

Ammonia

For blackwater and graywater systems, you should control for ammonia because the presence of ammonia or chloramine (or other chlorine-consuming constituents) will consume the free chlorine or convert the free chlorine to chloramine. A chlorine dosing control system should be used to ensure that a free chlorine residual is present. A control system allows chlorine to be dosed in proportion to the influent ammonia concentration so that if the residual is too low, the system doses more chlorine, and vice versa.

Free chlorine monitoring

If CT credit is sought for free chlorine, you should be able to provide evidence in the Engineering Report that the free chlorine monitor selected can distinguish between free and combined chlorine. This is important to ensure free chlorine, not chloramine, is present.

Secondary disinfection

Prior to distribution, chlorine residual monitoring must occur to ensure the chlorine residual is between 0.5 – 2.5 mg/L to prevent growth in the plumbing distribution system. Additional chlorine residual sampling may be required at or near the point of use, such as toilets. To facilitate sampling, installation of an inline chlorine residual monitor near the point of use should be considered during plumbing design and construction. Alternatively, projects may consider using a handheld chlorine residual meter.

4. What are the requirements for using UV disinfection to achieve pathogen reduction credits?

UV pathogen reduction credits are reactor-specific and dose dependent. To achieve credit for UV disinfection, the project's Engineering Report must include the validation report prepared by a licensed engineer. Validation reports must provide evidence of the reactor's ability to reliably and consistently achieve the pathogen reduction credit. The validation report must be prepared in accordance with NSF/ANSI 55 Class A or one of the following state approved procedures:

- EPA UV Disinfection Guidance Manual (USEPA 2006)
- German UV Devices for the Disinfection for Drinking Water Supply Standard (DVGW 2006)
- NWRI UV Disinfection: Guidelines for Drinking Water and Water Reuse, 3rd edition (NWRI 2012)

Submitted validation reports must include a letter demonstrating the report has been accepted previously by the California Division of Drinking Water.

If a validated UV reactor is used, the minimum dose to achieve 3.5-log virus credit, 6-log protozoa credit, and 3.5-log bacteria credit should be 80 mJ/cm^2. The minimum influent UVT should be greater than or equal to the minimum validated value for the UV reactor.

If a validated UV reactor is used, the minimum dose to achieve 6-log virus credit, 6-log protozoa credit, and 6-log bacteria credit should be 150 mJ/cm^2. The minimum influent UVT should be greater than or equal to the minimum validated value for the UV reactor.

A list of validated UV reactors is available on the Non-potable Water Program web page under Validated UV List.

5. What are the maximum pathogen reduction credits that can be achieved by using an MBR?

An MBR can achieve 1.5-log virus credit, 2-log protozoa credit, and 4-log bacteria credit if the MBR is operated within the Tier 1 operating envelope as defined in the AWRCE, *Membrane bio-reactor*, WaterVal validation protocol. See Table 1 below for the Tier 1 operating envelope.

Table 1. Summary of MBR operating envelope for Tier 1 default pathogen reduction credits

Parameter	Units	Minimum	Maximum
Bioreactor pH	pH units	6	8
Bioreactor dissolved oxygen	mg/L	1	7
Bioreactor temperature	C	16	30
Solids retention time	d	11	--
Hydraulic retention time	h	6	--
Mixed liquor suspended solids	g/L	3	--
Transmembrane pressure	kPa	3	--
Flux	L/m^2/h	--	30
Turbidity	NTU	--	0.2

6. What are the estimated costs associated with laboratory analysis for total coliform/E. Coli, BOD, and TSS?

Table 2. Estimated costs for samples of Total coliform, BOD, and TSS

Parameter	Estimated Cost per Sample
Total Coliform/E. Coli	$35-$55
BOD	$35
TSS	$20