

Understanding Disinfection

Presented by Grand Robertson

Question 1:

Our SWS serving 36 properties, our Interior health operating permit does include any conditions. Our deep well (110 feet) is considered confined due to 2 clay layers of isolation. The Interior Health recommends minimum 0.2 ppm hypochlorite. We operate at 0.5 to 0.7 ppm. However, is the recommendation a guideline or a mandatory regulation. Can we cease chlorinating. The water sampling results for decades have been acceptable.

The 0.2 ppm target that you are referring to here is generally considered a mandatory guideline to be met at all points in the distribution system for secondary disinfection purposes. This ensures that any failures of the distribution system that may allow the introduction of pathogens to the system are addressed (eg. crack in pipe at shallow depth that could be exposed to surface water).

Unless your distribution pipes are known to be in excellent condition and are minimal in their length (distribution is not significant), it is very unlikely that you would be approved to eliminate your chlorination disinfection despite the relatively lower risks of your confined source. While the source might be lower risk, the secondary disinfection requirement to protect the distribution infrastructure would still exist.

Question 2:

Are sulphites ever used to kill off bacteria like in the wine industry for cleaning bottles or stopping fermentation?

I have never seen a system approved to use sulphites for primary or secondary disinfection of drinking water.

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Question 3:

How is the chlorine level determined or indicated? Is there a titration method?

Chlorine levels are typically measured in milligrams per liter (mg/l) or parts per million (ppm). 1 mg/l = 1 ppm. There are a variety of common test methods, most of which use a reagent that changes colour in the presence of chlorine.

The intensity of the colour is measured which equates to a particular level of chlorine. Most often, this colour check is done digitally with a colorimeter, but a simple version would have the person doing the test compare it to a colour chart (much less accurate).

Digital hand-held chlorine testers typically cost about \$200-300 and are able to measure both free and total chlorine and often some other parameters like pH, ozone, and hydrogen peroxide. The reagents cost about \$15 for 100 tests.

Question 4:

Ironically, I work at a fishing lodge... I am diagnosing a system with 1um and UV that passed total coliform however failed E coli. I can't open a browser while on this webinar to look it up, however, shouldn't the e coli also show up in the total coliform number?

You are correct, since e-coli is a type of coliform bacteria, we should expect them to also reflect in a total coliform test so it is unusual that you passed the TC test but failed e-coli.

These tests can have difference sensitivities to very high levels of non-coliform background bacteria or turbidity which could explain the discrepancy.

I would recommend that you discuss this with the lab that did the testing, or consider re-running the tests in case there was an error/accidental contamination of one of the tests due to sample handling (this is common).

Question 5:

Is there an ideal relationship between free and total chlorine after treatment and holding period?

I should have addressed free and total chlorine in the webinar. I think I cut that slide for time considerations.

Total chlorine reflects the amount of chlorine we inject into the water at the injection point. A certain portion of this chlorine will react with contaminants in the water including iron, manganese, natural organic matter/tannins and of course microbiological contaminants such as bacteria.

The amount of the chlorine that is used up in these reactions is called our chlorine demand. The amount of un-reacted chlorine that remains after all the reactions have taken place is called our free chlorine.

So, total chlorine minus chlorine demand = free chlorine.

Contact time plays an important role here though since reactions with chlorine are not generally instantaneous. We need to allow time for these reactions to occur and be fully completed. This is why contact/holding time is important. The longer the holding time, the more complete the reactions that make up the chlorine demand will be.

At some point, all of these reactions will be complete and the free chlorine will be stable.

If stored too long, some of the free chlorine will eventually break down and the free chlorine level will begin to drop. The level of chlorine demand in a given water source will differ from other water sources since they will have different levels of iron, manganese, organics, etc. Even within the same source, the chlorine demand will change over time as these contaminant levels shift naturally. Systems with high variability in the chlorine demand will generally have a harder time maintaining consistent free chlorine levels.

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So generally, total chlorine will not generally drop after treatment and over the holding period, but free chlorine definitely will as some of the chlorine is consumed in the various reactions (chlorine demand). There is no specific amount that it will decline as this will depend on the chlorine demand in the specific source.

Question 6:

For a well that is only used for backup, sometimes never in a year, is it a good idea to shock the well with chlorine? And, if a well is shocked, how long does the chlorine remain active within the well?

This would depend on the nature of the well, but in most cases, yes.

This would be especially true for shallower wells at higher risk of contamination by surface water. How long it would remain active would depend on the contaminants present in the well.

Wells with high levels of iron and/or manganese or organic matter could consume the chlorine very rapidly (hours).

Wells with limited oxidizable metals or organics may see the chlorine persists for weeks, at least to some degree.

Even in a brand new container sitting on your shelf, chlorine degrades to about 50% in 6 months so it will degrade regardless and certainly at a much faster rate in the environment.

Any well that has been inactive for a period of time should be shock chlorinated before being brought back into use. Periodic shock disinfection of the well during periods of inactivity, will help prevent bacterial overgrowth that could make it much more challenging to bring the well back into safe production when needed.

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Question 7:

Is it right adding chlorine before the phase of coagulation and flocculation before adding alum powder □ Is it advisable to apply pre-chlorination before coagulation and flocculation, and if so, what is the purpose of adding chlorine before alum? How does this sequence affect coagulation efficiency and the formation of disinfection by-products?

Great question! There may be a suggestion to chlorinate before the coag and floc process mainly to aid in the oxidation of some metals like iron and manganese so that they can be subsequently addressed in the coag/floc process. This approach may also be used to address hydrogen sulfide or severe microbiological fouling as well.

However, chlorinating before the alum injection could certainly impact the formation of disinfection by-products if there were natural organics present. The trade-offs need to be considered carefully.

Alternative oxidizers could potentially be considered to address iron, manganese removal or biofouling without increasing DBP formation.

Question 8:

I have many complaints issues with home UV units that have ongoing alarms issues and alarms are often by passed/turn off due to alarms....any tips on approaching this issues?

These sensors are designed to be pretty sensitive, so this does come up for sure. Most UV alarms are related to one of these factors:

feed water quality - ensure that pre-treatment is done to maintain as high of UV transmittance as possible in the raw water, including during rain events, freshet, etc. when UVT is likely to be at its worst.

sleeve/sensor fouling - clean UV sleeve and sensor window regularly, and use suitable pre-treatment to prevent or reduce fouling (especially iron, manganese and hardness)

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heat build-up - use appropriate cooling equipment where necessary eg. thermostatically-activated dump valves, especially in systems where water can sit inactive for long periods.

chamber orientation - best orientation is usually vertically with sensor on the side. Horizontal chamber installation is technically permitted for some brands/models but can cause some problems that create UV sensor alarms - sensor on bottom can have sediment interference, sensor on top can have issues with air bubbles passing over sensor, and horizontal often has greater trouble managing heat. More heat creates more fouling as well as direct sensor issues. Some models have better cooling systems/temp management than others, lamp dimming technologies, or dose-based alarm monitoring rather than just UVT based monitoring alarm setpoints. These technologies can greatly reduce nuisance alarms.

Question 9:

If you have to order the cl2 solution once a year and you only open the 20L pails as you need them, would the unopened 20L cl2 pails maintain the original concentration?

I would really try to avoid this if at all possible as it will create operational challenges (harder to maintain consistent chlorine residuals).

Even the un-opened pails will degrade to about 50% strength in 6 months. Temperature and other factors play a role in the actual rate of decline, but regardless, the degradation is significant.

I once tested chlorine that was 1.5 years old on site and it tested as practically zero (which really explained why they were struggling so hard to achieve satisfactory treatment at their plant). If you can buy smaller containers, more often, it would be a much easier to achieve consistency in your disinfection process.

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Question 10:

What is the contact time difference between continuous chlorine injection or ozone? Is there any benefit between the two?

Ozone is regarded as much more powerful and faster acting than chlorine. It would generally require far less contact time as a result.

Both ozone and chlorine have roles to play in water treatment. The biggest challenge with ozone is that it very rapidly degrades so achieving lasting residual / secondary disinfection through the entire distribution can be challenging or impossible. It can also be very hard on equipment (seals and o-rings in particular).

Question 11:

Is aeration a reasonably effective method of minimizing short circuit tank storage?

Yes, aeration can be very effective at minimizing the risk of short-circuiting by creating a mixing effect.

