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2020 Frontline Regional Water Challenges

*Water quality issues **operators and water managers** should watch for:*

The last few weeks have presented extremely challenging water quality conditions for large parts of NSW due to the unprecedented combination of drought, bushfires and flooding. These impacts are likely to continue to impact water quality in catchments for a number of years.

Hunter H_2O continues to provide technical and on-site operational support assistance for councils across NSW to help resolve and manage challenging water quality and treatment issues. Over the course of these events we have identified a number of common issues outlined below.

1. Metal Contaminants

Iron (Fe) and Manganese (Mn) have been the predominant problems in terms of metal contaminants. But we have heard of Arsenic, Aluminium, Barium, Bromide and Mercury being elevated in regional NSW catchments. One client measured 18 mg/L of Mn that was feeding into one of their main sources. Due to a very low dam level, another client was forced to extract and treat water with 2 mg/L of soluble Mn. In our experience, the threshold for customer complaints for staining is only 0.020 mg/L.

2. Mn Removal

There are two relatively readily applied techniques for soluble Mn removal; pre-filter chlorination and potassium permanganate ($KMnO_4$) dosing. High pH processes (pH>10) remove Mn too, but these are typically limited to softening.

2a. $KMnO_4$ Dosing

$KMnO_4$ is dosed into raw water so the oxidised soluble Mn can be coagulated and removed through clarification and filtration. With $KMnO_4$ dosing, getting the ratio of $KMnO_4$ to Mn is the key, and it can be tricky. Assuming there is nothing else in the water to consume the $KMnO_4$, the ratio is ~ 2 mg of $KMnO_4$ to 1 mg of soluble Mn (2:1 ratio). However, iron and organics in the raw water will mean that a higher ratio will be needed. A minimum rule of thumb is 4:1, however, in places where organics and Mn are high the ratio may need to be much higher, and we have seen ratios of 10:1 needed in the last few weeks. NSW clients seeking assistance have previously been advised to start dosing $KMnO_4$ till the water goes pink then wind it back. Hunter H_2O recommends that you start with a screening jar test at 4:1 then go higher.

pH and Dissolved Oxygen (DO) are important factors to consider for optimising Mn removal. The higher the pH the better, but that needs to be bought back down again to make sure coagulation is not adversely affected.

Changing raw water quality will also complicate $KMnO_4$ dosing, so do not assume the raw water stays the same as it was when you did your last jar test. Measure Mn levels in the raw water often and change the dose rate as required. Several clients have been caught out with changes to raw water quality which has resulted in either under or overdosing $KMnO_4$ (Pink Water).

2b. Pre-filter Chlorination

Pre-filter chlorination involves dosing chlorine into settled water prior to the filters. This is sometimes called the oxide coated media process. The soluble Mn is oxidised and forms a coating on the filter media. The key to robust operation is maintaining a small residual of chlorine (0.3 – 0.5 mg/L or higher) in the filtered water. Initially the chlorine doses will be high but should drop back and stabilise at lower levels once the chlorine demand in the filter is consumed. The pH of the water being applied to the filter should be above 6.2 otherwise the Mn coating the media will be stripped off. Care needs to be taken when stopping this process.

There are some concerns that this process leads to increased THM formation. This is not necessarily the case in our experience. The difference in THM pre-cursors, as they are dissolved, is very similar in settled and filtered water, so applying chlorine before or after the filter doesn't make a lot of difference. Pre-filter chlorination can be a more robust process even if the raw water changes quality frequently.

Photo of treated water that had been overdosed with $KMnO_4$.

3. Dissolved Oxygen

Water quality, even in rivers, will vary at different depths. Having the ability to draw from different levels is a significant advantage. Even a flowing river may have a different DO depth profile. The DO in one northern NSW weir pool that was flowing over was 9.9 mg/L at the surface, but just 3 m below the surface there was virtually no DO. As mentioned above, DO is very important to providing favourable conditions for Mn oxidation. Operators and water managers should monitor the DO in their raw water at the extraction point if it can be safely accessed.

4. Dissolved Organic Carbon

Dissolved Organic Carbon (DOC) levels are reaching extreme levels in a number of catchments, associated with inflows of large quantities of organic matter. This will pose an aesthetic challenge in producing colourless water for customers. The more critical issue is, however, the amount of extra chlorine that is required to achieve disinfection. Even with UV disinfection, the extra organics in the water may mean the UV reactors are not validated for such low UV transmissivity.

To put in context how extreme levels are getting, most waters typically range from 8 – 15 mg/L of DOC. Clients in NSW are recording levels in excess of 40 mg/L. A water industry rule of thumb is to reduce DOC to ~3 mg/L prior to chlorination. This is just not achievable with conventional treatment process when levels are in excess of 25 mg/L. And some organics are harder to remove than others. Low molecular weight organics won't be removed by coagulation. For most regional conventional WTPs, the available barriers will be Powdered Activated Carbon (PAC) dosing, contacting and coagulation.

Alternative coagulants can be considered which may provide a temporary solution. Extensive jar testing is required to select the right one and define the right system configuration.

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5. Trihalomethanes (THMs)

Higher organics will generally mean the formation of greater concentrations of disinfection byproducts such as trihalomethanes (THMs). This may be unavoidable at these times if the DOC levels cannot be reduced. The presence of bromide may further escalate the concentrations of THMs formed. Blending bore waters with surface waters may inadvertently result in the formation of greater quantities of the brominated THM species.

6. Catchment Rains

Catchment rains are having an impact on treatability, with some clients seeing flashes of raw water turbidity in excess of 2,000 NTU. Generally, flood waters are low in alkalinity. The combination of high colour, high turbidity and low alkalinity is a challenge, as large doses of coagulants will be required for the turbidity and colour, which will depress the pH so low that coagulation does not occur (this can happen even with aluminium chlorohydrates). Alkali dosing systems are needed to enable enough coagulant to be dosed. If you can, it is often better to rely on water stored in your networks and allow the first flush to pass by your treatment plant intake. Use this time wisely and undertake raw water quality analysis and jar testing so you are prepared once you need to start the plant again.

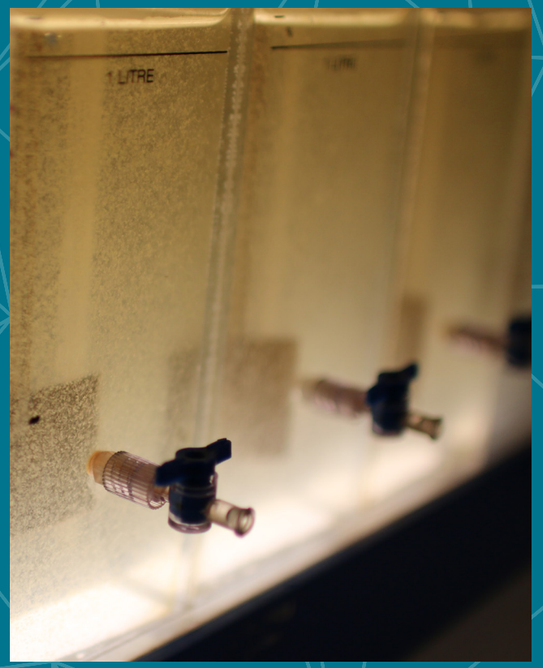
While flood waters are typically low in alkalinity, areas that are still drought affected or have only received low amounts of rainfall may, conversely, be suffering from high levels of alkalinity. When the levels of alkalinity are high this can also cause issues with coagulation as it may not be possible to get the pH low enough. This can result in poor coagulation and high aluminium residuals.

7. Be Patient

Be patient. Once a change has been made it will take some time before the impact of the change is seen, making systematic changes and observing the impact is recommended before making further changes. This can be difficult with lagoon sedimentation processes which have inherent lag times that can be in the order of many hours or even days.

8. Jar Testing

Higher doses are not always the answer, especially of polymers! Jar testing is a critical tool for optimising water chemistry to give you the best chance of successful outcomes on the full-scale plant. It gives you an educated starting point for the dosing requirements on your plant and enables a trial of alternative chemicals and approaches.



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While the above issues are important, the absolute priority is to maintain effective microbial protection. No adjustments or process modifications should be actioned that compromise microbial safety. If there is any evidence of unsafe water and/or Critical Control Point (CCP) exceptions, then water utilities should advise their local Public Health Unit immediately (NSW Health PHU can be contacted on 1300 066 055).

Should you find yourself in a situation where you need technical and/or operational support please don't hesitate to contact Hunter H_2O's Paul Thompson for a chat.

Our experience shows that the best outcomes for Council occur when we get involved on the ground, and early, but it is never too late to seek assistance.

The above points are provided to outline some of the challenges being widely experienced, and the techniques and strategies applied should be carefully considered. All waters are different, as are most water treatment plants. ***Careful and thorough investigation and assessment is a must before trying something new.*** *What works at one water treatment plant, may not necessarily work elsewhere.*

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hunterh2o *Water Together*