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TTHM and Haa5

A Backward Approach

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Disinfection by Products have been a known issue in water treatment for several decades. The creation of Disinfection by Products (DBP’s) has seen many ideas and operational strategies over the same time period. Back in the late part of the 80’s it was thought DBP’s were created when “Breakpoint Chlorination” was not achieved during the disinfection process. This resulted in many facilities over chlorinating in attempt to ensure break point chlorination was achieved, thus having issues with the creation of even more DBP’s.

Here in a small community water system in Central Florida we were faced with a system that had bad numbers on the DBP charts. With sample results being more than double the MCL; TTHM 183ug/l and HAA5 105ug/l were noted at the peak of our problems.

It wasn’t an easy thing to drill down on as we had several other factors that were working against us. The utility draws water from two different wells. One of which has a high iron content (5mg/l) the other an artesian flowing well which produces just enough water to eliminate the need for the draw from the iron heavy well. Lastly, we have an undeveloped section of the community with one home that is being served. After looking at data and understanding the type of TTHM we were creating, it was identified Chloroform was the primary TTHM created*.*

*I remembered years ago how the water at my house was drinkable and my neighbor 3 doors down was not. He used a Purple Permanganate system while I used a PAC system. Hydrogen sulfide was destroyed by my system, but not by his.* This gave me an idea! Fred Handy of Florida Rural Water (FRWA) put us in contact with Julie Guimond of Sensible Water Solutions (SWS) as our thought of using GAC or PAC as a possible means to remove the DBP’s was in line with a patented solution she had already been working on. She did preliminary sampling and designed a system to meet our needs. Unfortunately, the cost involved was not in our immediate budget. At the same time, we were just put on a consent order issued by FLDEP to remediate the issue within a two-year period.

Working with Engineer Blanche Waller of FRWA we looked at the system Sensible Water Solutions had proposed and gave thought as to how to install and implement the solution in stages. During a meeting with FRWA and SWS, Julie had mentioned it was found on another of her projects to be beneficial to produce as many TTHM’s as possible prior to filtration to prevent the reformations later in the distribution system. So, we set our sights on chlorinating earlier in our already operating treatment system. While in another meeting, SWS had made recommendation to install a large aeration tank. That’s when the light came on! I thought, If the DBP we are creating from chlorinating methane which is gaseous; the volatility must be high. If we aerate, we can strip the TTHM’s prior to GAC/PAC filtration which could lengthen the GAC media life and/or reduce the amount of filtration needed, thus reducing cost of system. We’re off with a plan!

FRWA assisted in obtaining FLDEP permit to make changes to our facility over a staged process. If we obtained good results in stage one, we could stop, if not we could proceed to stage two which would be the implementation of the GAC filtration.

We added chlorination prior to our raw water storage tank. Our raw water tank was designed with a cascade tray aerator on the top to aerate the influent prior to storage. So, to perchlorinate our influent, we bypassed the aerator and went straight to the tank after chlorination, as we did not want to strip without a good contact time. We then installed engineered aeration balls in the existing tray aerator. This was to enhance aeration and stripping. We then installed a recirculating pump with a 24-hour run time. Water is pumped from the bottom of the raw storage to a manifold of shower heads as diffusers to further enhance aeration. We put the system online, and the first results were very promising.

Wanting to ensure the project would be absolutely flawless, we drained and cleaned our raw storage prior to commencement. This caused our skewed results. Remember how I stated previously about two wells? Yeah, about that! Our wells operate on Lead Lag controls. As we refilled the tank, well #1 and well #4 were called. Well #1 has a capacity double of well #4. Therefore, most of the refill water was from well #1.

The first results were:

Post Aeration 5.1ug/l

POE 6.3ug/l

Live Oak 144ug/l (This is the unused housing development)

These results led us to change the way we were flushing in the new development. We added 2- 2” auto flushes and two other small flushes to eliminate short circuiting in the system. So, we again took samples and were left scratching our heads. This time the results were back up to 171ug/l at Live Oak and high readings at the other locations as well. (Remember well #4 was our primary use well)

As we were in our rainy season, we often have low atmospheric pressure which results in slower moving air molecules than during high atmospheric pressure. So, we installed an exhaust fan much like the ones used on the roof of restaurants to force the stripped TTHM’s away from the tank so the heavy (humid) air during rainy seasons would not push the TTHM’s back into the water storage tank.

We resampled using well #1 the following month at the plant only and got:

Post Aeration 14.7ug/l

POE 19.1ug/l

Iron 28 ug/l (more on this later)

What was different? Flushing obviously helped, the exhaust seemed to help, but what was the real reason for the drop? Well, I had an idea, but I had to be certain. I shut down Well #1 completely. (The well high in Iron) and we ran the system on well #4 for an entire month, maintaining flushes at their scheduled intervals. Then we shut down Well #2 and reversed the operation to feed from well#1 only. The results were night and day.

Well #1 Operating Well#2 Operating

Post Aeration

POE 5.3ug/l 89.5ug/l

Live Oak 6.6ug/l 194ug/l

Ok, Was it Pre-chlorination, The aeration, the air stripping or the well change?

The simple answer is yes to all.

Well #4 being very high in Methane and Haa5’s makes it a known source of problems.

Pre-chlorination is an approach needed as we still realize high CL demands (6ppm) even from well #1. Which indicate we are producing and removing TTHM’s

Air Stripping is needed as we see higher TTHM numbers without the use of the Exhaust fan.

Back to the Iron. It was believed that well #1 was high in iron due to the complaints from the community of yellow water, staining and a misconstrued reading by previous personnel. EPA Secondary Water Characteristics state an MCL of .3mg/l. Previous results came in at 5. 5ug/l. My sample of 28ug/l is far less than the 300 ug/l allowed. So where did the yellow water and staining come from? The bio film in distribution deposited from the use of well #4!

Now that we have addressed the creation of the TTHM’s from the treatment side, we are now working on biofilm remediation in our distribution system. Many years of well #4 well usage have created a biofilm in our distribution system that must be removed. Unlike the typical TTHM scenario in which TTHM’s are created in the warmer months, we see higher numbers in the winter months when our customer usage is higher due to seasonal occupancy. The higher numbers are created due to higher flows scouring the mains. We are currently looking at the addition of a product that will help eliminate bio film better than flushing alone. We will post the effectiveness of this product once program has been implemented.