Municipality of Southwest Middlesex

Secondary Disinfection with Peroxide

Figure: Glencoe Water Tower in the Southwest Middlesex Distribution System

High Level Results

- Understand Ontario Ministry of the Environment and Climate Change requirements for using hydrogen peroxide for secondary disinfection
- Increased understanding of the municipal distribution system
- Determine installation and operational costs

"Southwest Middlesex was very pleased to receive the Showcasing Water Innovation funding for this project. While we were unable to proceed to full introduction of hydrogen peroxide, we gained valuable knowledge about the THM situation and alternative solutions that we are sure will benefit other municipal systems facing similar challenges."

Janneke Newitt
Administrator/Clerk, Municipality of Southwest Middlesex

Project Context

Chlorine disinfection in drinking water distribution systems result in the formation of disinfection by-products (DBPs), such as Trihalomethanes (THMs), which can be harmful to human health if residual levels are too high. The sampling results for THMs in the Municipality of Southwest Middlesex's Distribution System showed that the THM levels had been increasing and getting close to regulatory limits.

Challenge

There are many technologies that could reduce or volatize THMs (sometimes only minimally), such as tank mixing systems, pretreatment systems such as chlorine dioxide, ozone, granulated activated carbon (GAC) and nanofiltration, and post treatment systems such as advanced oxidation process and Biologically Active Carbon (BAC) filtration. None of these technologies can completely eliminate THM formation or facilitate complete THM removal, and some of these technologies are capital intensive.

Project Goals

This project was to pilot Huwa San Peroxide (HSP), a stabilized form of hydrogen peroxide, as an alternative secondary disinfection product instead of using chlorine or chlorine based disinfectants (e.g. chloramines) as a means to arrest formation of DBPs and THMs.

Since there is limited experience using HSP in Canada, the project would determine actual installation and operating costs for a small municipal water system, and ascertain any other issues to address before a distribution system could use HSP for secondary disinfection. The project team also had to determine the regulatory requirements and approvals under Ontario's Safe Drinking Water Act.

The pilot would prove if the peroxide residual is measureable at the ends of the distribution system and verify that HSP arrests THM formation in the distribution system.

Solution

The municipality hired the Ontario Clean Water Agency (OCWA) to project manage the pilot test for the use of HSP in the Southwest Middlesex drinking water distribution system. HSP was chosen over the other technologies as it does not form disinfection byproducts and it was hoped that it would eliminate THM formation in the drinking water system. Until recently, hydrogen peroxide had not been used as a disinfectant in municipal systems because it breaks down readily into water and oxygen and a residual could not be maintained. HSP is a new stabilized form of hydrogen peroxide that is able to maintain a disinfection residual in a distribution system.

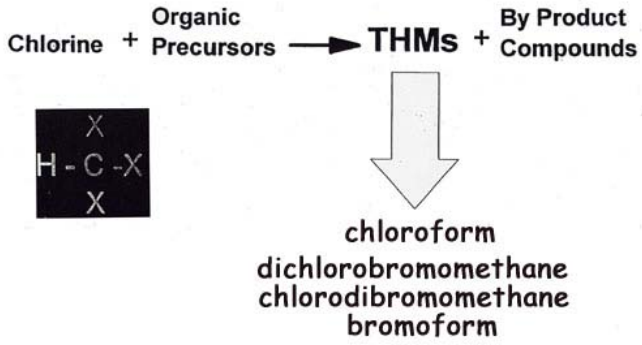

Figure: Basic diagram representing the formation of THMs

Funding from the Ontario Ministry of Environment and Climate Change's Showcasing Water Innovation Program allowed the Municipality of Southwest Middlesex (SWM) to proceed, as there were unknowns that had to be addressed due to HSP being relatively new to the Canadian market.

HSP is a product originating in Belgium and has been successfully used in Europe since 2004. HSP is also used in Canada by the company SanEcoTec in many different applications including private and public drinking water, animal husbandry and greenhouse water irrigation. For drinking water, HSP has been successfully used in a number of private Canadian residential water systems, in locations that are regulated by Ministry of Health, and in sites that fall under the Ontario Regulation 170 under Ontario's Safe Drinking Water Act. Additionally, after SWM applied to the Showcasing Water Innovation program, HSP was successfully implemented in November 2012 as a secondary disinfectant in the distribution system for the Village of Killaloe in eastern Ontario. The installation in Killaloe was the first use of HSP in a small municipal drinking water system and resulted in THM levels dropping from over 100 µg/l to about 25 µg/l. There still is some THM formation in the Killaloe system because chlorine is used for primary disinfection. Killaloe's system is different than SWM because of its size (about 90 connections), the drinking water system's raw water source is from groundwater and the watermains are plastic. SWM has a larger municipal drinking water system, uses surface water, and has a mixture of pipe materials.

Due to the limited use in Canada, the project was originally envisioned as a two-phase project. The first phase would test HSP in a community in the northeast end of the distribution system, and if successful, the rest of the system would be converted to using HSP. However, there were complications segregating the northeast section of the distribution system, and the applicability and effectiveness of HSP was being successfully demonstrated in Killaloe. Therefore, the project was changed to a one-phase project to introduce HSP into the entire SWM distribution system.

The Ontario Ministry of the Environment and Climate Change has set standards for secondary disinfection for chlorine or chlorine based products, but not for hydrogen peroxide. Therefore, an Application for Relief from Regulatory Requirements was required to be submitted to MOECC to be able to use HSP for secondary disinfection. SWM sought the regulatory relief by consulting with the Ministry and formally applying for relief. Conditions for regulatory relief included a limited term approval (a trial period), standards for minimum peroxide residual, additional sampling, approved plan to change from one disinfectant to the other disinfectant, and additional reporting.

SWM obtains its drinking water from the neighboring Municipality of West Elgin, which uses chlorination for primary and secondary disinfection. This meant the project team had to ensure the two water distribution systems were segregated before the addition of HSP in the SWM system, and HSP had to be injected in a high enough dose to quench the chlorine residual and maintain the minimum peroxide residual. Also, water from the SWM distribution system flows into neighbouring municipal drinking water systems, which meant SWM had to work with these neighbouring municipalities to implement the change to HSP and ensure the peroxide residual was adequate for their drinking water systems. There was considerable time and effort put into working with neighbouring municipalities that would receive the HSP drinking water because

those municipalities had their own drinking water permits and licenses, which meant they also had to seek regulatory relief.

Results

As the project progressed, the issue was raised of a possible reaction between HSP and tuberculation in old cast iron watermains, potentially causing localized coloured water conditions. These types of watermains exist in the community of Glencoe.

Chatham-Kent championed hiring an outside consultant, Lexicon, to investigate any potential issues that might arise from using HSP with various pipe materials. The study by Lexicon showed there was a possibility of coloured water forming in tuberculated pipes with the introduction of HSP. SanEcoTec strongly contested the study findings, citing objections to the methodology and principles applied. SanEcoTec assured SWM that, based on chemical analysis, no coloured water issues would arise from using HSP. SWM advised that discolouration, even for a short period of time, would be unacceptable to customers. Therefore, SWM sought to address the potential of discolouration by increasing the scope of the project to remediate the tuberculated watermains before the HSP was added to the distribution system.

The first step in pipe remediation was to determine where the sections of tuberculated cast and ductile iron watermains were located in the Glencoe area using The Investigator camera system. Once the tuberculated sections were located, the sections of the watermains were swabbed to try to remove the tuberculation, then re-inspected to determine how much of the tuberculation was removed. The Investigator inspection showed that, while swabbing was effective for marginally tuberculated pipe, additional remediation would be required for several of the sections on Main Street that exhibited significant tuberculation. It was determined that these heavily tuberculated sections would need a more aggressive method of cleaning to remove the remaining tuberculation.

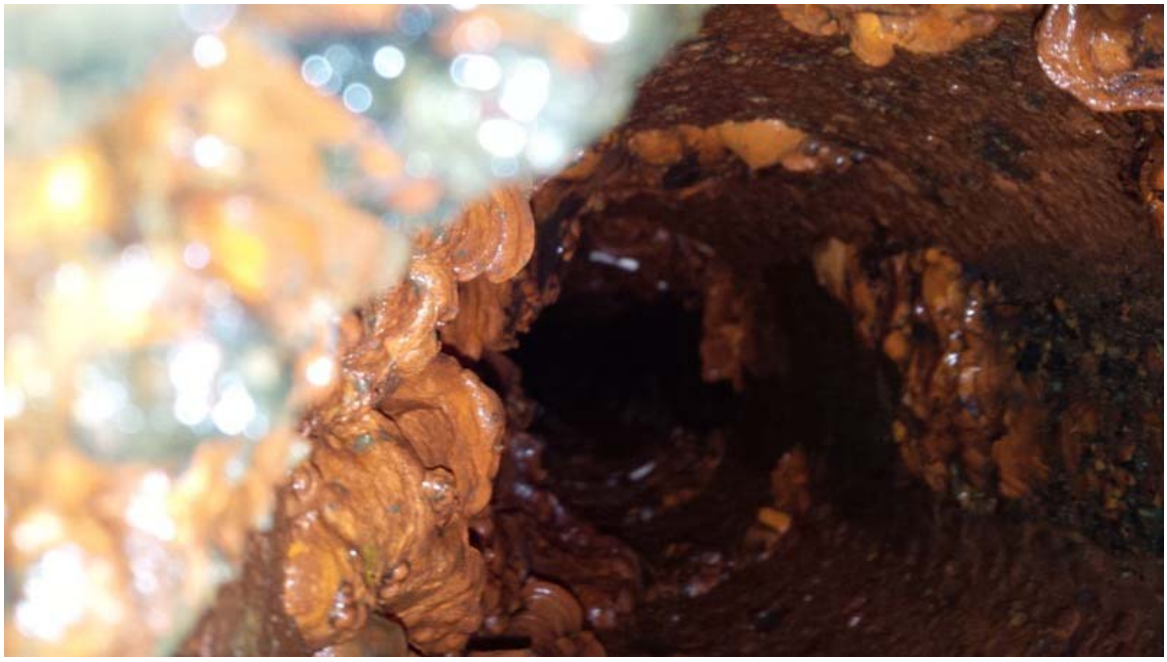

Figure: Tuberculated cast iron pipe found on Main Street in Glencoe

After the initial investigation and swabbing, it was decided to put off further remediation work until completing a review of available technologies for removing the remaining tuberculation in a cost effective and non-invasive manner.

The following options were considered:

1. Continued Swabbing – Some swabbing was carried out during the investigation phase but did not effectively remove all of the tuberculation. Other more aggressive swabbing methods might still not remove all of the tuberculation and would carry a higher risk of damaging older watermains.

2. Tomahawk Method – The municipality decided against this technology because it was too disruptive where it would be used in the downtown core, and too costly for SWM since this level of remediation was not included in the project budget. The Tomahawk method requires pit excavation and part of the distribution system could be without water for up to a few days. Also, the pipes in the system are quite old and could be damaged by the cleaning method, leading to expensive repairs.

3. Passivation of tuberculation via a chemical intervention – SanEcoTec proposed to inject large doses of HSP into isolated sections of the tuberculated watermains, allow the solution to sit for about 24 hours, and then flush this water from the system. This method (based on water chemistry in relationship to Langelier and Ryzner Index) should result in enough reactions between the tuberculation and higher dose of HSP that the lower dose of HSP in the drinking water should not react with the tuberculation. Therefore, this method should prevent coloured water issues when switching over to HSP for secondary disinfection. There were no actual in-situ test results available from other projects to confirm this would work. For this process, parts of the system in the downtown core would have to be isolated and out of use for an extended period of time.

Initially the Municipality expressed a preference for option 3, but there was no additional budget for these additional costs and the deadline imposed by grant funding was looming. SanEcoTec was willing to proceed as its team members felt confident that this solution would succeed. However, the Municipality continued to have reservations about all options and so, given the overall budget limitations, the inability to identify a solution that guaranteed to be 100% effective and the time constraints imposed by grant deadlines, SWM reached the decision to discontinue the project.

Next Steps

Due to the composition and age of some portions of the SWM distribution system, as well as the cost of remediation, SWM and OCWA believed the use of hydrogen peroxide as a secondary disinfectant to minimize THM formation would run the risk of producing coloured water. Without the ability of determining the most appropriate remedial method, HSP was unable to be applied for this particular drinking water system at this time. Alternative solutions will have to be explored to reduce the formation of THMs in the SWM distribution system.

Application for Ontario communities

HSP may be a viable solution for Ontario municipalities coping with THM formation in their drinking water systems. The successful use of HSP in Killaloe is a promising result. However, for communities that have other water challenges, such as tuberculated piping, the situation should be reviewed in more detail. The review should include bench scale tests, remediation and start-up plans to ensure applicability.

There are always unknowns to be worked through when trying something new. As a result of this project, OCWA and SanEcoTec are now better prepared to raise and address challenges using HSP as a secondary disinfectant. This project benefitted from Showcasing Water Innovation funding by enabling SWM to pursue a new technology at a reduced financial risk - without that financial assistance the project would not have moved forward and these valuable lessons would not have been learned.

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