MORRISON HERSHFIELD

December 23, 2019

Hytec Water Management

Attn: Sean Russell, President Email: srussell@provtank.com

Re: Technical Review of Hytec Domestic Water Piping Remediation Crossbridge HCC 381

Morrison Hershfield was retained to provide an independent review of Hytec, and how it addresses the issue of pinhole leaks and scale control in water systems. Hytec is a water management company with over 30 years of experience in soft and hard water management. Their treatment product is a food grade, natural mineral based water management solution. The treatment has been marketed as a repair solution to pinhole leaks in potable domestic water systems, with a secondary benefit of increasing water quality throughout water distribution systems.

Applicable Potable Drinking Water Standards

Hytec is NSF certified and has also received approval from Public Health Ontario (PHO) for Hytec's treatment product. Hytec follows all the applicable recommendations and guidelines outlined by the standards listed below:

- National Sanitation Foundation (NSF)
- Health Canada
- Safe Drinking Water Act in Ontario (2002)/Ontario Regulation 170/03

Composition of Hytec

Hytec's water treatment consists of three different parts:

- Hytec AquaSoft SW – Consists of zinc orthophosphate which is used for corrosion control
- Hytec pH Control – Hytec pH Plus, which consists of potassium carbonate, is used for pH adjustments after AquaSoft SW has been added, giving the water chemical base characteristics
- Hytec AquaSoft HW – A blended corrosion and scale inhibitor which consists of phosphates and polyphosphates, which inhibit and sequester soluble metals found in water

Zinc orthophosphate is injected into the water stream in the form of phosphoric acid and zinc chloride, and helps to combat pinhole leaks. When exposed to copper piping in water, zinc orthophosphate is attracted to the bare metal at sites where there are pinhole leaks, and forms a seal at the corrosion sites. This creates a paper thin coating on the interior of the pipe, which does not significantly reduce the cross sectional area of the pipe. The coating that is created also acts as a barrier to prevent the lead in old pipes from being exposed to the water stream,

causing the lead to oxidize. When oxidized, lead breaks off from the pipe and mixes with the water stream, leading to lead consumption and poisoning of any individuals downstream of the pipe. NSF 60 does not permit more than 2 mg per litre of zinc to be present in finished drinking water. The typical water consumption for a person is two litres per day, yielding a daily zinc consumption through drinking water of approximately 4 mg. For comparison purposes, zinc has been consumed by people in therapeutic dosages at a rate of 150 mg per day for a one week time span. Zinc is also a component of common cold remedies found in over the counter products, which do not cause any adverse impacts on human health. This demonstrates that the quantity of zinc in the Hytec water treatment solution is well within acceptable intake levels.

Hytec pH Control is used to alter the pH of water, and its usage depends on the location/municipality the Hytec system is being implemented in. pH is a measure of the acidity/basicity of water, and per the Guidelines for Canadian Drinking Water Quality (GCDWQ), drinking water should fit within a pH range of 7 to 10.5. The pH of water can determine which chemical reactions will occur in piping infrastructure and possible leaching of metals. The average pH in Vancouver, British Colombia is 7.63. Metro Vancouver's corrosion control program treats the region's naturally soft and acidic water by raising the pH so that it is less likely to damage a buildings pipes. Where required, Hytec raises the pH of water through their Hytec pH Plus product, which consists of potassium carbonate. While pH control is an important part of water treatment in British Colombia, it is often not required in other regions, such as in Ontario. Most of Ontario has naturally alkaline water due to most municipal water coming from rivers and lakes. This water comes into contact with limestone as it naturally flows down to bodies of water, which causes the water to become hard and basic, and therefore does not typically require pH control.

Polyphosphate is injected into water in the form of sodium polyphosphate. This component is especially important in regions where the water is very hard, such as Toronto and its surrounding regions. Hard water causes a large amount of scaling within pipes, leading to lower flow rates, and overall worse performance. The polyphosphate molecule is attracted to the calcium in the hard water, and binds to it. This calcium-polyphosphate complex disrupts the crystal structure of lime scale, and prevents it from forming. Polyphosphates inhibit future scale formation, and also has the potential to remove current calcium buildup in pipes.

The use of polyphosphates and orthophosphates in limited concentrations is permitted as part of regulations and standards listed in the Ministry of the Environment, Ontario Building Code, Safe Drinking Water Act in Ontario (2002), and the National Sanitary Foundation/ANSI Standard 60 Drinking Water Treatment Chemicals – Health Effects. The National Sanitary Foundation (NSF) limits the use of phosphates and orthophosphates to 12-17 mg/L depending on the exact compound. The Hytec system process does not inject more than 3.0 mg/L of Hytec AquaSoft to maintain the potable water system. This quantity of phosphorus consumption is far below the upper intake limit for humans to be negatively impacted, which is within the range of 3,000-4,500 mg/day. Hytec has been accepted under NSF 60.

Products such as Hytec AquaSoft are becoming essential components of water treatment and distribution for cities and companies around the world due to an aging pipe infrastructure. Along with scaling and pinhole leaks, lead and copper leaching from old pipes into the water stream is becoming a large problem, and pipe replacement is often not feasible to combat this. Hytec AquaSoft has the potential to heavily extend the life of existing pipework, well beyond the

typically expected industry norms for non-treated piping. This can drive significant savings for multi-unit residential buildings, such as condominiums, by dramatically reducing the amount of reserve fund money required for future funding of piping/water distribution replacement.

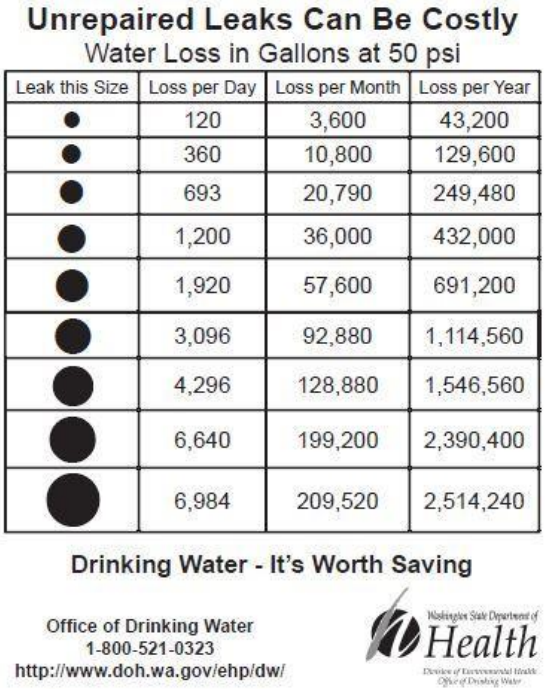
Protection of Potable Water Infrastructure

While designed to protect pipe systems, Hytec AquaSoft also helps protect all devices used in plumbing systems that are at risk of corrosion. Items such as hot water tanks, boilers, heat exchangers and valves could all benefit from Hytec AquaSoft. The polyphosphates and orthophosphate will create the same protective coating as seen in pipes, and prevent further corrosion and scaling. Scaling acts as an insulator, and for devices employing heat transfer to modify the temperature of the water, will affect the devices performance depending on the amount of scaling. Long term, this will lead to failure of the heating device, as more heat is required to perform the same job, leading to overheating and rapid deterioration. Decreasing scaling within these devices, such as a heat exchanger and boiler, will increase efficiency and decrease maintenance and fuel costs.

The Hytec system also typically eliminates the need for additional water softeners. The injected sodium polyphosphate binds to calcium particles in the water, which prevents the calcium from hardening the water. Depending on the water condition in the region, Hytec pH Plus is injected into the water to increase the pH of the water to a slightly basic pH of 7.8-8.0. Increasing the pH will allow the orthophosphate to form its protective coating quicker, and also stop staining found in showers and tubs due to acidic water. Increasing the pH also helps protect pipes, as acidic water causes corrosion and leaching.

In addition to significant savings possible for a condominium’s reserve fund, Hytec’s protection of piping infrastructure can also result in thousands of dollars saved in operational costs each year, as repairing pipes and fixtures can be very costly. The table below shows the significant amount of water lost due to different sized pinhole leaks.

Table 1: Different Pinhole Leak Sizes and their Attributed Water Loss



Unrepaired Leaks Can Be Costly

Water Loss in Gallons at 50 psi

Leak this Size	Loss per Day	Loss per Month	Loss per Year
	120	3,600	43,200
	360	10,800	129,600
	693	20,790	249,480
	1,200	36,000	432,000
	1,920	57,600	691,200
	3,096	92,880	1,114,560
	4,296	128,880	1,546,560
	6,640	199,200	2,390,400
	6,984	209,520	2,514,240

Drinking Water - It's Worth Saving

Office of Drinking Water
1-800-521-0323
http://www.doh.wa.gov/ehp/dw/

Washington State Department of Health
Division of Environmental Health
Office of Drinking Water

Even a small pinhole leak can result in large amounts of water loss per day. But the majority of maintenance costs due to pinhole leaks is not from the actual water loss, but the cost of accessing and repairing the leaks. In order to repair pinhole leaks, many items must be taken into account, such as mold remediation, drywall repair, painting, and plumbing rehab. This does not take into consideration entering tenant or owner spaces, and repairing any possible water damage.

Protection of Sanitary Drain Risers

One of the additional benefits that Hytec claims is the ability to protect sanitary drainage and risers from scale build up. This is based on Hytec AquaSoft removing minerals, such as calcium, that catch and buildup on pipe walls. MH reviewed a video file taken from a sanitary riser from an existing site that was receiving Hytec water treatment. While MH cannot comment on the condition prior to the Hytec treatment process, our observations were that throughout the pipe and tee joints, there were no scale buildup and blockages on this sanitary riser which served a kitchen drain.

Hytec System Controls

Hytec water treatment products are injected into the buildings water supply via a stainless steel injection spool. A second stainless steel piece, located 10 feet downstream of the injection site, samples the water and its contents, before the water is distributed to the building. The composition of the water, pH and product consumption is all monitored by a computer. This computer is connected to the internet, and can be controlled and monitored remotely by Hytec. This ensures the safety of tenants within the building, as well as to ensure operational efficiency of the system. It allows Hytec to always ensure the correct amount of water treatment products

are being injected into the water. If the computer detects abnormally high dosages of the water treatment products, it will shut the system down and send e-mails to the 24/7 Hytec service team. The computer is also able to send emails for service if the water treatment tanks are empty, or if other items such as the pumps are not working correctly. It also has the ability to send weekly data log reports to the property manager.

Water Quality Improvements

Hytec/orthophosphate systems improve water quality after a period of time, as the product must slowly build up the protective coating. This time period is different for every system, as water composition is different for every municipality/building. Hytec AquaSoft was originally installed in Oakridge Heights in October of 2017. Oakridge Heights has reported a large reduction in pinhole leaks, and maintenance costs within the building since it was installed. The data captured via periodic water quality measurements supports this claim from the Oakridge Heights management. The table below shows water samples taken from the ground floor wash room from its install date in October of 2017, to June 6, 2019.

Table 2: Water Quality Measurements Taken Over a 20 Month Timespan.

Date	pH - Cold	Total Dissolved Solids (ppm)	Copper – Cold (ppm)	Copper – Hot (ppm)
2017-10	7.50	250	0.2	0.4
2017-12-17	7.80	220	0.1	0.3
2018-03-27	7.93	230	0	0.2
2018-07-03	7.88	329	0	0.1
2018-09-18	7.50	210	0	0.05
2019-01-03	7.60	268	0	0.05
2019-03-04	7.60	253	0	0.05
2019-06-06	7.70	217	0	0.05

Since October of 2017, the water quality has steadily improved. Particularly, the quantity of copper found in the water decreased significantly between the two domestic water streams. A reduction of copper found in the water signifies less corrosion occurring within the copper pipes of the building. Less copper corroding signifies the Hytec product is working correctly, and that the orthophosphate has successfully created a coating within the pipe.

Hytec Testing

The data and feedback from management at Oakridge Heights showed very positive results for the Hytec system. To determine the physical appearance and get actual tangible results, several pipe sections were removed from different water lines at Oakridge Heights, located at 50 Old Mill Rd. Oakville, Ontario. Four total samples were taken, two from the domestic cold

water line (DCW), and two from the domestic hot water line (DHW). The pipe sections can be seen below.

Figure 1: From left to right: DCW, DHW Boiler Inlet, DHW, and DHW Recirculation. Photos taken after lab testing.

After removing the pipe sections and letting them dry, it was clear that there was a difference in appearance between the pipe coatings. It was expected that, due to past tests done by Hytec, the coating inside the pipe would be completely white, similar to the result found in the left photo above. But the four pipe samples ranged from completely white, to no visible coating at all. To determine if there was adequate coating despite a difference in appearance, the pipe samples were taken to an independent testing lab, BV Labs. The lab tested for total phosphorous, the component of Hytec AquaSoft creating the protective coating. The lab results showed that every pipe sample taken had the desired phosphorous coating, despite differences in appearance. The amount of phosphorus found varied depending on the location the pipe sample was taken from, as higher phosphorous quantities were found in the cold water line, and in larger pipes/areas with higher volumetric flow rates. This difference in coating colour can possibly be attributed to some of the orthophosphate reacting with other components within the water, and not the zinc. The table below shows the amount of phosphorus found on the inside of the different pipe samples.

Table 3: Pipe Sections and the Total Phosphorous Found in Coating.

Location	Total Phosphorus (µg)
DCW	89,000
DHW	61,000
DHW Recirculation	46,000
DHW Boiler Inlet	20,000

Also during this test, thermal imaging was used on the domestic hot water line to determine if the Hytec coating altered the surface temperature of the copper pipes. This was done by using a FLIR thermal camera on a section pipe for two scenarios: initial Hytec coated pipe conditions, and after the same section of pipe was removed and replaced with a new and clean copper pipe. Images were taken for both trials once the surface temperature of the pipe remained constant for a couple of minutes. Black electrical tape was wrapped around the pipe for

consistent readings. The thermal images captured for this test can be seen below. The measured temperature can be seen in the top left of the photo.

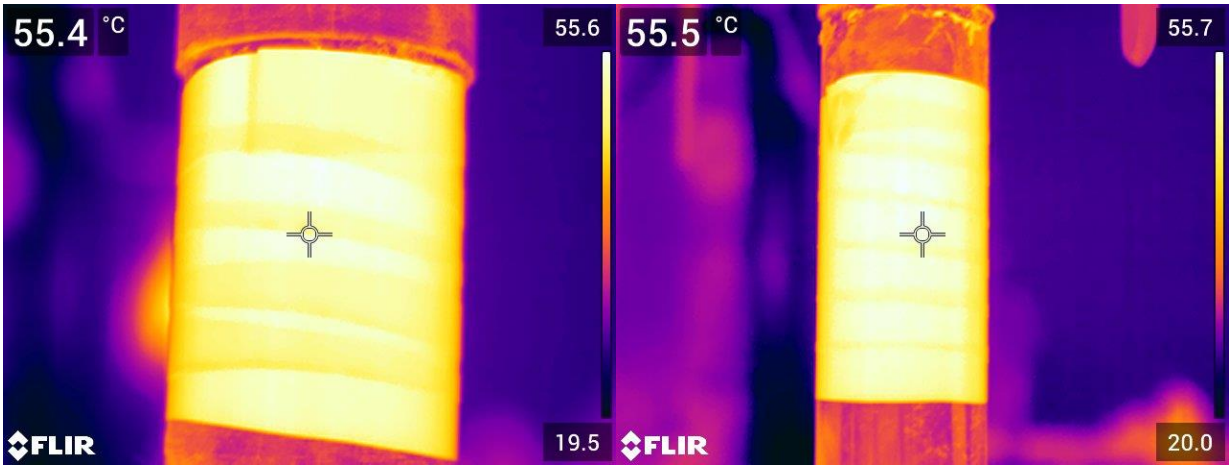


Figure 2: Left shows the thermal picture taken of a Hytec coated pipe, and the right shows a thermal picture taken after that section was replaced with a new copper pipe

Almost the exact same temperatures were measured for both the original pipe, and for the new copper pipe. Therefore the Hytec coating was found to have negligible impact on heat transfer through the pipe, as almost the exact same surface temperature was recorded for both trials.

Municipality Usage

Many municipalities and buildings have been using orthophosphate as an effective way to reduce scale buildup, as well as to prevent further scale from forming. But the more important reason most municipalities have adopted this water treatment technique it is to reduce lead levels within drinking water. Many cities still have thousands of lead pipes underground, such as Toronto, and they often cannot be removed quickly. In 2008, Toronto's tap water was measured to contain on average 11.9 µg/L of lead, far above the 5 µg/L recommended limit by Health Canada. After careful consideration, the city of Toronto began to add orthophosphate into their water in 2014. In 2018, when lead measurements were taken again, measurements were found to be substantially lower than the 2008 measurements, with an average reading of 1.2 µg/L. The table below outlines all measurements taken by the city of Toronto since the beginning of 2014, when they began to implement orthophosphate into their water treatment process.

Table 4: Results from City of Toronto's Lead Testing Program

Time Period Tested	Average Residential and Non-Residential Taps (µg/L)	Average Distribution System (µg/L)
December 2013 - April 2014	-	0.6
June 2014 - October 2014	-	0.3
December 2014 – April 2015	-	7.9
June 2015 – October 2015	-	0.3
December 2015 – April 2016	-	0.2
June 2016 – October 2016	-	0.3
January – December 2017	2.8	0.28
January – December 2018	1.2	0.14
January – July 2019	0.85	0.27

Other municipalities have also begun to use orthophosphates for lead control in Canada, such as Hamilton, Winnipeg, Sudbury and many more. While relatively new in North America, orthophosphate has been a popular solution in Europe for lead and corrosion control for a long time. Orthophosphate has been used in the United Kingdom for the last 30 years, and is currently in approximately 95% of the UK's drinking water.

END OF REPORT

Yours truly,

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