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Observing the Effect of SeaQuest Addition on Manganese Buildup in a Clear Well

Desoto Parish's water treatment plant (wtp) doses potassium permanganate (KnO4) to oxidize and remove the influent Mn. However, the KnO4 does not remove all the Mn, especially during high inflows of Mn water up to 0.8 ppm.

The layout of the system was studied, and we believe the root cause of the manganese issue is lack of residence time. It appears there is enough time to oxidize and remove a certain portion of manganese, but there is slippage downstream. The fact that no manganese is removed via the mechanical filtration indicates the manganese is soluble at this point. SeaQuest works best in keeping manganese soluble (rather than forcing oxidized manganese to become soluble), so the best place to feed the SeaQuest is directly downstream of the physical filters. SeaQuest should not be added near the permanganate feed.

The wtp was built and rated for 350 gallons per minute (0.5 MGD). Current flows are running at 800 gpm or 1.152 MGD. The floc basins are not designed to handle double-paced flow rates.

After the basins, the water flows to a membrane filtering system. The amount of Manganese found in the basin water is equal to the amount of Manganese coming out from the membrane filtering system. This fact suggests that this Mn is soluble because had it been insoluble, the membranes would have captured the Mn.

The soluble Mn leaves the wtp traveling throughout Parish's distribution system. Over time, the Mn becomes oxidized and coats the distribution PVC piping and turns the water brown.

To simulate the effect of SeaQuest addition and the effect on distribution pipe and water clarity we performed an experiment in the clear well by dosing SeaQuest in 1.0 ppm increments to observe the effect on manganese "stripping" and the ability of the SeaQuest to keep manganese soluble.

Our recommendation is to feed 3.0 ppm of SeaQuest downstream of the filters, and observe the immediate effect on the distribution system by opening the closest fire hydrant to the plant. If any colored water is observed, turn off the SeaQuest feed immediately. If no colored water is observed, keep the dose at 3.0 ppm for 7 days, then reduce to 2.0 ppm for 7 days, then 1.0 ppm for 7 days, then 0.5 ppm…

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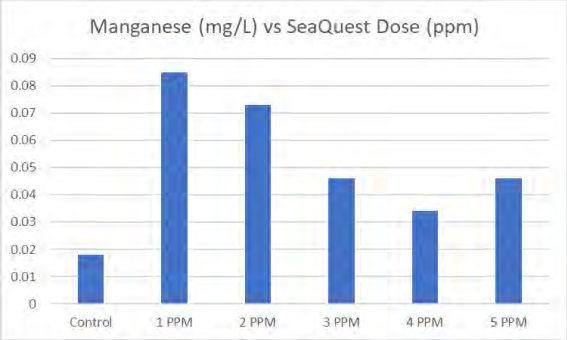
Mimicking Manganese Increase in Distribution Piping

We postulated that the soluble Mn was being oxidized causing particulates and staining on the PVC piping. PVC piping is designed to be 'slick' to inhibit corrosion deposit growth. However, PVC does allow for staining as the pipe becomes scratched giving surface area for Mn to adhere.

To test this theory, the wet well was used to simulate the worst case scenario of coated pipe walls. We see from the photographs, there is Mn staining adhering to the wet well's walls.

The following table shows the PPM and correlating amount of SeaQuest added to the wet well. Manganese levels jumped from the baseline 0.018 mg/L to 0.085 mg/L at 1 PPM. At 3 PPM Manganese levels reduced.



		Manganese Levels Increased & Then Dropped Off			
SeaQuest PPM		**Amount of SeaQuest**		**Manganese mg/L**	**Time**
No SeaQuest		0 mL		0.018 mg/L	10:50
1 PPM		33 mL		0.085 mg/L	11:10
2 PPM		66 mL		0.073 mg/L	11:35
3 PPM		100 mL		0.046 mg/L	11:55
4 PPM		133 mL		0.034 mg/L	12:20
5 PPM		166 mL		0.046 mg/L	12:35

The water samples all remained clear. This test indicates there should be no brown water at a 3 PPM because there is enough SeaQuest to hold effluent Mn in solution and to seize existing particulates and staining. We believe 3 ppm should be the startup dosing rate.

Control	1 ppm SQ	2 ppm SQ	3 ppm SQ	4 ppm SQ	5 ppm SQ

Wet Well Soak

The second test performed was to determine whether additional Mn could be removed with 1,000 PPM. The purpose of this experiment was to find out whether the previous volume of SeaQuest had already saturated the wet well's walls and removed the manganese that could be removed quickly.

	1,000 PPM Wet Well Soak			
1,000 PPM	7 SeaQuest gallons - immediate reading		0.017 mg/L	15:30
	15-minute wait; pulled from top		0.018 mg/L	15:50
	45-minute wait; pulled from bottom		0.013 mg/L	16:45

Manganese levels remained at baseline figures of 0.0177 mg/L and 0.018 mg/L and below. The wet well posed no further threat of Manganese release on that day, October 10, 2021.

This experiment shows that grossly over-dosing the SeaQuest will not have an immediate effect on water quality, even with significant manganese buildup on pipe walls. The SeaQuest is designed to remove buildup over a very long period of time, so this result is in line with what we would expect.

0 Minutes	15 Minutes	45 Minutes

Conclusion

Manganese leaving the water treatment plant is soluble and can be oxidized in distribution piping. Dosing SeaQuest at higher levels should maintain clear water as PVC piping is cleaned of Mn staining and particulates.

Dosing recommendation

We suggest dosing SeaQuest at 3 ppm or 6.4 SeaQuest gallons per Million Gallons.
At 800 gpm (1.152 MG), 7.4 SeaQuest gallons will be used every 24 hours the WTP runs.

There are 2 full 55-gallon drums on hand. Below is a chart that indicates how long 55 gallons of SeaQuest Liquid will last at differing dosing rates at 800 gpm.

	SeaQuest Dosing Over 4 Weeks	
3 ppm & 800 gpm	7.4 gallons per 24 hours of run time	55 gallons will last 7 days
2 ppm & 800 gpm	5 gallons per 24 hours of run time	55 gallons will last 11 days
1 ppm & 800 gpm	2.5 gallons per 24 hours of run time	55 gallons will last 22 days
0.5 ppm & 800 gpm	1.3 gallons per 24 hours of run time	55 gallons will last 42.5 days

We suggest dosage rates 3, 2, 1 ppm be applied for 1 week each in that order. The chemical feed pump should be set to deliver 7.4 gallons per 24 hours in our example and so forth.

Beginning with 1 ppm, SeaQuest liquid should be diluted on a 1 to 1 ratio to maintain 5 solution gallons. We do not recommend going below 5 solution gallons over a 24-hour run time because it is a better application to have a greater diluted solution hitting the chemical pump more often per hour than a more concentrated solution but lesser liquid going through the chemical pump per hour.

Upon arriving at the 4th week, dosing shall decrease to 0.5 ppm. This equals to 1.1 SeaQuest gallons per MG. As the chart indicates, if gallons per minute are 800 gpm, then 1.3 SeaQuest gallons are required over 24 hours of operation.

In this case greater dilution is needed. Recommendation for 0.5 ppm at 800 gpm, calculating 7 days of product at that rate (1.3 gallons x 7 days), 9.1 SeaQuest Gallons should be added to 50 gallons of water. This equals to 0.182 SeaQuest gallons per gallon of water. Per example, if the 50-gallon mixing tank is half full, 4.6 SeaQuest gallons are needed (0.182 SQ gallons x 25 gallons).

Once dosing is properly calculated, pump set and calibrated, SeaQuest dosing should begin.
Note – there are 128 fluid ounces in 1 gallon. For example 0.1 gallons = 13 fluid ounces & 0.6 gallons = 77 fluid ounces.

Monitoring for Brown Water & SeaQuest Residual

The fire hydrant located on the water treatment plant's property should be monitored closely for Mn increase and color. If colored water appears, recheck dilution, pump settings and calibration of pump (mL per minute).

If everything checks out with the dosing, then discontinue SeaQuest feed.

If no colored water appears from the wtp's fire hydrant, then move to a fire hydrant downstream, i.e., half mile, mile or 2 miles. Monitor for color and SeaQuest residual.

Follow the same procedures above. If no colored water, move farther out into the distribution system.

A PO4 residual should fall within this range after calculating the following:
0.23 X SeaQuest PPM & 0.25 X SeaQuest PPM.

Raw or background PO4 should be measured and subtracted from the meter reading to arrive at SeaQuest PO4.