

Hysham Notes for 2/01/2023
Permanganate Optimization and Filter Inspection

To Do:

- Inspect filter and bead chambers. Collect enough data and photos to support a quote for media, air nozzles, and new grates.
 - Photos have been uploaded to https://drive.google.com/drive/folders/1mB53D2GTMWTmA6HIYiy7NZzCrgKND47R?usp=share_link
 - A preliminary list of supplies for the east unit is attached as file: "Hysham East Unit Rehab Supplies List.docx"
 - We will send the preliminary supply list to Josh Queen and Goble Sampson at jqueen@goblesampson.com. They are a preferred provider for WesTech. WesTech forwarded my initial inquiry to Goble Sampson.

- Look for a filter nameplate
 - No nameplate was found.

- Measure lower garnet bed depth (top of blocks to top of angle iron supports)
 - The angle iron rises 3" above the media retaining plates.

- Sketch with parts list for chlorine system repairs.
 - In progress

- Get started with moving turbidity meter.
 - In progress

- Calibrate turbidity meters.
 - We cleaned the sample chambers and performed 20 NTU single point calibrations on both the west filter effluent analyzer and the clear well effluent analyzer. Both calibrations reported a small gain (around 1.015) and both analyzers didn't change readings after calibration indicating the instruments were reading reasonably before calibration.

- Change chlorine bottle / safety practices discussion
 - Bill and Roy completed this on Friday.

- Install large permanganate pump and tubing to permanganate injection point
 - Good team effort installing this with a check valve at the process on Wednesday.

- Work up permanganate rate up in steps watching for pink in top of filters. Set the pump for 100% stroke length and vary the stroke frequency in percentages as noted below. The following

ramp plan is a starting point for our trials. The bead chamber has a residence time of 8 minutes at 250 gpm excluding the volume of the beads, so wait at least 8 minutes between adjustments.

- 0.5 ppm = 40 ml/min (15% on new pump) (4x current dosage)
 - 1.0 ppm = 80 ml/min (29%) (Forsyth Rate)
 - 1.5 ppm = 125 ml/min (44%)
 - 1.7 ppm = 140 ml/min (50%) (Iron & Manganese stoichiometry)
 - 2.0 ppm = 170 ml/min (59%)
 - 2.5 ppm = 210 ml/min (73%)
 - 3.0 ppm = 250 ml/min (88%)
 - 3.4 ppm = 280 ml/min (100%) (4.5 GPH pump max capacity)
 - 4.2 ppm = 350 ml/min = 5.5 GPH (target dosage from manual)
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- We worked permanganate rate up to 2.0 ppm using the schedule above. The top of filters turned from clear to brown as the permanganate rate increased as shown in Figure 1. We monitored the top of filters closely for pink color breakthrough indicating permanganate additions might need to be reduced, but never observed pink.
 - We also monitored filter effluent closely and observed clear liquid as shown in Figure 2 with the increased permanganate usage.
 - We had concern that we could not see flock in the brown water at top of filters. We did a very approximate jar test to see if more chemical additions might be supported. The test samples were:
 - Base top of filter water
 - Base +1 drop of alum solution (+1.8 ppm on 1.7 ppm base as powder alum)
 - Base +1 drop of polymer solution (+0.27 ppm on 0.4 ppm base as powdered polymer)
 - Base +5 drops of alum solution and +5 drops polymer solution (+9 and +1.4 ppm)The tests showed no improvement, so chemical addition rates were left as they were. Addition rates were estimated based on 20,000 drops per liter in a 2-liter sample. The figures above account for the alum and polymer solution strengths.
 - Air scour of the bead chamber after a few hours of operation at higher permanganate rates showed a significant amount of material was being removed from the system / water. The air scour normally looks like Figure 3. The scour looked like Figure 4 after the permanganate was increased. It seemed that there is more material being removed than could be explained by iron and manganese in the feed water, so we suspect material is being removed from the system / beads. We will monitor if air scour operations show reduced red colorations after operating at the increased permanganate rates for a few days.
 - Although the floc was very small in the brown water at top of filters, the filters were effective at removing the color. Turbidity of the brown water was measured at 4 NTU. Turbidity of the filtered water stayed below 0.100 before and during testing. Clear well turbidity started improving on Friday and was down to 0.624 (from 0.9-1.2) by Friday at 1 pm.



Figure 1 – Top of filter water after increasing permanganate additions. A spot check at 2 ppm permanganate was 4 NTU turbidity.



Figure 2 – Filter effluent water. The calibrated turbidity analyzer was indicating in the 0.050 NTU range.



Figure 3 – Typical bead chamber air scour.



Figure 4 – Bead chamber air scour after a few hours of increase permanganate additions.