Krofta Boil Out Report, August 5, 2006

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As planned on August 5, 2006, the Krofta unit was chemically treated (boil out) using 50% sodium hydroxide (NaOH or caustic soda). Preparation for the boil out included a safety review of the project with staff involved with the procedure and Loren Anderson, JF Brennan, Site Safety Coordinator. Those involved from Earth Tech included Roger Pyle, Operations Specialist, and Mark Schmidt, Project Manager. Assistance by JF Brennan staff was provided for forklift operation. The pad level was 6.1 feet at the start of the procedure. A 2 ½ inch fire hose was set up for safety wash down in case of spill or splash. The fire hose would later be hooked up to the non potable tank for backwashing the filter media after the boil out. The GAC valve tree's (6) and plant effluent valve were closed preventing water flow to the GAC units or to the river discharge. Valves were positioned to permit eventual flow from the Krofta to the pad.

Chemical Addition: The plant was taken offline and the Krofta water level was drained down to 6 to 8 inches above the filter media. The center well of the Krofta, or the flocculation area was then drained allowing space for the caustic soda addition. This was accomplished by attaching a hose to the sample line and draining the inlet line to the Krofta through the hose back out to the pad. Once the water was removed, the valve was closed and the temporary hose was removed. The tote of caustic soda was then lifted using a fork lift, out over the Krofta, towards the center well area. Special attention was given to placement of the forklift and the tote avoiding any contact with equipment in the area. The forklift stabilizer pads were used and placed in front of the Krofta control panel and just on the other side of the ramp curb on the flat concrete. A hose had been secured to the tote for product delivery. Once the tote was in place the hose was secured on the Krofta, preventing any possible hose movement during delivery, and then the valve was carefully opened, dispensing the caustic soda to the center well of the Krofta. This was a very quick process. The level in the tote was difficult to see and emptied quite rapidly. Once the flow from the hose had slowed, the forklift was slightly repositioned to tilt the contents, enabling complete draining of the tote. The valve was closed and the hose was removed and pulled through the water for flushing and cleaning purposes. The tote was then removed from the area and placed outside where it was cleaned of any residual chemical on exterior surfaces. The tote was then secured for return to the chemical supplier.

Recirculation: With the caustic soda now in the center well, the carriage pumps were turned on forcing the chemical and water mixture into the 17 cells of the Krofta. The carriage pumps remained on until the level reached 6 to 8 inches from the top of the Krofta. Once the level topped out the carriage pumps were stopped. At that point the ADT pump (without air) was turned on and recirculation began. Recirculation lasted for approximately 1.5 hours. After recirculation, the Krofta was drained down to approximately 6 to 8 inches above the filter media. The drained water from the Krofta went through the filtered water pumps and out the GAC backwash drain line to the pad. The GAC valve trees and plant effluent line had been previously closed preventing flow into the GAC units and or out to the river. The drained high pH Krofta water was

neutralized with acid. Please refer to the process as noted under the air scour section below for neutralization procedures.

Air Scour: With the Krofta level approximately 6 inches above the media, air scouring of the media began. A 45 second air scour was applied to each cell. This was accomplished 4 times during a 4 hour period. After the 4 hour period, the Krofta was refilled and drained twice to the pad in an effort to neutralize the caustic soda with muriatic acid (hydrochloric acid, 20 deg.). The neutralization was accomplished on the pad using a tote of acid. Acid was fed into the stream of water as it exited the backwash hose on the pad. It was gravity feed setup and flow from the tote was adjusted using the tote valve. A hose attached to the tote directed acid to the proper feed point for optimum mixing. Once neutralization was completed, the valve was closed, the hose was removed and cleaned, and the tote prepared for return to the chemical supplier. All exterior surfaces of the tote were flushed with water in preparation for return.

Krofta Backwash: Once the Krofta was drained the second time and the effluent was neutralized on the pad, the Krofta was refilled to operating level and the backwash sequencing began. Initially a 10 minute automatic backwash was programmed into the first cell as a test for benchmarking. It was evident that 10 minutes was not long enough and that other in plant support equipment would prevent a single thorough backwash. A 5 minute backwash was programmed and manual start stop operations of the automatic sequencing were then initiated to permit time for refilling of the non potable tank with potable city water. City water from the fire hydrant was supplied to the non potable tank through a 2 ½ inch fire hose. Over the next two days, 4 backwashes were performed on each cell. A meter and backflow preventer were used during this procedure. Pad level settled at approximately 6.5 feet at the end of the boil out procedure. On Monday, further backwashing and recirculation operations from the pad through the Krofta back out to the pad took place until subsequent dilution and water quality improvement was noted. Dredging operations water also played a key role in rebounding on Monday.

Observations: During the recirculation the water quality changed significantly. The color looked like a dark tea or tannin color and the turbidity after ½ hour went from 59.1 NTU to 75.3 NTU approximately 45 minutes later. This was impressive as it started at less than 5.0 NTU at 3.53 NTU. The pH was at 13.08, 12.89 and 12.73. Other grabs or field samples with the portable pH meter unit that were not recorded showed that the pH was consistent throughout the Krofta and that the recirculation was effective in mixing. A significant observation was the dropping of the gravel in the sight glass window of cell #13. The recirculation process showed stratification of the media in the sight glass during this period. Also of note was the floc layer approximately 1 inch in depth above the media. This layer would expand later during the air scour portion of the boil out procedure to approximately 2 to 2 ½ inches. A positive note was an increase of approximately 10 psi in pressure in the ADT pump during this process.

During the drain down cycles after recirculation when neutralization took place, the quality of the water from the Krofta was reminiscent of a coffee and cream mixture. It was highly turbid with very fine material in the water stream. Foam formed as it exited

the backwash hose and exited the GAC backwash trough. Form spread was significant and the height of the foam was as high as 1 ½ feet. The foam was light and white in color. As the drain water flow slowed, and foam disappeared, long strings of material were left behind. Foam disintegrated when dried, handled and when wetted.

Foam was also present on the Krofta at water level and during air scour, but reduced with time. Foam on the Krofta during air scour was light to dark brown in color.

The air scour again showed pH in the high 12 pH range as per field measurements. These were not logged, just checked to verify that pH remained optimum. NTU as logged started at 1244.0 NTU and progressed upward. 2820.0 NTU, 2835.0 NTU, 3616.0 NTU and 3536.0 NTU was the final sample taken. The under drain tree pattern was evident during air scouring which indicates a positive. Prior to the boil out the pattern was not evident and rat holes dictated the resultant pattern. As previously noted, a layer of floc 2 to 2 ½ inches thick was present after the air scour had time to settle between each air scour.

Backwashing the Krofta after the boil out is key to the effective and final clean up of the unit. A backwash near 20 minutes is required to effectively remove the material from the Krofta. At a full backwash rate near 1000 gpm the present non potable tank with a connection to a 2 ½ inch fire hose does not permit the final required flush of the dirty media. A change is needed to improve this part of the procedure. This can be accomplished by plumbing in a line that feeds the non potable tank at the over flow pipe. This water will only be used for Krofta boil out backwash and GAC backwash when appropriate. The overflow pipe of the non potable tank can be used as a dual purpose pipe depending on valve positioning as per the improvement recommendation envisioned. This improvement should be considered prior to GAC chemical cleaning.

In the future, boil outs should be engineered to make the procedure less cumbersome. A remedy to the backwash issue is required as noted above. This too will impact the GAC chemical treatment plans. A chemical feed pump that will be used during the GAC procedure should be used during the Krofta procedure, eliminating the need to lift the tote of caustic soda overhead. Although this was a planned and safe act, this will limit a potential for an issue to arise in the future.

Next day operations were also impacted. On Monday the influent NTU was at 81.5 NTU and the Krofta effluent was at 79.0 NTU. The pH was at 9.0 pH and the pad was at 6.5 feet. TSS in the influent to the Krofta was at 80 mg/l and the effluent was 76 mg/l. The water quality was not good and dilution from dredging operations was a key to resuming operations. The Krofta was in recirculation mode as all water was redirected to the pad until the effluent water quality had improved enough to release to the river. During the day it continued to improve with the pad level reaching 8.4 feet before the plant was returned to full service at approximately 4 pm. TSS was at 32 mg/l at the influent to the Krofta and at 26 mg/l post Krofta when the plant was returned to service. At 2300 hours the TSS had dropped to 12 mg/l at the Krofta influent and 10 mg/l post Krofta, while post GAC TSS was 6.6 mg/l. The daily composite for TSS was 10.5 mg/l. The bottom line

issue is 3000 plus NTU will have an impact as it concentrates in the pad. This will need to be addressed when the GAC chemical cleaning is planned, as a single unit GAC or a pair of GAC units chemically treated will have less impact on operations then treating all 6 units at the same time. Another concern is the downstream impact as the impact is transferred or migrates to the GAC as the GAC is used to cleanup the poor water quality after the Krofta chemical clean out event.

The filtered water pumps prior to boil out were experiencing vacuum from -15 to -22 inches Hg, with a -18 to -20 a common value. After the boil out the pumps showed minimal pressure or no vacuum.

Further concentration of solids in the pad will impact operations as we move forward...

The Krofta boil out procedure is a 2 to 3 day process that could be minimized with greater initial backwash flows and required duration. Initially it was anticipated it would take 8 to 10 hours. Backwash issues lengthened this time significantly and the required dilution also added to the time increase. However, both are necessities and one has a solution to minimize the impact. Pad settling is a need and future chemical treatments should be planned to boil out completely on Saturday, followed by backwashing, settling in the pad on Sunday, dilution on Monday with an increasing pad level, followed by system startup as water quality dictates.