Implementation of High Efficiency Trickling Bio Scrubbers to Meet Regulatory Requirements and Treat Odors at the Sand Island Wastewater Treatment Plant A Plant Perspective.

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City and County (C&C) of Honolulu operates the Sand Island Wastewater Treatment Plant (SIWWTP) located at the entrance to Honolulu Harbor. As the largest plant in Hawaii, it treats residential wastes from the City of Honolulu, the resort area of Waikiki and wastes from the industrial area in and around Honolulu Harbor. Average plant flow is 65MGD, with peaks as high as 120 MGD.

Located close to the commercial, residential and resort areas, the SIWWTP historically has had challenges meeting the air discharge requirements as well as treating the offensive odors, which are most prevalent from the areas of the headworks and clarifiers.

The main factors contributing to the odor problems are:

- High H2S levels in excess of 600ppm
- Improper technology currently applied for high H2S levels at the clarifiers
- Rapid spikes of H2S created by changing velocities and turbulence from the fluctuating plant flows.

In 2006, a plant improvement project at the SIWWTP included work at the headworks and two new clarifiers. At that time, the clarifiers were equipped with an odor control system. However, after start up, it was obvious the odor control system provided was not capable of adsorbing the levels of H2S, as these high levels were not anticipated during the design phase. The carbon system became saturated with H2S in some cases as quickly as after three days of operation, and the plant personnel were not able to keep up with carbon replacement. Replacement costs for the carbon became substantial, well in excess of $100,000 year for media alone, and as a result of costs and the non compliance, alternative treatment solutions were investigated.

In 2007, the Department of Health (DOH) Clean Air Branch inspected the Sand Island facility and found that the plant had been operating in violation since August 2006, of the 3.0 parts per million (ppm) H2S emissions concentration limits set for the SIWWTP Clarifier Odor Control System. In July of 2009, the DOH issued the City a Consent Order for the SIWWTP (Docket No. 07-CA-EO-05). The consent order requested that penalties of $408, 000.00 should be paid for the permit violations that occurred between August, 2006, and September, 2007. During the negotiation of the consent order, the DOH required the City to address the clarifier odor control emission violations by December 31, 2009. In turn, if the City could achieve this, then the DOH agreed to waive penalties for any stack emission violations from the period of September 2007 until December 31, 2009.

Several odor control technologies were considered to meet the challenges presented by now having to design and construct an odor control system within the two-year window that was provided. As part of the overall evaluation for solutions; operational costs, chemical costs and available footprint were all factors considered before the City concluded that the bioscrubber technology manufactured by Azzuro was the best available technology to help address the plant concerns.

Moving forward, as part of an overall plant upgrade project awarded to Hawaiian Dredging Construction Company (HDCC); a total of 3 separate large odor control systems have been installed at the Headworks, Primary Clarifiers and Solids handling locations. All systems are bioscrubbers followed by carbon polish. In order to assure compliance with the DOH directives before Dec. 31st, it was decided two towers from the Headworks Odor Control System would be set at the location of clarifiers 7 and 8 ahead of the existing carbon system, to be able to treat the high H2S levels, extend the carbon life and allow DOH compliance directives.
To meet the deadline of being compliance by Dec. 31st, the bioscrubber system was started up immediately after installation on September 28th. The start-up period began with initial seeding of the biology taking approximately 30 days then immediately followed by a (required) 60 day performance test. The 60 day test continued on through the Dec 31st target date and ended on Jan 13th.

During this start up and test period, care was taken to not create any H2S emission problems; and no stack emissions were reported during this time period. Compliance was achieved by two main strategies; a start up that slowly increased the airflow through the scrubbers and the use of remote monitoring to carefully monitor performance.

The vendor installed remote monitoring technology to allow real time viewing of all critical data via the internet so all aspects of the start-up could be carefully monitored and any problems anticipated before any violations could occur.

The following parameters were measured and reported continuously:

- pH of bioscrubber drain water
- Air Flow
- H2S - inlet-bioscrubber
- H2S - outlet-bioscrubber (before carbon)
- Water Use

All instruments reported into the bioscrubber control panel which was equipped with modem capabilities and the results were transmitted via a cellular modem to an internet site. The internet site and data was monitored continuously by the manufacturer and the manufacturer's representatives Hawaii Engineering Services, who performed any required settings throughout the start up and performance period. By having real time data available at the manufacturer's site in Phoenix, the bioscrubber performance could be evaluated real time by the biological experts who then could forward any instructions immediately to the field service technicians on site. All data points were recorded every 5

minutes and data-logged, providing a complete electronic file history of all start-up and performance data, also on file with the City. Weekly summary reports were provided by the vendor to the City for review.

Given the magnitude of the daily H2S spikes that occur at the plant, from an average of 20ppm to over 600ppm there was a valid concern of H2S breaking through the new treatment system during the peak times. It is known that with biological scrubbers, the biomass or colony size within the scrubber will adjust to the level of available food in the airstream. Properly designed bioscrubbbers can handle "some" spikes of a reasonable magnitude of H2S without breakthrough. A "rule of thumb" in the industry has historically been bioscrubbers can treat a spike up to a magnitude of up to about 2 times, the average; when measured as the difference between the average inlet level and the magnitude of the spike. The other factor to consider is the frequency and duration of the H2S spike. For example, a spike that occurs every few hours will promote a better biomass growth (and hence treatment response) vs. a spike that only occurs once per day, such as we see at the SIWWTP.

In the SIWWTP scenario, the bioscrubbers showed the ability to absorb spikes up to magnitudes of about 4 times that of the average; much higher than industry standard. Though some H2S would periodically break through when the peak was extreme (see graphs attached) the bioscrubbers showed the ability to adapt to the higher peaks over time, and especially when the average H2S level was elevated. This phenomenon was demonstrated during the 60 day performance test where a (required) artificial H2S gas spiking was performed for a period of 4-6 days to elevate the average H2S levels and prove treatment performance at levels at or above 300ppm. For this procedure, a 3rd party consultant was hired to safely introduce the dangerous gas and monitor the results. In the performance data (graphs) it confirms that as the H2S level was increased from 20 ppm to 180 ppm on average that as the biomass adapted to the higher levels of H2S each day showed a marked improvement in reduction of H2S breakthrough. After 4-6 days of H2S spiking, the bioscrubber was capable of achieving virtually no H2S breakthrough.

To summarize, the bioscrubber achieved average removal efficiencies of 98% at all times and even higher when the average H2S inlet levels were increased.

The City is very pleased with the technology and hopes to now realize the benefits of operating a system that is:

- Reliable
- Does not require media change-outs
- Capable of meeting permit limits
- Less expensive to operate because of less pressure drop across the new media

Since the Azzuro units were put into service, there have been no reported violations at the clarifier odor control stack. By the fall of 2010, the City hopes to have all the other new technology odor control systems started up and operational at the Headworks, Clarifiers and Solids handling.