IRWA News & Events

Lenox Iowa Bio-Dome Pilot Study a Success

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John Veach was initially contacted by the previous independent representative of Wastewater Compliance Systems (WCS). They were looking to do a pilot study in Iowa with their Bio-Reactor Technology, to gather data to be used for Iowa DNR. Mr. Veach went through his list of communities he works with that fit the criteria of WCS and who also had the ability to work with the pilot and perform the laboratory testing. The City of Lenox fit all the criteria and John contacted their operator to see if they had interest in participating in this pilot study. The following is a report from Taylor Reynolds of WCS on this pilot study.

Introduction

The State of Iowa has approximately 700 wastewater systems utilizing lagoons as part of their wastewater treatment system. Most of the continuous discharge systems, are expecting, or have already received new permits from the Iowa Department of Natural Resources (IDNR) that contain new limits for ammonia levels in their effluent discharge. According to the IDNR, the majority of these systems in the state will now be required to meet an ammonia level of around 5 mg/L during the winter months; which are exactly when most wastewater lagoons aren't capable of nitrification to any significant degree. Historically, such stringent winter limits have forced communities to upgrade their continuous discharge lagoons with some form of treatments that can reliably provide nitrification to below 5 mg/L during the winter.

Wastewater Compliance Systems (WCS) and its independent representatives Jim McFarland and Eddie Stewart, of JCI Inc., have been working with the IDNR to prove that communities do not have to abandon their lagoons. Rather, by retrofitting the wastewater lagoons with fixed film bio-reactors, lagoons can, and have shown the ability to nitrify in water temperatures as low 0.4 oC (32.7 oF).

The City of Lenox Iowa, and Quent Dalton, their Wastewater Operator, agreed to work with WCS to provide an in-state pilot study of the efficacy of WCS's fixed-film bio-reactors, known as Bio-Domes. After coordinating with the IDNR, Lenox and Lenox's consulting engineers, Pat

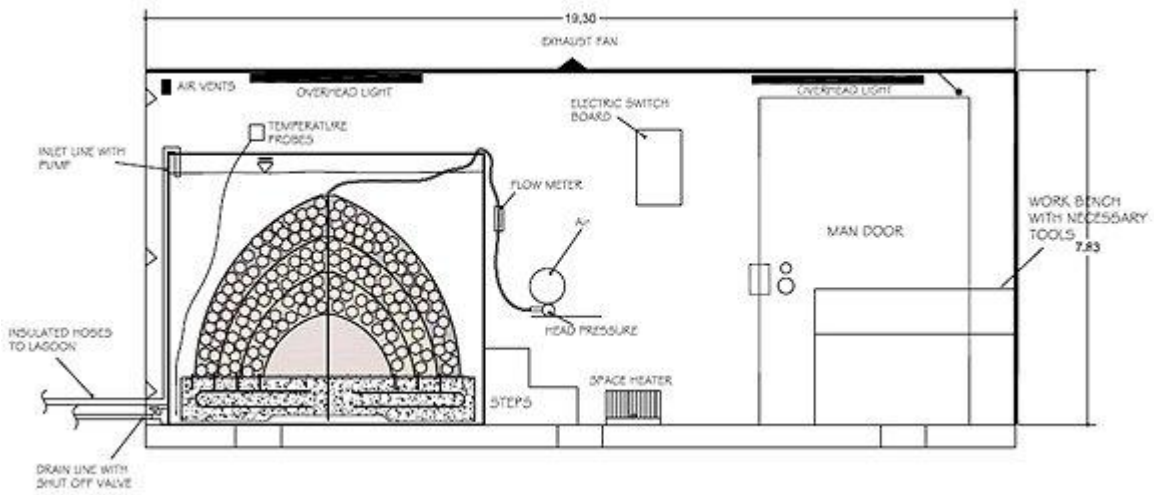
Hall and Ryan Brandt of Snyder & Associates Inc., WCS delivered the Mobile Pilot Unit in August 2011. The pilot study has run through the winter months, during which Quent has pulled samples of both the influent and effluent each week in order to measure the performance of the unit.

The following document provides a description of the equipment used, the operational procedures, and the results of the pilot study to date. Additionally, readers of this summary should be aware that there is a companion spreadsheet with the results of all samples taken that is available upon request.

Setup and Operation

Equipment

Wastewater Compliance Systems' (WCS) Mobile Pilot Units are designed to be a turn-key pilot demonstration of the Bio-Domes for small communities. The pilot unit, consisting of a 20 foot cargo container, comes equipped with 1 Bio-Dome in a 1500 gallon tank, an air compressor with air-flow meter to provide air to the bio-dome, a pump to provide fresh influent, a four channel temperature data logger and all of the paraphernalia required to connect the system and operate the Bio-Dome. The drawing below provides a general layout of the equipment in the pilot unit. The only requirement for Lenox was a 120 VAC source of power on a 30 amp breaker.



Installation

The WCS Mobile Pilot unit was delivered to Lenox IA August, 2011. Shortly after delivery, a WCS representative was sent out to aid in placement, installation, startup and training. Over the following 24 hours the pilot unit was placed on the southern edge of Lenox' third cell and brought online. A pump was suspended in the lagoon roughly 20 feet from the shore of the lagoon using an old surface aerator pontoon to anchor it in position. The influent and effluent lines were wrapped in heat tape, insulated and covered with a protective shell in order to prevent

freezing of the 1" lines during the winter months. The air compressor was set to provide 20 liters/minute which is roughly 2/3 CFM. With the pump providing fresh influent and the air supply in operation the pilot unit was fully operational.

Operation

After delivery and installation, the operation of the pilot unit was managed 100 percent by Quent Dalton. A minimum of three trips per week were made to the pilot unit to ensure everything was operating as it should and samples were collected from the influent and bulk solution (effluent) every Thursday for analysis. The pilot unit was allowed to run for a few weeks before sampling began on September 1, 2011. Thereafter sampling has occurred every week, and will continue until the water temperatures rise and no more ammonia is entering the pilot unit. The samples are analyzed for BOD, TSS, Ammonia, Nitrates + Nitrites, pH and once a month alkalinity. Additionally, tank water temperature, pH and later DO are measured during each visit.
The pilot unit was set up to operate on a "punctuated flow" basis. WCS uses punctuated flow to allow for greater process control in providing product demonstrations. Punctuated flow is achieved by setting the influent pump on a timer so that it turns on every three hours for a pre-determined amount of time. By initially measuring the flow rate of the influent (which varies from location to location) WCS can then adjust the pump-on time to create different Hydraulic Retention Times (HRT). Lenox initially began operation with a seven day HRT and over the course of the winter has reduced the HRT four different times until the most recent samples have been taken with a one day HRT.

Significant Events

The following list is intended to identify changes in operating conditions, and explanations for any oddities in the data.

- September 13, 23, and October 6, 21, & 31 – Ammonium Bicarbonate added to the pilot unit in order to provide food for the biology. The influent from the lagoons during this time didn't contain any ammonia for the biology to use.
- December 15 – HRT in the pilot unit reduced to 3.5 days.
- December 31 – HRT reduced to 1.75 days.
- February 6 – Ice flow in the lagoon tore the pump pontoons free from their anchors causing the system to lose influent over the weekend, and the breaker to trip for no air to the system.
- February 20 – HRT reduced to one day.
- February 27 – Operator identified problems with the pump timer, and had to replace the timer. Sample taken on the 23, un-reliable as the HRT might not have been one day.

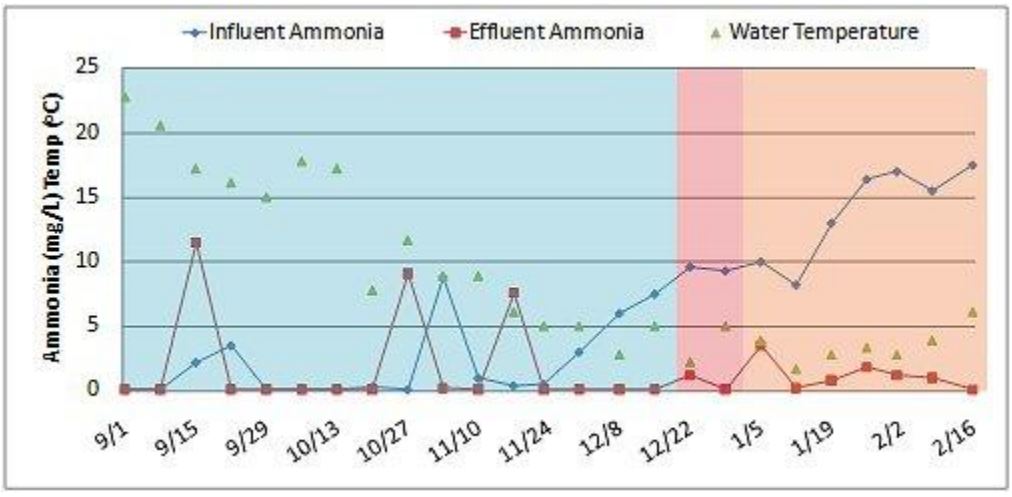
Results

The following chart illustrates the results of the influent and effluent ammonia samples taken from September 1, 2011 through February 16, 2012. Additional data on the BOD and TSS results is available upon request.

Ammonia

The blue shading denotes the samples taken with a seven day HRT, the red for samples taken with a 3.5 day HRT, and the green samples taken with a 1.75 day HRT. The results from our pilot study are a perfect example of the cold weather nitrification difficulties most lagoons have. From September through the middle of November, the water temperatures (shown with green triangles) are above 40 oF (~5 oC). During this time the lagoon is able to nitrify the ammonia for the most part and no ammonia is entering the pilot unit. To keep the biology alive and fed, Quent Dalton was adding a little over 1 lb of Ammonium Bicarbonate to the pilot unit every week, which is shown by the effluent ammonia spikes during this time. Notice though that as soon as the water temperatures drop below 5 oC, the ammonia in the influent starts to rise. This is a result of the biology in the lagoon, shutting down due to the cold temperatures. Regardless of the water temperature however, the Ammonia levels in the effluent stay consistently below 2 mg/L. As the retention time is cut in half on December 15, and again on December 30, there are temporary spikes in the ammonia effluent levels as the biology growth increases to meet the heavier loading demands and the more abundant food source.

On February 20, 2012, the HRT was reduced to one day. To see how the Bio-Dome responds to the increased loading, please contact either WCS or JCI for the latest data.



Conclusion

The pilot study has shown that the Bio-Domes are more than capable of nitrifying ammonia even in water temperatures as low as 35oF (1.7 oC) to levels below 1 mg/L (sample taken on January 12, 2012). In addition to ammonia removal, the Bio-Domes can also act as a final polishing step for BOD and TSS before the wastewater is discharged from the lagoon.
Not only are the Bio-Domes capable of providing the much needed additional treatment they are capable of doing so without any major infrastructure changes to the lagoons, at a fraction of the cost of conventional mechanical systems, and with minimal ongoing O&M expenses. The Bio-Domes are simple to install and maintain, reliable in their performance, and most importantly effective at removing ammonia from wastewater at cold water temperatures for effective, year round nitrification.

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