Treatment of FOG at a Virginia Lift Station Using an Innovative Method

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Introduction

A county in central Virginia has experienced rapid growth in recent years, primarily due to its proximity to Northern Virginia, Fredericksburg, Charlottesville and Richmond. Presently there are approximately 15,000 residents within Town limits and boasting a total population of 44,622 (2006 census). Overall it has grown by a notable 30.2% from 2000 to 2006. The growth has continued at a significant pace since 2006.

Two new shopping centers with several restaurants have come on line in the last couple of years in addition to significant residential growth in the area. Wastewater generated from the new restaurants and associated new contributors has resulted in significant oil and grease issues for the Town's pump station that services the area. A significant grease mat routinely forms across the top of the wastewater within the pump station resulting in regular interference with the floats that control the wastewater level. Backups within the gravity system feeding the wet well could occur, causing overflows as an end result of this situation.

Town staff has had to clear the grease from the pump station as a result of this situation using a costly and operationally difficult measure involving the hiring of a private vacuum truck. Typically, the vacuum trucks have difficulty offloading the grease while dumping at the POTW. Hoses would frequently clog and the activity associated with dumping activity created a significant mess at the plant. The cost of the truck was $1,500 for the first four hours and $500 for each additional hour. A $2,000 pumping fee was not uncommon. As the problem has built up over time, it has not been unusual for the problem to sometimes resurface in only a week's time. The cost to the Town for vacuum trucks would typically approach $8,000-$10,000 per year. However, significant additional costs were realized in the expense for efforts associated with the usage of the Town's staff. Finally, there are certainly additional costs for solidifying and disposing of the grease at the local landfill. All told, the cost for this activity would likely approximate $ 14,000 per year.

Currently the Town has no Fats, Oil and Grease (FOG) policy in place and has no records of the grease traps that are in place. This, however, is on the Town's agenda to remedy in the future.

Typical flow into the pump station is about 70,000 gallons per day. It is believed that meal times likely represent peak flow into the pump station. Cursory analyses for oil and grease seems to confirm the staff's suspicions that the bulk of the FOG issues come into the station during these periods. Data gathered for FOG concentration within the wastewater during these times have ranged between 1,000 to 6,000 ppm. Overall, grease levels within the pump station could reach several inches of thickness in a short period of time.

Fats, Oils and Grease in Wastewater Collection Systems and Solutions to the Problem

Fats, oils and grease can clog wastewater collection and treatment systems, causing sewage spills, manhole overflows and/or sewage backups in homes and businesses. Animal and vegetable based oil and grease generated by restaurants and fast-food outlets are a big part of the problem.

Grease is singled out for special attention because of its poor solubility in water and its tendency to separate from the liquid solution. Large amounts of oil and grease in the wastewater causes trouble in the collection system pipes. It can, and often does, decrease pipe capacity and, therefore, requires that piping systems be cleaned more often and/or some piping to be replaced sooner than expected. Oil and grease also hamper effective treatment at the wastewater treatment plant. Grease in a warm liquid may not appear harmful. However, as the liquid cools, the grease or fat congeals and causes nauseous mats on the surface of settling tanks, digesters, and the interior of pipes and other surfaces. This situation can result in a shutdown of wastewater treatment units.

Problems caused by wastes from restaurants and other grease producing establishments have served as the basis for ordinances and regulations governing the discharge of grease materials to the sanitary sewer system. This type of waste has forced the requirement of the installation of preliminary treatment facilities, commonly known as grease traps or interceptors.

A grease trap is a small reservoir built into the wastewater piping a short distance from the grease producing area. Baffles in the reservoir retain the wastewater long enough for the grease to congeal and rise to the surface. The grease can then be removed and disposed properly.

An interceptor is a vault with a minimum capacity of approximately 600 gallons that is located on the exterior of the building. The vault includes a minimum of two compartments, and flow between each compartment is designed for grease retention. The capacity of the interceptor provides adequate residence time so that the wastewater has time to cool, allowing any remaining grease not collected by the traps time to congeal and rise to the surface where it accumulates until the interceptor is cleaned.

A number of companies offer products that claim to resolve grease issues. However, it is generally understood within the professional wastewater community that solutions are hard to come by in the absence of removal of the problem using an agressive program to stop FOG at its source (i.e. typically restaurants).

EGS-12

The Town's wastewater treatment staff was approached by Jarus Cox with Innovative Remediation Technologies, Inc. (IRT) with a new product that had demonstrated to have positive effect on FOG issues. However, very little had been done with this product outside of a laboratory setting to confirm its efficacy under "real world" conditions. Given the nature of the problem and the costs associated with the problem, the staff was willing to provide an opportunity to test the product at the pump station. Early results were very encouraging and Innovative Remediation Technologies, Inc. was then commissioned to conduct a three month study.

The product used is known as EGS-12. It is a combination of several ingredients including an emulsifying agent and additional chemistry that contemplates providing natural bacteria with the nutrients they would need to digest the FOG once emulsified. Concerns about the approach included the following

1. Would the process prove to be too costly?
2. Would the process solve the grease build up problem?
3. Would FOG reform downline after it accomplished the task of emulsifying the problem?
4. Would the product have a negative affect on the biological population within the POTW?

IRT and the Town agreed on a plan to conduct testing to confirm each of these concerns. The results of these findings are presented within this paper.

Description of the Lift Station

The lift station is located behind a new shopping center. Several new restaurants discharge effluent into the collection system that comes into the station to include several fast food chains and restaurants. The town is unaware of whether they have grease traps and/or how well maintained they are. This situation has resulted in a signficant increase in FOG concentration entering the system. As previously mentioned the flow into the lift station is about 70,000 gallons per day on a normal discharge day with documented FOG concentrations often exceeding 1,000 mg/l to as high as 6,000 mg/l. The resulting buildup of FOG in the wet well can be rapid with problematic levels occurring within a week of a wet well cleaning at times.

Description of Treatment Method

The dose rate for the pump station “wet well” was administered at 4.5 gallons of EGS-12 per day split between two dosing periods. The dosing rate was determined by assuming the total estimated mass of FOG that entered the lift station daily from previously collected data. Based on information provided by the collection system staff, it was determined that the hours of 10 am and 10 pm represented the periods of time when the highest concentration of fats, oils and grease (FOG) entered the wet well. It was concluded that treatment should be administered approximately one hour after these times to best accommodate saturation of the floating FOG. The system, therefore, turned on at 11:00 AM and 11:00 PM each day to spray apply approximately 2.25 gallons of EGS-12 over a 30 minute period of application.

Spray application was accomplished using a Walchem E-Class metering pump. BETE spray nozzles were fitted to 3/8” I.D. HDPE tubing for delivering EGS-12. The Walchem pump was set up to turn on at the prescribed times using an Intermatic Timer with 30 minute on/off switch capability. The discharge side of the Walchem pump was fitted with a Walchem backpressure valve to assure even flow to the spray nozzles. An inline liquid filer was installed to assure that particles that might obscure flow to the spray nozzles would be filtered out. The pump was calibrated to a 4.5 gallon per hour pumping rate using a calibration column to accomodate the 2.25 gallon delivery rate for individual 30 minute pump cycles.

Two weeks prior to initiation of the pilot study, the FOG within the wet well was removed by a vacuum truck as previously described. The EGS-12 pilot test was initiated on October 29, 2008. Some collection of FOG was noticed up the initiation of treatment.

Because of pending cold weather the entire liquid pump system was outfitted with insulation heat tape. Further, a 220 gph submersible pump was placed into the EGS-12 storage vessel to move liquid and impart heat to the EGS-12 during extreme cold events.

Every 4 to 8 business days a Innovative Remediation Technologies, Inc. (IRT) technician conducted an equipment maintenance check to assure that the system was operational and delivering the prescribed dosage of EGS-12. Chemical Refills were done as necessary.

Cursory Laboratory FOG Treatment

Samples were taken from the wet well prior to initiation of the pilot study to determine if the spray application dose rate would be adequate. Wastewater samples containing significant amounts of FOG was obtained from the pump station site. Dewatered grease was added to each of five 250 ml Erlenmeyer flasks. Approximately 3.50 grams of grease was added to each flask along with 150 milliliters of filtered wastewater.

One untreated flask sample was analyzed for total FOG immediately upon readying the vessels for treatment. The remaining four flasks were placed onto a 25 flask New Brunswick Model R-2 Shaker Table. The flasks were rotated at 175 rpm's for a 24 hour treatment period. Two of the flasks were designated "untreated controls". The remaining two treated flasks received an equivalent surface spray dosageof EGS-12 that equated to the 4.5 gallon per day rate contemplated for the wet well. Appropriate dosages of EGS-12 were spray applied twice per day. The first application was done at the start of the experiment and the second dosage administered 10 hours later. All four flasks were removed after 24 hours of shaking and analyzed for total FOG.

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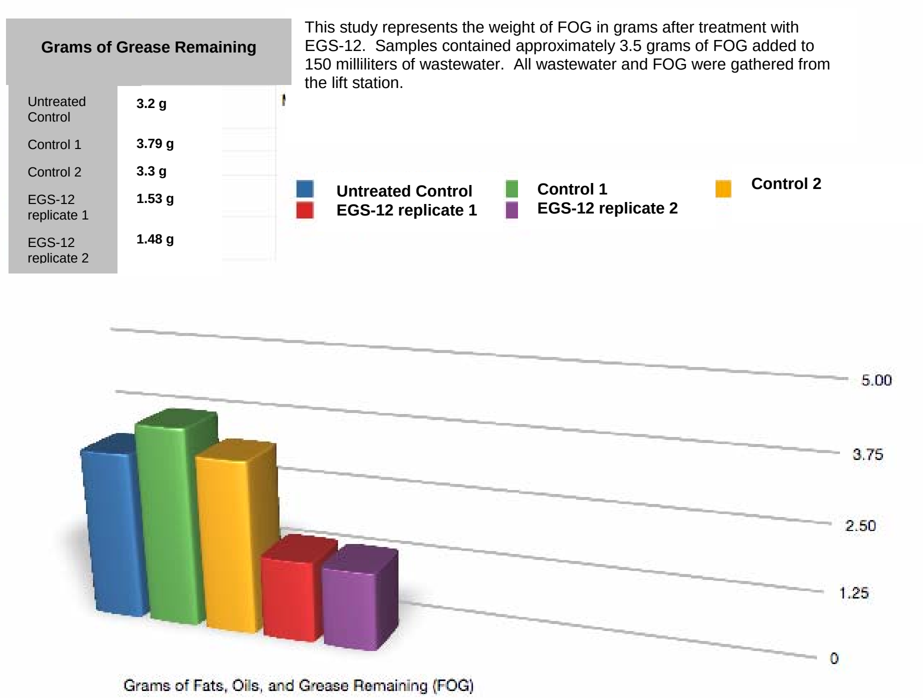
The following graph is the data and results from that test.

Figure 1. Cursory Demonstration of the Effect of EGS-12 on FOG



Results

After 24 hours of treatment, EGS-12 treated beakers had approximately 2 grams less FOG within them than did the control beakers. The data suggests that the population of micro-organism within the wastewater sample may have altered the chemical make-up of the FOG to a point that it was not detected as FOG or the EGS-12 product was somehow involved in altering the chemical structure of the FOG. Additionally, no reformation of FOG was noted in test beakers after the 24 hours study. Visually there appeared to be less floating FOG at the end of the study.

Effect of EGS-12 on Treatment Efficiency of FOG and the Biological Population within Activated Biosolids from the Wastewater Treatment Plant

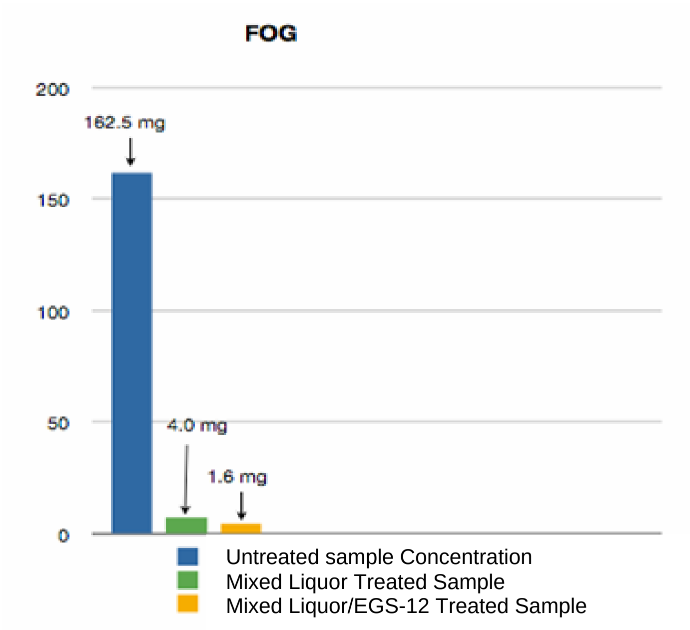
In order to demonstrate that EGS-12 would have no adverse effect on the biological population within the aeration basins of the Wastewater Plant, an experiment was conducted to treat a relatively heavy concentration of EGS-12 within lift station wastewater containing FOG. A sample of activated sludge was taken from the Wastewater Treatment Plant aeration basins along with a sample of wastewater from the influent to the lift station. An analysis was conducted for FOG within the sample. Results indicated that the FOG concentration was 162.5 mg/l.

Two one-liter beakers were filled to the one liter mark with activated sludge from the facility. The activated sludge was allowed to settle below the 500 milliliter mark. Five hundred milliliters of clarified supernatant was decanted from the surface of the beakers, leaving the settled activated sludge. The decanted supernatant was replaced with the lift station wastewater (162.5 mg/l FOG). Beaker 1 received 500 milliliters of wastewater without EGS-12. Beaker 2 received 500 milliliters of wastewater with the equivalent dosage of 4.5 gallons/day of EGS-12 applied to the surface foot of the lift station (~5.3 mls/liter). The intent of the high dose was to determine if high dosages of EGS-12 would adversely affect the biological population and/or reduce the ability of the activated sludge to degrade FOG.

The two test beakers were vigorously aerated for 6 hours. Air flow was cut off after 6 hours to allow the biosolids to settle. A sample was collected from the supernatant of both beakers and sent to the lab for FOG analysis.

Results

The results of this study are presented in Figure 2 below.
Figure 2. FOG Concentration After Treatment



As noted in Figure 2, degradation of FOG within the EGS-12 treated sample and the untreated sample occurred within each sample substantially. The assumption would be that the biological population was responsible for degrading the FOG. The results indicated a drop in FOG concentration in both samples by over 95% (95% for sample not treated with EGS-12 and 98% destruction with EGS-12 treatment) within the 6 hour treatment period. These results would support the presumption that EGS-12 does not inhibit the degradation of FOG related organics within an activated sludge wastewater system.

A test for oxygen uptake rate was conducted on the activated sludge within each beaker after the treatment event to determine if there was a substantial difference in the uptake rate of oxygen between the EGS-12 treated and untreated samples. The oxygen uptake rate for both treated and untreated samples was similar at ~3.2 mg/l/minute for both samples. These findings would further support the assumption that EGS-12 did not have an adverse effect on biological growth.

Visual Results from Lift Station Pilot

The following two pictures represent the visual nature of the results of EGS-12 treatments. The untreated photo was taken two weeks after the wet well was cleaned with a vaccuum truck (Figure 3). Two weeks of FOG buildup is obvious in this picture. The second picture is a visual of the same wet well a few days after treatment with EGS-12 was initiated (Figure 4). This picture is representative of the consistent visual quality of the FOB situation within the wet well over the three months since the initiation of treatment.

Figure 3. Untreated Wet Well at Lift Station

Figure 4. Lift Station after EGS-12 Treatment

Conclusions

1. EGS-12 treatment for FOG at the Lift Station was effective and represented a lower cost alternative to mechanical removal of FOG.
2. The addition of EGS-12 to a biological waste treatment system did not appear to adversely affect the biological population.
3. There was no sign of reformation of FOG downline from the treatment application at the Lift Station or within beakers during lab testing.
4. Lab treatability results indicated that biological destruction of FOG occurred in the presence of EGS-12 emulsified fats, oils and grease with > 98% destruction after 6 hours of contact with aerated activated sludge.