Concurrent Sessions
Track: Case Studies

Tuesday, October 15, 2019
8:00 am to 8:30 am
Attached growth biological treatment of residential gray water with Eljen® GSF modules and #20 filter sand
Eric Daniels

A 5,700 L (1,500 gal.) concrete septic tank was used as the vessel for a gray water treatment system serving a 3-bedroom home in Macon, Ga. The tank was separated into two compartments with capacities of 1,900 L (500 gal.) and 3,800 L (1,000 gal.). The first compartment, 1,900 L, received the gray water flows from the house and provided an opportunity for settling. The settled gray water was discharged from this compartment via gravity flow through a bristle-type septic filter and into the 3,800 L compartment which contained an attached growth biological treatment unit (AGBTU) and sump. The AGBTU consisted of a single-layer of three Eljen® GSF modules over 36.8 cm of #20 filter sand. A sump was created beneath the AGBTU by wrapping Atlantis D-RaintankTM modules with a high strength woven geotextile. The effluent was discharged from the sump via a ½-HP high-head effluent pump connected to sub-surface drip emitter fields. Pump operation was managed with an AquaWorx controller. The system has been operated in both recirculating (forward flush discharged to the settling tank) and single-pass (no forward flush) modes. Research results indicate that the households average potable water demand is 966.45 lpd (255 gpd) of which 54% or 538.2 lpd (142 gpd) is used for bathing/showering and laundry. Settled gray water had average COD, BOD5, and SS of 347, 161.6, and 35.6 mg/l, respectively. When operated in recirculating mode, the AGBTU had an average loading rate of approximately 5.9 gpd/ft2 and produced an effluent with average COD, BOD5, and SS values of 55, 13.5, and 2.2 mg/l, respectively. Single pass operation resulted in an AGBTU loading rate of approximately 6.1 gpd/ft2 and produced an effluent with average COD, BOD5, and SS values of 94, 21.8, and 3.5 mg/l, respectively.

Tuesday, October 15, 2019
8:30 am to 9:00 am
Strategic Alliances: Decentralized and Centralized Treatment Working Together
Allison Blodig

To help facilitate sustainable community growth options while protecting public health, engineers and health officials need innovative wastewater treatment solutions. The evolution of decentralized systems over the last 25 years has resulted in providing efficient and cost-effective alternatives to large centralized wastewater treatment plants. In fact, decentralized community systems are equipped to collect and treat more than 1 million gallons of wastewater per day. In this case study, a decentralized treatment strategy was designed to be used in concert with a centralized wastewater system and offered an innovative and environmentally friendly solution for a lakeside development lacking space and a wastewater treatment facility close to capacity.

Concurrent Sessions
Track: Case Studies

Tuesday, October 15, 2019
9:00 am to 10:00 am
Characterization of Wastewater from Cannabis Processing Facility and the Impacts on Domestic Wastewater Treatability
Brenda Martinez

Cannabis farming and processing has limited published data in the United States regarding the constituents in wastewater and process by-products, and what type of impact it has on on-site and municipal wastewater treatment facilities. This type of information is critical to policy makers in order to establish best management practices for the processors and provide a clear understanding of the waste being produced. The presentation will walk through a bench scale study performed in a laboratory using a combination of respirometry and suite of standard wet chemistry analysis to determine the impact of introducing cannabis process water collected from the wash areas of a recreational cannabis processing facility in Colorado, in varying dose rates, to a biological reactors containing typical domestic wastewater collected from a municipal treatment facility in Mississippi. The assessment will be based on standard industry parameters for determining effective effluent treatment, such as microbial health, sludge production, odor production, and treatment effectiveness, in addition to characterizing process waste stream for standard wastewater parameters such as pH, dissolved oxygen (DO), biochemical oxygen demand (BOD), total suspended solids (TSS), and nutrients, to determine overall process impact.

Tuesday, October 15, 2019
10:30 am to 11:30 am
Wastewater in Marijuana Cultivation
Scott Moore

This presentation focuses on the methods used to determine the waste strength from an active marijuana cultivation center. The presenter will examine the concerns attached with specific results (BOD, TSS, Nitrogen, pH, cannabis byproducts, etc.) from testing. The environmental impact of each identified result will be examined, specifically focusing on disposal concerns. The presentation will end with a discussion on methods used to manage the wastewater and will include an examination of treatment options, standards that exist to address the concerns of the industry and considerations on pump and haul. The research is ongoing and the results will be presented at NOWRA.

Tuesday, October 15, 2019
1:00 pm to 1:30 pm
Mitigating pathogen concentration and regrowth: managing septage for land application using geotextile bags
Christine Gan

The disposal or beneficial use of hauled sewage (septage) should consider the quality of the material to ensure that any potential environmental impacts are mitigated. This presentation will focus on the microbial quality of hauled sewage, specifically looking at the indicator organisms: *Escherichia Coli*, *Fecal streptococcus*, and *Pseudomonas Aeruginosa*. Organic residuals, such as hauled sewage, that may have high in pathogen content pose a higher risk due to their susceptibility to runoff and subsequent contamination of ground and surface waters, and increasing pathogen content during storage can lead to coliform densities exceeding provincial/territorial biosolids guidelines. In the past, it has been found that mechanical methods of dewatering digested municipal sewage biosolids can lead to increases in certain types of indicator bacteria, such as *Escherichia coli* and fecal coliforms. This likely happens as a result of shear forces causing floc breakup and the release of reactivation compounds, which in turn encourages the regrowth of bacteria. Regrowth of bacteria typically occurs in the cake over several days because of the readily available substrates and nutrients released from floc perturbance. In this limited study, a non-mechanical form of solids dewatering--the Geotube --was used to dewater

and consolidate hauled sewage. It was hypothesized that the passive dewatering process would prevent shearing of the floc, which would in turn prevent both lysis of bacterial growth inhibitors and the release of growth-supporting proteins. Counts of three indicator organisms were enumerated in the Geotube cake over a period of 36 days. It was observed that concentrations of all three indicator organisms decreased considerably from the initial concentrations, with total reductions of 91%, 72%, and 66%, respectively. The results indicate that a passive method of solids dewatering and consolidation, such as the Geotube, can be used for treatment of septage prior to land application, and can reduce the incidence of sudden increase and regrowth of pathogens.

Tuesday, October 15, 2019
1:30 pm to 2:00 pm
Treatment of Michigan Winery Wastewater with Gravel Bed Vertical Flow Constructed Wetlands
Katelyn Skornia

Intermittent production and high concentrations of biochemical oxygen demand (BOD), ammonia, and soluble phosphorus (SP) make winery wastewater challenging for on-site treatment. Currently, many Michigan wineries use land application for wastewater management, but new regulatory recommendations require more land so a compact alternative is desirable to prevent the loss of vineyard space to wastewater treatment. To reduce the treatment area, this study investigated the use of gravel bed vertical flow constructed wetlands (GBVFCWs) in removing high concentrations of BOD, nitrogen, and SP from winery wastewater. GBVFCWs consist of three subsurface gravel cells connected in series that utilize aerobic and anoxic conditions to promote biological degradation. The addition of SP adsorption media removes high SP concentrations from the effluent wastewater. In this study, a bench-scale GBVFCW exhibited rapid performance when inoculated with secondary effluent from a domestic wastewater treatment facility prior to winery wastewater flow. At 68°F and various loading frequencies, the GBVFCW removed an average of 99% COD (used as a proxy for BOD), 66.5% nitrate, 93.8% total nitrogen, and ammonia to levels below detection limits. Nearly all treatment occurred within the first cell, indicating that aerobic and anoxic environments were present. The SP adsorption media, PO4Sponge by MetaMateria (Columbus, OH), removed 99% of total phosphorus from the effluent wastewater. Preliminary results indicate that the performance of the system is not impacted at a reduced temperature of 50°F. A HYDRUS Constructed Wetland 2D model is being developed to predict performance under different influent concentrations and temperatures. Based on this research, GBVFCWs are a compact and effective option for winery wastewater treatment.

Tuesday, October 15, 2019
2:00 pm to 2:30 pm
Case study: Using algal biofilms to treat onsite commercial wastewater at a truck stop in rural Indiana
Daniel Johnson

A rotating algal biofilm system was installed at a commercial truck stop in October of 2016 to treat a design average flow of 12,000 gallons. The system in fact received flows ranging from 3000 gallons to 20,000 gallons but there was no dilution associated with the increased flows. The project was problematic due to incomplete design information concerning the influent criteria. The influent CBOD5, TSS and TKN often exceeded 800 mg/L, 600mg/L, 100 mg/L respectively. This was unknown at the time of design because of the way the influent had been sampled in the past because of the previous plant design. The short collection system did not allow for the conversion of TKN to ammonia or the breakdown of particulate CBOD to soluble CBOD. The plant was designed based on influent CBOD5, TSS and ammonia of 440 mg/L, 400 mg/L and 40 mg/L respectively. The biofilm system proved to be resilient and performed better than expected under the overload

circumstances and after the biofilms carrier enhancements, aeration modifications and the inclusion of a recycle line the it reliably met the 18-12-1.3 NPDES discharge limit. This paper reports the actual surface area loading rates and in particular focuses on the CBOD5 removal and the conversion of TKN to ammonia.

Tuesday, October 15, 2019
2:30 pm to 3:00 pm
Consistent Compliance with Low Level Nutrient Limitations with Extreme Flow & Load Variation Using Small System Membrane Bioreactor
Laura Marcolini

The performance challenge for an Enhanced Nutrient Removal (ENR) process is in the control of the biology. In the case of large municipal wastewater treatment plants (WWTPs), flow and load variations are typically diurnal. In the case of small systems associated with schools, rest stops, retail complexes, and even shared residential systems; however, flow and load variations are extreme and may have seasonal maximum and minimums lasting for periods of time greater than treatment system bacterial growth and decay cycles. These extremes cause tremendous challenges for process control and stability, as they cause biological stress and make it difficult, if not impossible, for operators to achieve consistent regulatory discharge compliance. Small wastewater systems typically include septic tanks for primary suspended solids removal; however, some degree of degradation of biochemical oxygen demand (BOD) and nutrient (ammonia-nitrogen and phosphate-phosphorous) release is also achieved. The relatively low BOD-to-nutrient ratio provided in septic tank effluent creates further challenges for advanced or enhanced nutrient removal processes. Typically, liquids handling equipment is not designed with large turndown capacity, and operations staff do not always have full-time purview over operating setpoints. Table 1 providesexcerpts related to pollutant variation in septic tank effluent used for membrane bioreactor (MBR) and reuse research (Nam 2006). This paper will present at least two (2) years of operating data from the Gerstell Academy wastewater treatment process. The facility is a school, and as such, wastewater generation is sporadic and seasonal, indicated by extreme flow fluctuations in Figure 1, where the blue line represents the average flow through the plant on any given day from January 1st, 2018 through August 1st, 2018. Gerstell Academy is an independent, co-educational pre-K to 12th grade school located in Carroll County, Maryland that was established in 1996 by Dr. Frederick G. Smith. The school was initially permitted to discharge wastewater through a standard home use septic system, due to its relative small size. In 2002, a 9,800-GPD Sequencing Batch Reactor (SBR) was designed for phased installation, as the school faced growth. Extreme variations in the diurnal and seasonal flow cycles proved to be too difficult of a challenge for the SBR to treat wastewater to local ENR discharge levels and the School was unable to commission the first phase of equipment for use. Membrane bioreactors (MBRs) have proven better-suited for treatment of small system waste streams, but challenges associated with turndown and control must be considered. Comparative advantages with respect to traditional treatment techniques include smaller footprint, high loading rate capabilities, modularity and disinfected/highly clarified effluent immediately suitable for reuse (Boguniewicz-Zablocka and Capodaglio, 2017). In Spring 2017, Innovative Treatment Products (ITP) delivered its miniMBRÂ® Advanced Membrane Bio-Reactor Package Plant with ENR and Water Reuse Capability, which was set in place pre-wired, pre-piped and pre-tested for final connections on a single day. Within two weeks of delivery, the complete system was operational and commissioned for startup. The ITP system is built into a vacuum infused, close-molded monolithic fiberglass reinforced plastic (FRP) structure, measuring 10' wide x 13' tall x 36' long. Sanitary wastewater is collected in underground infrastructure (septic and equalization tanks), then screened and processed by the miniMBRÂ® Package Plant. The biological process reactors and

the membrane skid are housed within the FRP structure and are decoupled in ITP's miniMBRÂ® process. The membranes are skid-mounted, out-of-basin, tubular, crossflow units, requiring low airflow to support membrane scour. The 0.03 micron ultrafiltration (UF) membranes and ancillary MBR process equipment including pre-screening and grit removal, blowers, control valves, pumps, instruments and controls are skid mounted so operators do not have to routinely access biological process basins. Skid mounted equipment including pump and blower motors, valves, and sensors are designed for easy maintenance with standard tools and equipped with quick disconnects, which allows the operations staff to safely disconnect devices for calibration, repair or replacement without lock-out tag-out issues and without taking the system offline. A unique hydraulic flow and air scour system affords extremely low energy consumption and minimal dissolved oxygen carry-over to the biological process. The design criteria for the miniMBRÂ® process is based upon influent containing up to the flows and pollutant loads stated in Table 2. The miniMBRÂ® process is operated with dynamic control parameters and provides turndown far-exceeding that typically offered in the wastewater treatment industry. By applying a dynamic model of the plant, the return sludge ratio was identified as the most important parameter, and during vacation periods without loading, the Bio-P activity is kept constant if the aeration is reduced to 5-20 min d-1 (Abegglen, Ospelt, and Siegrist 2008). Graphical analysis of the system's effluent quality is provided in Figure 2, showing continuous compliance with discharge criteria. The gray line represents Total Nitrogen (TN), the blue line is Biological Oxygen Demand (BOD), and the orange line is Total Suspended Solids (TSS). ITP's miniMBRÂ® effluent is consistently below the Nutrient Pollutant Limit of 10 mg/L, and the compliance status is attributed to the system's turndown capacity and dynamic process control.

Tuesday, October 15, 2019
3:30 pm to 4:30 pm
Design & Operation of a Decentralized Wastewater Treatment & Recycling System in an Australian Ecodevelopment
Ben Kele

The Sunrise at 1770 development is a 172 lot eco-village located in Queensland, Australia. It adjoins the Great Barrier Reef Marine Park and has stringent environmental controls; especially on off-site impacts. The development is completely off-the-grid in regards to the engineered water cycle. It provides its own potable water, wastewater treatment, and water recycling scheme. Potable water is a combination of roof harvested stormwater and treated groundwater. A bespoke batching treatment chain has been developed for wastewater treatment. The sewage treatment plant (STP) produces Class A recycled water that is used internally within the dwellings to flush toilets and at the cold water tap in the laundry. Externally the recycled water is used for irrigation and as a back-up fire fighting water supply. Each house in the development has dual septic tanks installed. The primary treated effluent is then pumped to a Balance Tank; which acts as the inlet works to the main STP. The balance tank is aerated by a recirculating venturi system. The stored water is then pumped through zeolite, sand, and granulated activated carbon filters. It is disinfected with a high velocity sonic disintegrator which uses sound waves and pressure to kill microbes. Further filtration is provided microfiltration and reverse osmosis. The treated water undergoes chlorine disinfection and is stored in recycled water tanks. The Sunrise at 1770 development started construction in 2005 and Arris has designed, built, operated and maintained the system. This paper will detail the design of the treatment systems, the regulations and monitoring schemes covering the operation of the installation. The paper will also detail how operational knowledge has influenced the upgrades performed on the treatment chain since its installation.

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