Upflow Anaerobic Sludge Blanket (UASB)

Upflow Anaerobic Sludge Blanket (UASB)

Fall 2015

The Fall 2015 Upflow Anaerobic Sludge Blanket (UASB) group has continued the previous work of the AguaClara anaerobic wastewater groups. Challenges addressed during this and next semester include testing reactor leakage and creating an airtight design, combining a UASB unit with a GSBR unit in an attempt to improve overall treatment capacity, and oxygen stress testing to determine the robustness of the reactor. The beginning of the semester was spent cleaning and removing biomass from reactors, testing for leaks using a bubble solution, and performing a single-day pressure test in an attempt to approximately quantify the volumetric leakage rate. Two UASB reactors were inoculated and began producing biogas within the first week of operation. COD analysis and gas chromatography were performed to characterize the efficiency of COD treatment and methane production within the reactors. UASBs are part of AguaClara's wastewater program, which is working to expand wastewater treatment programs in rural areas in Honduras and future AguaClara work sites.

Spring 2016

The Spring 2016 Upflow Anaerobic Sludge Blanket (UASB) group moved from the teaching lab to the AguaClara lab. As a result of the smaller lab space and problems with older reactors, 4 new reactors were built of a height of roughly 2.4 ft, and an inner diameter of 1". The reactors were designed to have a hydraulic retention time of 4 hours, based on vavlues in the literature. The upflow velocity was fixed at 0.05 mm/s. This upflow velocity is 2x lower than the lowest value found in literature. It was decided that it was similar to an operating UASB range and was chosen due to equipment constraints including pump size available, feed concentration, and required inlet flow rate. The team has modified the new reactors to have fewer ports to the reactor to minimize opportunities for gas leakage. The team also added a union in the center of the reactor body to make it easy to disassemble when maintenance is required. It is our hope that the next UASB group will be able to use the newly fabricated reactors to assess the effect of oxygen stress and variable influent strength on culture resilience.

Fall 2016

The Fall 2016 UASB team is looking to further progress the research conducted by previous teams. The reactors were kept running over the summer by the diligent work of Andrew Kim, so time will not be spent on inoculation. Instead the team will focus on optimizing reactor performance by upgrading the gas measurement system and increasing air tightness. The experiments conducted by the team this semester will include testing the reactors ability to degrade high strength wastewater such as backwater. The HRT of wastewater flowing through the settled bed will also be measured this semester. The team plans to characterize reactor performance through the use of GC, COD, pH, and VFAS analysis. Once sufficient data is recorded, comparisons to wastewater in Honduras will be made and models will be developed to determine feasibility of implementation in Honduras.

Spring 2017

During January 2017, a proposal for a novel UASB reactor was submitted to the Environmental Protection Agency P3 competition. This novel UASB reactor would be prefabricated, operated electricity-free, and affordable for small communities in the global south. Two innovative components of this UASB reactor is the submerged lid and plate settlers. The Spring 2017 UASB team tested the efficiency of these two elements and found that the submerged lid has the capacity to be gas-tight and therefore should be part of the UASB reactor. However, the results of the plate settler tests were inconclusive and the test should be repeated to determine if plate settlers improve solids (granule) retention.

Summer 2017

The Summer 2017 UASB team worked on conlusively determining the need for plate settlers in the proposed pilot-scale design. Over the length of the summer, the bench-scale reactors were kept running to establish steady state conditions in the sludge bed. In this time, different reactor geometries were tested to determine optimal reactor designs that would improve SRT while preventing overdesign that would be time consuming and costly in fabricating the pilot scale design. The team ultimately determined that capture velocity may be maintained on the same order of magnitude as the upflow velocity prevent granule escape.

Fall 2017

The Fall 2017 UASB team has worked the pilot scale UASB design and working on the EPA P3 Proposal Phase 2 application. We have been communicating with the Ithaca Area Wastewater Treatment Facility, hereafter referred to as the IAWWTF, about housing a pilot scale UASB that is similar in design to the 1 L/s plant. We also worked on the bottom inlet geometry of the UASB as well as the gas lid design and capture method.

Members

Cynthia Chan - cc2467@cornell.edu

Zac Chen - zc76@cornell.edu

Ian Cullings - idc25@cornell.edu

Sarah Yingge Wang - yw895@cornell.edu

Documents

	Challenges	Tasks	Symposium	Final Presentation

Fall '15	UASB Fal...nges.pdf	Report U...2015.pdf	UASB Sym...ptx.pptx	UASB Fina...tion .pdf
Spring '16			UASB Spr...ium.pptx	? Unknown Attachment
Fall '16				
Spring '17		Please see final report appendix		
Summer '17				Summer '17 Final Presentation
Fall '17	Challenges	Task List	Symposium	Final Presentation

Spring