Sequencing Batch Reactor

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INTRODUCTION

Raw wastewater contains a high concentration of microorganisms. If these high concentrations of organics were introduced into natural aquatic bodies, they would consume the dissolved oxygen in the water and causing mass macro-fauna deaths.

A Sequencing Batch Reactor is one of the many ways available to treat wastewater. It cycles of mixing and oxygenation to stimulate certain micro-organisms to remove nutrients such as phosphorus and nitrogen which then renders the effluent safe for the natural environment.

Building

Electrical Building

Setting up the electrical components for the automation of cycles required three critical components. An Arduino, to manage timings, an air pump, to aerate the fluid, and a motor, to mix the fluid.

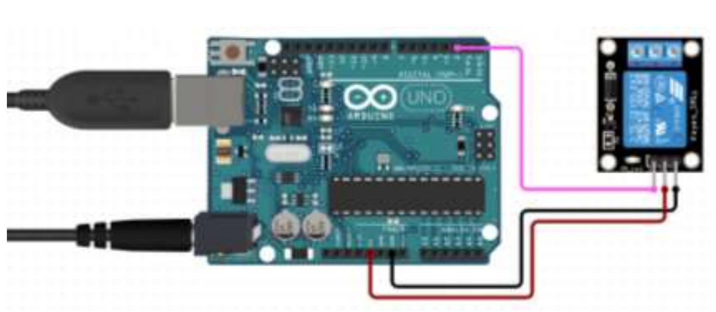

Figure 1. Motor Control Schematics

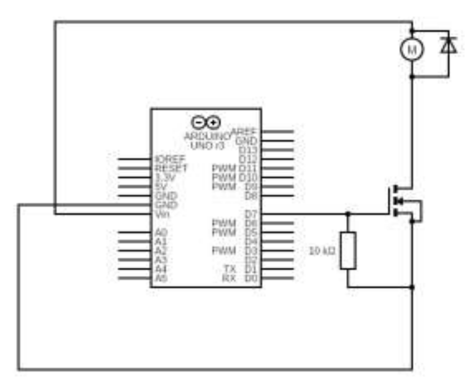

Figure 2. Air Pump Control Schematics

Mechanical Building

The mechanical portion of this project was the main portion. The SBR was created using aluminum stock and parts ordered from McMaster Carr. The most important part was to create a watertight seal around a rotating shaft. This was achieved by compressing the shaft against a rubber washer to seal it and a nylon washer to reduce friction and promote rotation. The second defense against leaks is a spring-loaded shaft seal that closes around the shaft to prevent water passing through it. Finally, this is connected to the motor to spin it. The rest was building the base to hold everything together and the tank for the reactor.

Results

The project itself was a success in terms of building and mechanical function. Unfortunately due to the CODVID-19 outbreak, testing became near impossible without access to campus resources. The project itself did do the cycles as intended. This means there was no water leakage, no deviation in cycle timings and the microcontroller successfully turned on and off the other components.

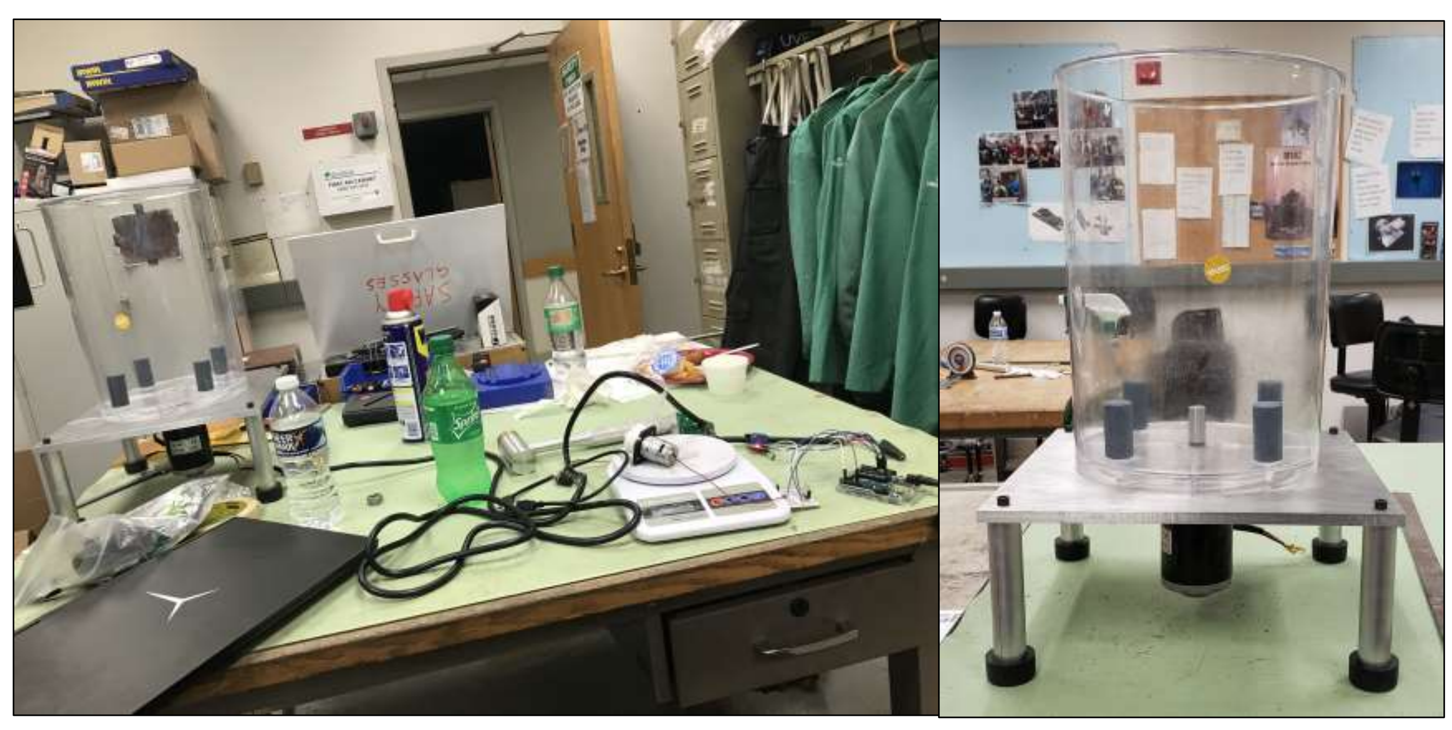

Figure 3. Testing the SBR and final design

Future Work

Conclusions

The SBR is ready to be tested and only needs minor modifications to get things running. As stated before, this was the only thing we could complete with the COVID-19 pandemic closing facilities on campus.

The future of this project is dependent on, building the circuit box for the sequencing batch reactor, changing the length of tubing used in the project, or upgrading to a more powerful air pump.

With a singular microcontroller it is possible to make more SBR's with the proper implementation of a user interface. This means usage of buttons to turn on and off certain sequencing batch reactors as well as labeling them.

Of course for the future, this project needs actual testing to be done. The plans for this project were to test for the following: ≤ 10 mg/L Chemical Oxygen Demand, ≤5.0 mg/L Suspended Solids, ≤2.0 mg N/L Nitrite Nitrogen, ≤5.0 mg N/L Nitrate Nitrogen and ≤5.0 mg P/L Total Phosphate. If future work is done with this SBR these are the recommended standards, as they are reasonable to obtain and close to being environmentally safe.

Acknowledgements

Thank you to Dr. Mines for not only providing this project to us but also advising and guiding us with the chemical aspects.

Thank you to Dr. Hill for your guidance with all aspects of the mechanical side of this project.