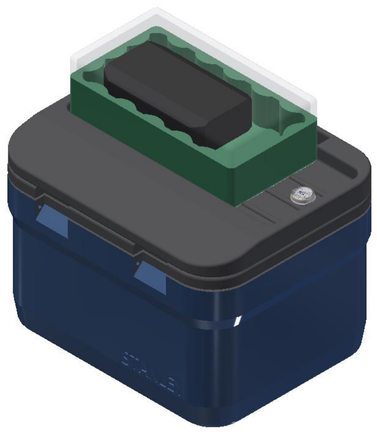
Designing a Portable Incubator for Engineers Without Borders

Sarah Hall – Science, Discovery, and the Universe
Mechanical Engineering – info.sarah.hall@gmail.com

College Park scholars

Objective

To design, build, and test a prototype for a more efficient and accurate portable incubator to be used for Engineers Without Borders water bacterial testing. The device will be taken to other counties for use in the field.

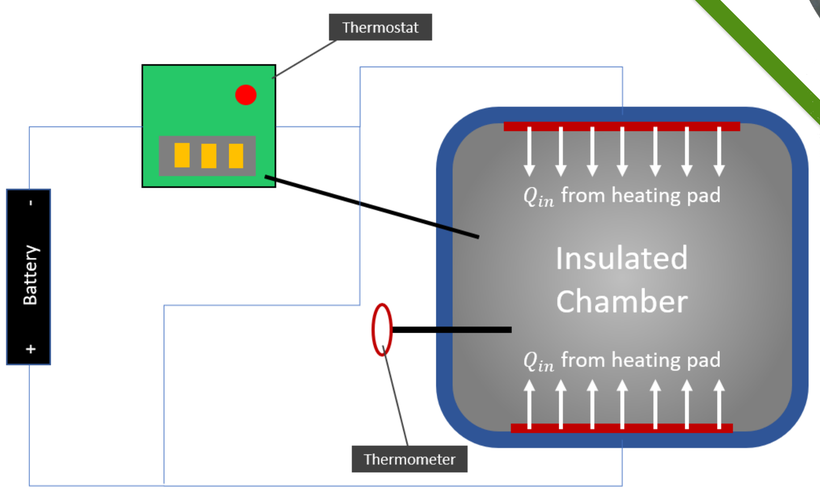


Background

Every year, the University of Maryland chapter of Engineers Without Borders takes various out-of-country trips to work on international design projects. An essential step of projects that concern water sources is to test for harmful bacteria. However due to lack of lab resources, many teams are not able to accurately complete testing which leaves the potential of severe infection and illness amongst those using water sources built by EWB teams.

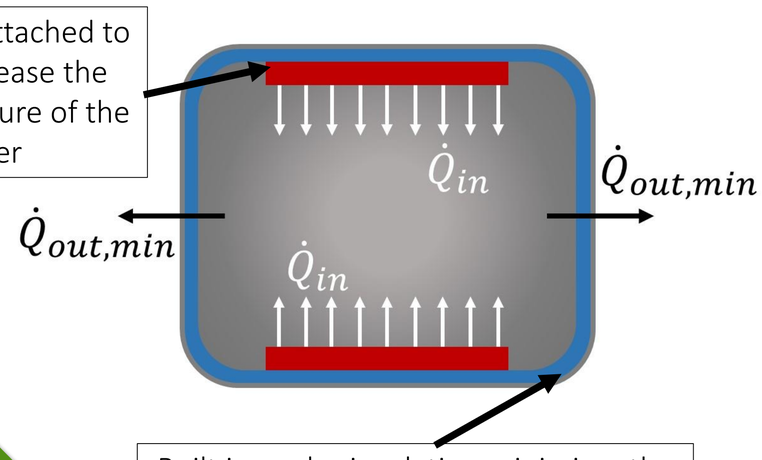
Electrical Components

The figure below shows the schematic design of the portable incubator device. A rechargeable 9V battery initially runs through a thermostat chip, which is set to keep the insulated chamber at a temperature of 37°C. The chip is wired in a parallel fashion to the heating pads inside of the chamber. As current flows through the pads, they heat the air inside of the incubator. One the thermostat senses a temperature of 37°C inside of the chamber, the current supply to the heating pads is paused until a temperature drop of great than 1-2°C is detected. The thermometer display on the outside of the incubator is so that the user can determine the inner temperature without opening the device.



Thermodynamic System

Heating pads attached to the walls increase the inner temperature of the chamber



Built in cooler insulation minimizes the heat transfer out of the incubator

Above is a diagram of the thermodynamic system of the incubator. The goal of the system was to reduce both the heating time of the inner chamber and prolong the battery life. As seen in the electrical component diagram below, the heating pads are powered by a 9V rechargeable battery source. When building the incubator, the surface area of the heating pads were increased using a thin sheet of aluminum. By doing so, the thermal efficiency of the system was increased and therefore required less power input from the battery. Although the exact timing has not yet been testing, by calculations it can be predicted that the inner chamber will be able to maintain the temperature of 37°C for ~36 hours without recharging.

Future Plans and Improvements

The next steps for this project are to test it alongside lab equipment and send it into the field with an EWB travel team. To confirm the accuracy of the design compared to professional lab equipment, testing of samples from the same water source will be completed. Once accuracy is perfected, sending the device with a team on an out-of-country trip will be the final step of putting the incubator to use.

Citations

Edberg, S., Rice, E., Karlin, R., & Allen, M. (2000). Escherichia coli: the best biological drinking water indicator for public health protection. *Journal of Applied Microbiology*, *88*(S1). doi: 10.1111/j.1365-2672.2000.tb05338.x
Water Testing Nepal. (n.d.). photograph.
Hall, S. (n.d.). *Incubator Cad Screenshot*. photograph.
Hall, S. (n.d.). *Incubator Schematic*. photograph.

Thank you

Engineers Without Borders, University of Maryland
Dr. Peter Chang
Dr. Jungho Kim
Dr. Alan Peel
College Park Scholars, Science Discovery, and the Universe