Sustainable Desalination System

The First Multi-National Senior Design Project for RIT and RIT Dubai

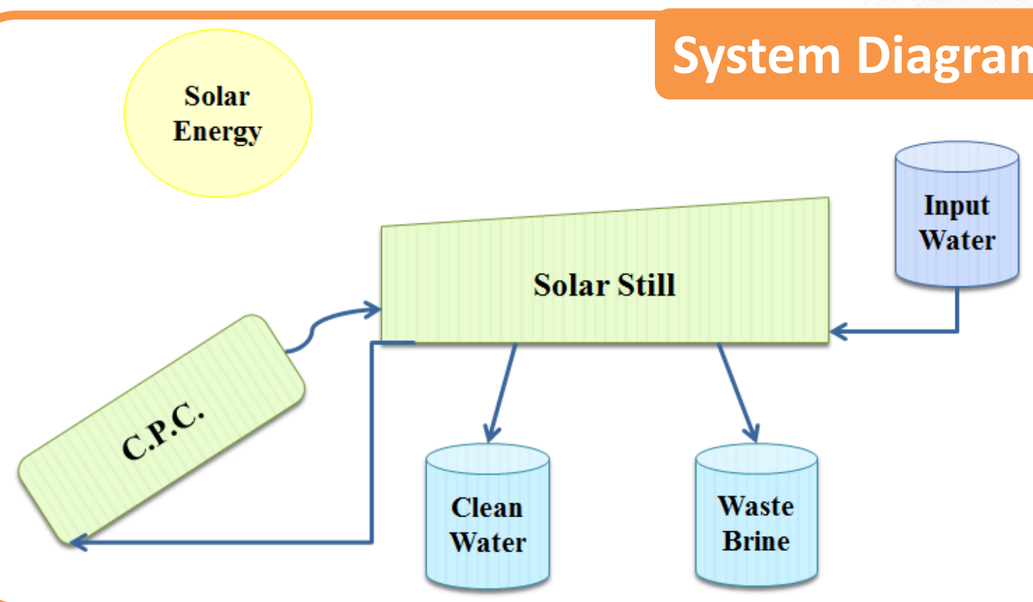
Project Statement

Our goal is to design and fabricate an educational water desalinization tool for RIT and RIT Dubai students that will demonstrate the small scale operation of a desalinization in an educational laboratory setting.

Project Objectives

-Design and manufacture a laboratory-scale desalinization unit
-Provide manual for instructors and design experimental set-up
-Capture requirements for new MSD infrastructure at RIT Dubai
-Create a template for future multi-national MSD projects
-Optimize International Collaboration

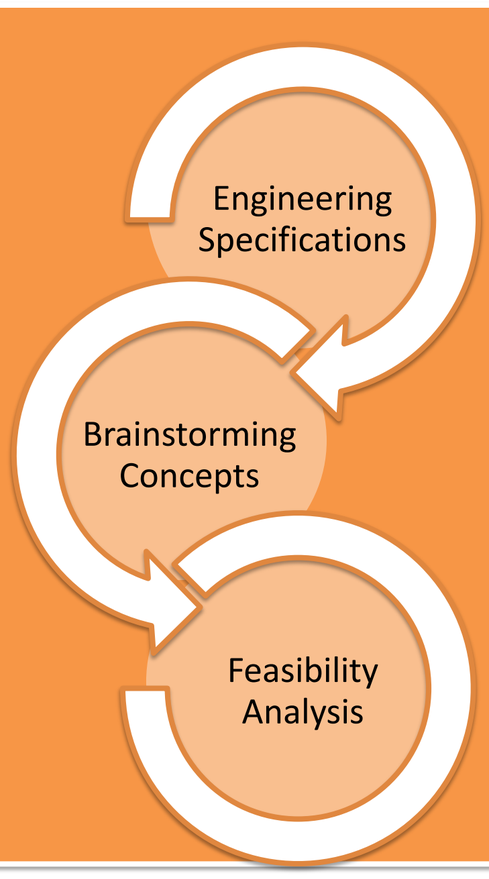
System Diagram



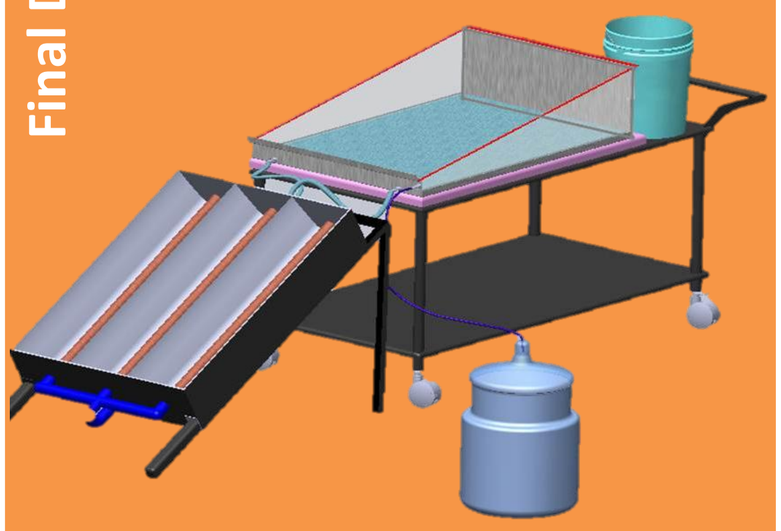
Customer Needs

- Limited technical scope
- Desalinate at least 2 liters of Persian Gulf water per day
- The system will be used by 2nd to 5th year level engineering students
- Document challenges faced due to the international team dynamics
- Provide assembly instructions and bill of materials to reproduce system
- Develop procedures to operate the device
- Renewable energy sources are preferred

Engineering Development



Final Design



Theoretical Models

The model for the Still was based off of V. Belessiotis et al. [1] . The model for the Solar Still was based off of S.A. Kalogirou [2]. These models are combined and the results calculate the temperature of the water in the system and the mass output of the system for every hour for a year. The average mass output per day is 3.88kg.

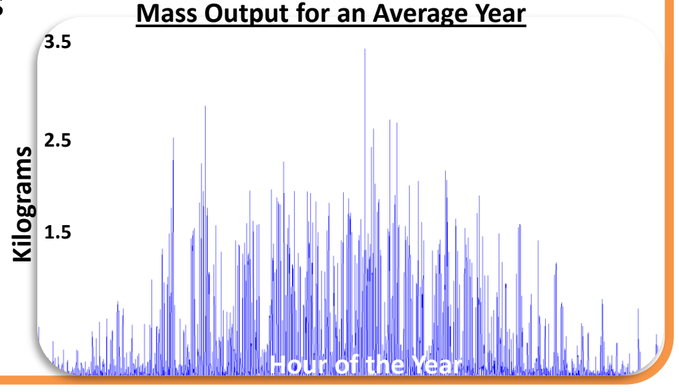
Equation for the Water Temperature in the System:

$$T_w = \Delta T + \left(T_w(i) + 3600 \left(\frac{A_w}{1000 * C_w} \right) \left(n_o I - U_t (T_w - T_a) - U_b (T_w - T_a) \right) \right)$$

Equation for the Mass Output :

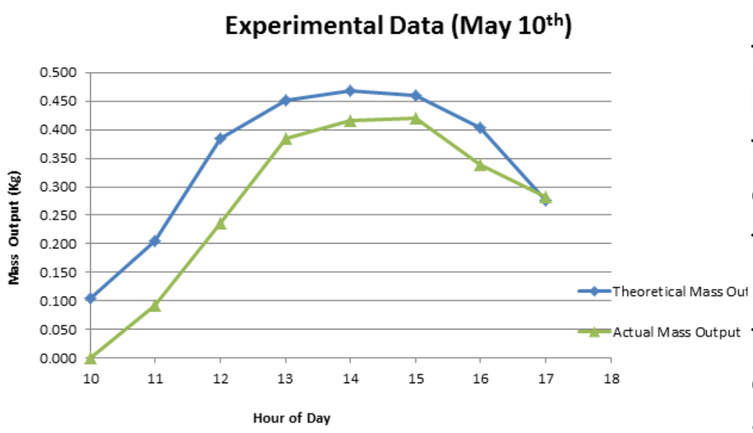
$$M_{out} = A_g \left(\frac{h_{ewg}}{h_{fg}} \right) \left(\frac{U_t}{U_i} \right) \Delta t (T_w - T_a)$$

Mass Output for an Average Year



Testing and Results

After the manufacturing was completed, many experiments were completed to ensure the system was working properly. The theoretical model uses the average weather data collected by NREL in order to calculate the systems temperature and mass output. Below is the system water temperature from an experiment conducted and the theoretical prediction.



The main cause for the difference between the theoretical and the experimental is that the input solar insolation was less for the theoretical data, causing a lower system temperature.

Completed System

Left to Right: Sergey Chiripko, Andy Thistle, Wayne Evans, Allison Schneider, Dylan Connole, Gerald Garavuso, Kelsey McConnaghy

Multi-National Project

Local & Cultural Differences

- Gender restrictions
- Different work week
- Language barriers
- No standard address system
- Government controls holidays
- Government controls internet
- Poor internet speed
- Little corporate and student interaction
- Limited hardware or supply stores

Recommendations

Initial Measures:

- Met with group and faculty members
- Orientation in Dubai
- Ensure sufficient meeting time
- Download communication software
- Set up document sharing

Continuous Effort:

- Include all members in communication
- Share information before meetings

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[1] V. Belessiotis, et al "Experimental and theoretical method for the determination of the daily output of a solar still: input-output method," *Desalination*, vol. 100, Jan. 1995, pp. 99-104.
[2] S. Kalogirou, "Solar thermal collectors and applications," *Progress in Energy and Combustion Science*, vol. 30, 2004, pp. 231-295.