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The Autoclave Project

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Carbon Neutrality Initiative Fellowship

Introduction

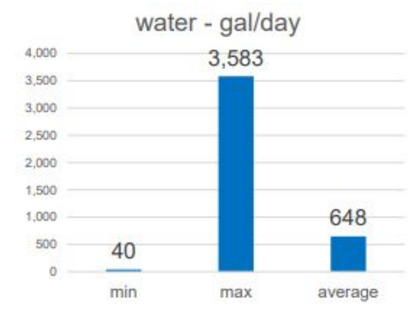
What's an autoclave?

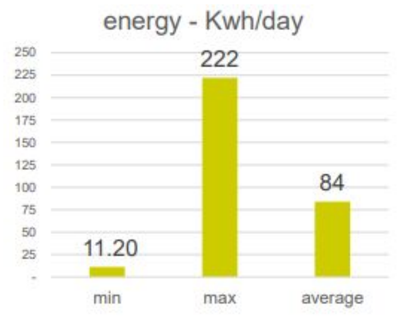
An autoclave is a pressure chamber used to kill harmful bacteria, viruses, fungi, and spores on items that are placed inside a pressure vessel. An autoclave is used to sterilize surgical equipment, laboratory instruments, pharmaceutical items, and other materials.

Recent studies have known some of the cons about autoclaves when it comes to waste of water and energy usage.This is due to the amount of water use to properly sterilize equipment and supplies and the amount of energy it takes to power the runs.

Previous Research

In 2016, the Office of Sustainability run a study on autoclaves to understand how the autoclaves in UCR are been used. The average autoclave consumes an average of 654 gal/day of water and uses about 84 kWh/day of energy between 0 - 5 runs per day. It also states that most the autoclaves are medical grade.





Project Goals

The goal of this project is to decrease carbon emissions emitted by autoclaves on campus by finding solutions that can contribute to the reduction of the waste of water and the overuse of energy caused by the runs of autoclaves.

1. Conduct inventory for autoclaves on campus to determine how often autoclaves are used.
2. Investigate how much water/energy autoclaves use during a run / or when idle
3. Analyze the excel file provided by the Department of Equipment Management to determine the locations and some data that will help identify each one of them
4. Research efficient ways to approach the units that consume the most energy and water around campus.
5. Reach out to popular autoclave companies for feedback and questions

Findings

- UCR consist of 61 Autoclaves around campus
- In terms of Chamber Shape, 38 are Rectangular and 23 are Cylindrical.

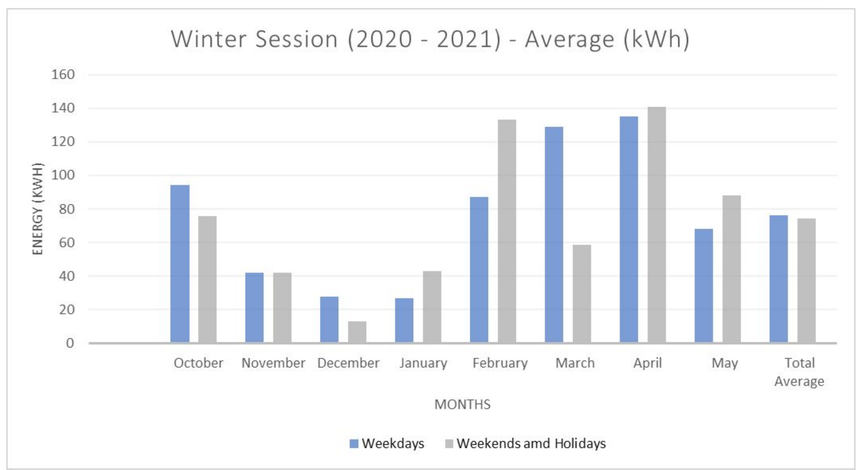
Medical – Grade	Research – Grade
Heavy rib- reinforced rectangular vessel	Cylindrical vessel- needs no reinforcement; one - third the mass for the same volume
Must be run 24/7 or risk harm to the unit	Can be powered - down for long periods
"High - throughput"- designed for 24/7 hospital use, over dozen cycles per day	"Light duty" – less than five cycles per day
Consumes up to 150 gallons of wáter per cycle	Consumes as little as 4 gallons per cycle

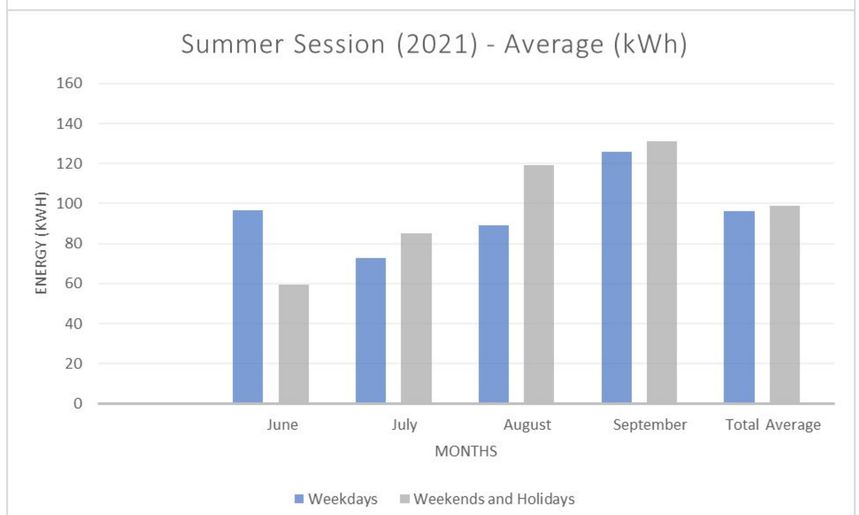
- UCR consist with a energy and water meter trackers in 2 autoclaves which had record data since 2016.

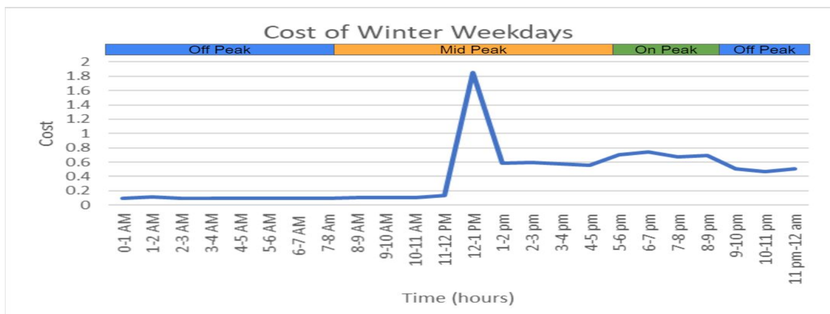
Results and Outcomes

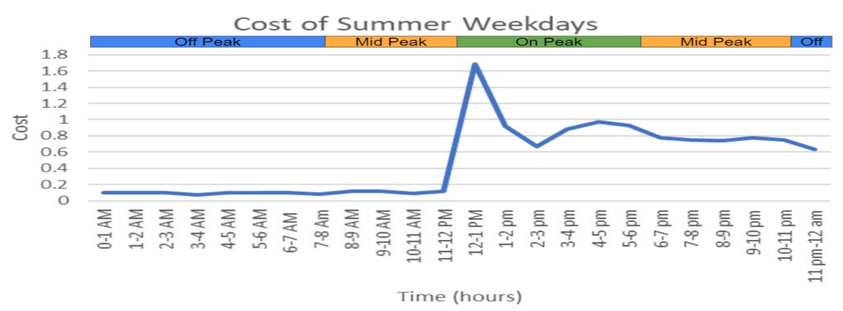
- An autoclave waste around 1200 Wh or 1.2kWh with no usage.
- If we get to calculate the 3 utility rates, On Peak, Mid Peak, and Off Peak, these would be the cost over a year if the autoclaves just are use for a couple of hours:

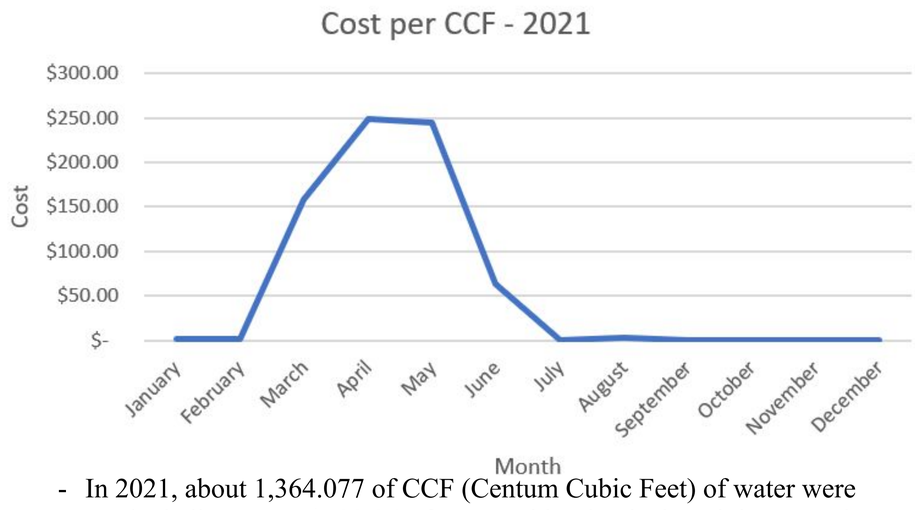
1.2 kWh per hour		Usage of hrs per day over a year		
Utility rates	Billing Demand	21 hrs	19 hrs	17 hrs
On Peak	$ 0.1124	$ 1,033.86	$ 935.39	$ 836.93
Mid Peak	$ 0.0922	$ 848.06	$ 767.29	$ 686.52
Off Peak	$ 0.0787	$ 723.88	$ 654.94	$ 586.00











- In 2021, about 1,364.077 of CCF (Centum Cubic Feet) of water were used whcih turns to $722.96. If we consider that is the minimum and multiple it by 61, it will cost us at least $44,100.56 per year for all the autoclaves on campus.

Solutions

·**Analysis of single pass cooling**

Some autoclaves have a single-pass cooling system which contributes to the use of hundreds of thousands of gallons of water each year. To prevent that, it is recommended to eliminate the single-pass cooling system and/or install water-saving system since it helps to reduce the use of water and to lower the cost of ownership.

•**Savings from changing Rectangular-Chambered Autoclaves to Cylindrical-Chambered Autoclaves**

Rectangular-chambered autoclaves require an enormous amount of water under normal operating conditions. Cylindrical-Chambered Autoclaves are more environmentally efficient than Rectangular-Chambered Autoclaves due to the use of constant flow "bleeder valves" for cooling waste outflow–even though very few training, research, or industrial applications actually call for constant wastewater cooling.

This doesn't just contribute to the saving of water and energy, but it also reduces the cost of use.

•**Remplacing Medical – Grade autoclaves to Research – Grade autoclaves**

Research–grade autoclaves can be eco-friendlier and more efficient than Medical – grade autoclaves due to the constant use of water-cooling bleeds, which often ran for 24 hours per day.

·**Energy Efficiency**

Those 4 benefits are,

1) Technology Efficiency,
2) Environmental Efficiency,
3) Increased Control & Reliability, and
4) Cost- Efficiency & Lower Overall Cost of Ownership.

These benefits can contribute to the saving of water, energy, and reducing the cost of use.

·**Purchase meters**

Adding water and energy meters for each autoclave to keep track of their usage so that way, we will be able to recognize which autoclaves and been used the most and record the amount of water and energy each unit is wasting. That way, we can approach the autoclaves that wasted the most.

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