"Temperature Control System of a Mold for the Preparation of Organic Dishes"

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Abstract

The original idea of this project is to develop a semi-automatic temperature control system for a mold, used in the production of organic dishes.
The design of the mold is made of AISI 6061-T6 aluminum alloy so that when working with the required temperature it can withstand the heat that increases and avoid any aesthetic changes that affect the structure of the plate.
For this system, a press made of AISI-1018 carbon steel was used, which uses a hydraulic piston, that allows pressure to be applied to the mold in order to shape the material at a high temperature and then be able to cool the material for the drying of the plates and maintain the standard and uniform shape that was planned to have, in the part of temperature control, the way to adapt the structure of the mold with the control system was established, this system that was in charge of regulating the temperature, since the raw material with which the plates were manufactured needed a standard temperature to be able to dry and obtain the desired product.

Keywords: reduction; molding; system; temperature; control

1. Introduction

The implementation of this project is related to a temperature control system for a mold that will be used for the preparation of dishes made with some organic materials (starch, collagen, and carbonate) thus contributing to the reduction of environmental pollution.
The mold we worked with is made of an AISI 6061-T6 aluminum alloy, due to the temperatures with which it was worked, it was necessary that the material from which the mold was made could withstand the temperature that was required, this mold has a rectangular shape of 20.03 cm wide and 25.06 cm long, it must have a certain temperature to heat or cool the material with which the organic dishes will be made, in this case the temperature at which the mold must be is 100º Celsius in variable temperature, for this temperature control has been implemented.
For the whole drying process, about 15 to 20 minutes should be considered as a standard time.

2.- Pollution

The excessive use of polystyrene styrofoam (Bibayoff, 2021) is particularly harmful since it is not a biodegradable material and its biodegradation time is hundreds or even thousands of years, this represents a major problem in the world. According to the National Association of Plastic Industries "ANIPAC" and the National Association of the Chemical Industry "ANIQ", it is estimated that the national consumption of plastics in Mexico is estimated at 125 thousand tons per year, of which 25% is used to manufacture of disposable products for the food industry such as plates and cups. 75% is divided into the handicrafts construction sector.

For this was the implementation of this project that will help us for the realization of organic dishes as well as to reduce pollution in the world, since a temperature control system is required to implement in the mold, this system will help to reduce the excessive consumption of styrofoam.

On the other hand, styrofoam is a material that is very constantly used in packaging, construction, and disposables for the food and craft sectors (Mx, 2019), however, it is a great generator of garbage because this material is not organic and can take years to decompose, it is also harmful to the health of people, animals, to the environment and ecosystems.

When products made with styrofoam are used, they are usually only used once and then discarded, further increasing the amount of waste that affects the environment, filling up landfills more, and even affecting aquifers (Ezpak, 2020). When styrofoam is discarded, it is very difficult for it to biodegrade or decompose in the environment, nature can only break it down into a few molecules, and they slowly begin to disappear, including toxic particles that take about 1000 to 1200 years to disappear. According to the United Nations report for the environment, more than eight million tons of plastic enter the sea every year, when burned it generates gases that produce a greenhouse effect and releases toxic substances harmful to the respiratory system is the greatest danger to human beings because its basic component is a styrene. which is a chemical classified as carcinogenic (AcuaeFoundation, 2023).

According to some data that could be collected, the figures indicated that due to population growth, industrial growth, and urbanization. In an average of 30 to 35 years, the waste we generate will increase by 70% worldwide, this makes us think a lot about organic and ecological alternatives to reduce the use of non-biodegradable objects (BIRF, 2019).

Therefore, we can say that the chemical gases used to make styrofoam dishes are currently destroying the ozone layer because it is made of a plastic material derived from petroleum, gases are injected to expand it like foam, and when it reaches the oceans, marine life, such as turtles, birds and fish. They mistake it for food and die from ingesting it.

By using organic materials, many benefits are generated to reduce environmental pollution, some benefits of recycling are: A) Saving money, B) Saving energy, and C) Conserving resources. (Isan, 2022)

3-. Methods and materials

The methodology proposed to carry out the temperature control system to make an organic dish (starch, collagen, and carbonate).

This project revolves around two axes, the first part of the descriptive research is the one that allows us to describe the characteristics of the temperature control system, and the second axis refers to the exploratory

research that will allow us to capture the idea by making a mixture of organic material to be able to manufacture organic dishes.

The design includes the analysis of the following variables:

- The context for obtaining the system consisted of a review of the types of materials used to make the dish.
- We determined the implementation of 4 resistors to heat the internal surface of the mold.
- The use of the sensor was established, through a technical sheet that allowed us to determine the variable temperature of 100 degrees Celsius.
- The use of fans and a radiator connected to a pump was determined for the cooling of the mold when it reached the maximum temperature point.
- Four springs were used to separate the plates from the mold and prevent deformation of the material.

3.1- The bill of materials allowed for temperature control

Table 1. Materials

Bill of Materials	
Temperature control	Car radiator
	Rex c 100 digital temperature control
	20mm copper pipe
	Pt100 thermopart temperature sensor
	TYP 4840 N ventilator
	4 round resistors
	Anti-corrosion fluid
	Water pump for Fish Tank

4.- Development of the control system

It was carried out in conjunction with a semi-automatic system formed with a metal press that helps to shape the organic materials by applying pressure with the help of a hydraulic piston that requires four shock absorbers or springs that receive the weight that will shape the plates, in the elaboration of the temperature control was needed a 115 V TYP 4840 N fan adapting a copper pipe of 20 mm in diameter, This material was used because copper is resistant to high temperatures, according to (Plumbing, 2023) copper pipe can withstand high temperatures without deteriorating its quality and characteristics.

Due to its high-temperature resistance and its ability to withstand heat and cold, it can withstand temperatures between -20 °C to 150 °C without damage, copper can withstand both hot and cold extreme temperatures which makes it an ideal material for temperature control since a variable temperature of 100 °C is required to mold organic materials (Illustration 1)

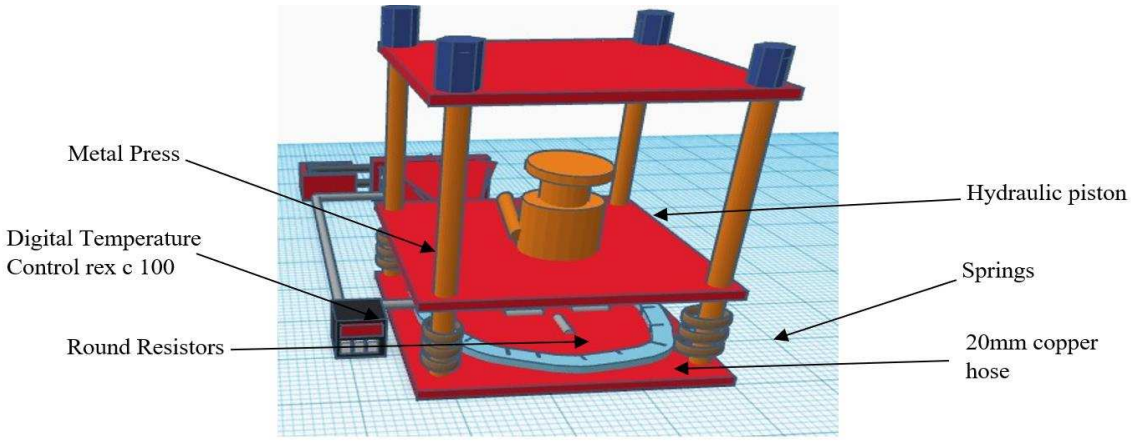

Illustration 1. Structure of the press (Own elaboration, 2023)

Holes 1/8 inch in diameter by 2 inches deep were drilled in the upper parts of the mold to adopt the methodology of a stove or local system that will heat the mold uniformly. (Gaserveis, 2022).

A radiator was placed that will work for cooling by adapting a fish tank water pump that pumps corrosive liquid to the radiator for the cooling of the material, the radiator works by dissipating the heat of the antifreeze coming from the engine, through the transfer of temperature by circulating the liquid through the engine tubes (Motor, 2023).

To control these variables, a thermocouple PT100 temperature sensor was placed, the terminals of the temperature sensors are completely attached to the resistive part that is active during the operating process, in such a way that they resist the vibrations that occur, the active principle of the PT type 100 sensors is completely focused on the modification, that as the temperature increases, its electrical resistance increases greatly; these sensor systems can collect the average value of the temperature that exists along its entire length (C.V, 2023), it must be connected to an indicator that will show us the data reading, which is why a digital temperature controller has been installed REX C 100 is a standard panel mount PID temperature controller that is available in several different combinations. In addition to regular PID control, the REX-C100 PID temperature controller can be configured to function as a regular on/off P or PI controller that will allow temperature monitoring and control in basic systems such as resistance devices, heaters, burners, within a range of 0 to 1300°C (Xiao, 2022). (Illustration 2).

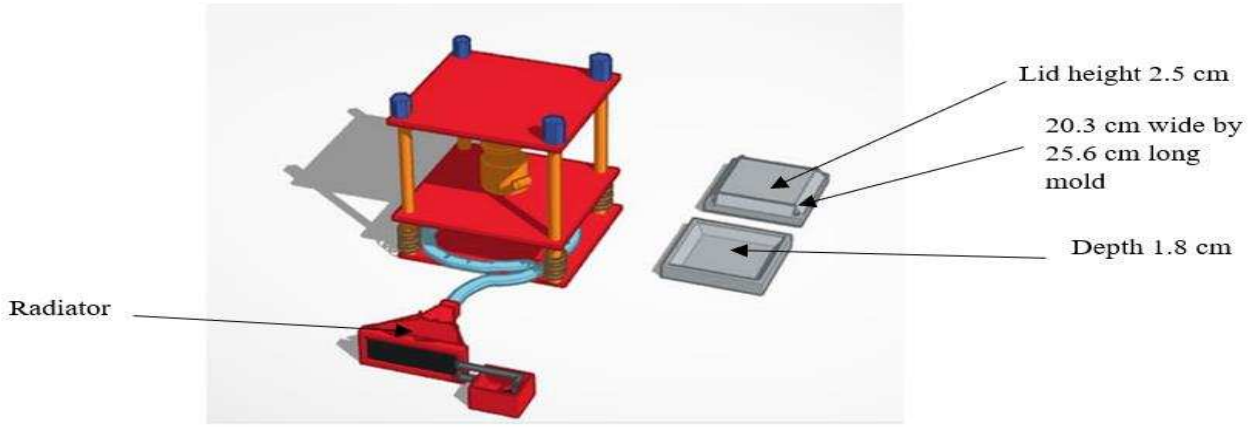

Illustration 2. Mold Structure (Own elaboration, 2023)

5.- This allowed us to work with a basic formula to calculate the temperature.

The basic expression that relates the amount of heat (Q) exchanged by a substance of mass "m", where "c" is the specific heat of the substance and with a variation in temperature "Δt" is:

$$Q=mc\Delta t.$$

This means that the greater the specific heat of a substance, the more energy is required to raise its temperature (Black, 2022).

6.- Tests Performed

For the temperature and material strength tests, a circular part with a diameter of 7 inches and a thickness of 1.5 inches of AISI 6061-T6 aluminum material was required, four holes with a diameter of ¼ inch were drilled in the thick part with a depth of 2 inches, then four resistors were inserted into the holes to heat the part and record the results. (Illustration. 3)

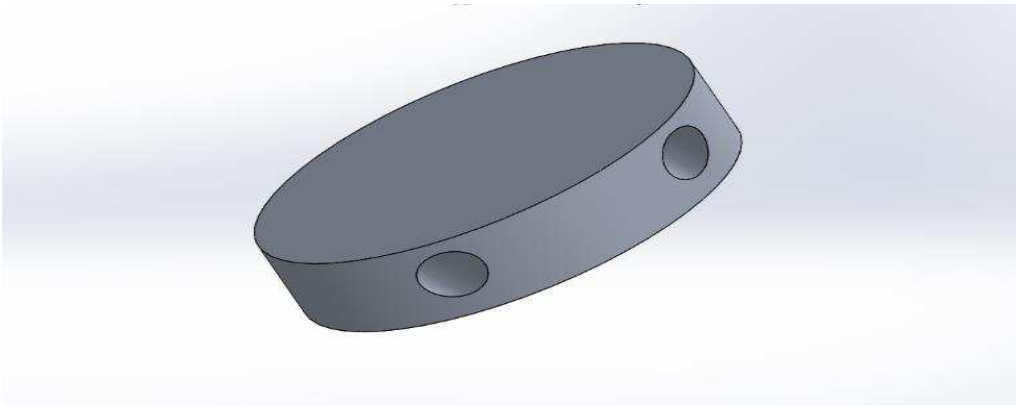

Illustration 3. Temperature test (Own elaboration, 2023)

7.- Results

Project Impact:

- Environmental
- Reduce the use of styrofoam
- Prevent environmental pollution
- Project
- A functional control system
- Preparation of organic food
- Temperature regulation

8.- Conclusion

The implementation of this project will help to reduce the use of styrofoam, which is a major pollutant and affects the environment too much. We thought of carrying out this project to be able to take advantage of some organic materials and be able to generate a product that is less polluting for the environment.

In the process of carrying it out, we encountered a series of difficulties that slowed down the process and made it necessary to look for different options to continue with the project. A limitation that affected me a little more could have been the acquisition of some materials, but a way was sought to be able to continue.

Throughout this process, different knowledge was acquired, both theoretical and practical, which served to achieve success in this project.

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