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Development of a Mixer for Organic Soap Manufacturing Process

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Abstract - *This project was carried out with the design and calculation of the prototype of an automatic mixer. Its function is to agitate the mixture on a container, increasing the quality of the soap manufacturing process, controlling the speed of the Mixing automatically. Once the type of prototype was selected, we proceeded to the detailed design of each of the parts that make up the machine, as well as showing calculations of forces, dimensions, adjustment, tolerances and an analysis of the possible materials that can be used for the manufacture and development of the mixer.*

In view of the need to produce more efficiently the soaps that are manufactured by hand, a homogenizer is designed for the mixing of substances, which processes the raw material with an optimal mixing in order to obtain the substance with an improved consistency. For the general design and construction, we took as a reference existing machines in our environment and also machines from different origins to combine characteristics.

The manufactured mixer is capable of beating 3 kg of raw material, this in order to automate the mixing process for the manufacture of organic soap. The mixer is designed to guarantee a smooth mixing, this will reduce the time and the quality of the product will be maintained.

In order to ensure the proper functioning of the equipment, experimental tests have been conducted to verify the correct operation of the machine.

1. INTRODUCTION

The mixing systems have increased in the pharmaceutical industry, since with the implementation of these machines the times and speeds of mixing of the products are optimized, guaranteeing a high standard of efficiency.

According to the requirements of the formulations in the manufacturing equipment, the machinery used for soap manufacturing has consistently evolved to allow the use of filling agents, soaps with high liquid content, particulate material. The idea of this project arises to minimize the time of realization of the soap.

The mixers are identified by the types of blades it can have, depending on the geometry of the impeller and its position, which influences the reduction of time in the improvement process and the quality of the product, which shows the solutions used to avoid certain problems, characteristic that can occur in this process.

Based on the current mixing systems, several alternatives of prototypes were raised and then the one that was most adapted to obtain the expected result was selected.

With the help of Autodesk Inventor software in which a stress analysis was performed, detailing each of the parts that make up the prototype.

By means of the realized calculations, it proposed a method of finite elements, to check that the design fulfills the efforts to which they are going to be submitted, obtaining results put on test, the results of the speed and capacity indicate the efficiency of the created product, as well as to the solutions that satisfy the problematic.

2. DEVELOPMENT

An industrial mixer is a mechanical device that uniformly mixes two or more materials by mechanical force, gravity, this machinery guarantees the homogenization of solid and liquid components for the elaboration of products.

The prototype of the mixer consists of a primary motor, an automatic microcontroller control, shaft and propeller push buttons. Most of the installations have vertical shafts, that is, without a fixed bearing to support the free end of the shaft. Followed by the shaft design, different crucial components of the mixer such as the motor support, the frame, the impeller hubs, etc. They are designed following standard procedures.

2.1 MIXING CHARACTERISTICS: The mixture calculated its density is the following, since the materials to be used are water, olive oil and bait, mixed at a temperature of 68°F.

Density:

Water: 1000 K/m^3.

Oil: 920 K/m^3.

Tallow: 904 K/m^3.

Total density: 2806 K/m^3

$$\rho = \frac{M}{V}$$

2.2 CONTAINER CHARACTERISTICS: The container is intended to contain the organic soap mixture, but the characteristics are different from a common container, since the mixture will go to a temperature higher than 68°F, also the humidity of the mixture does not damage the container, therefore, the material of the container must be of a metal resistant to humidity, friction, and temperature. First of all, it must be suitable for use by the pharmaceutical industry as it will facilitate mixing and resistance to moisture and easy cleaning.

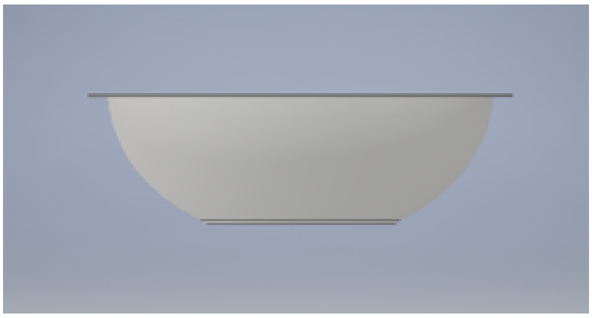

Fig-1 Soap mixture container

The design and resistance should be the other two aspects to take into account, without sharp edges that can lodge the dirt will facilitate its correct cleaning and disinfection after each use, its use of the contour of the container should be round and reinforced to facilitate the grip and transport and provide great strength and rigidity during use.

The amount of fluid to be mixed had to be decided before making additional calculations, since the dimensions of the container have a great impact on the prototype of the mixer, the forces acting on the shaft and the configuration as a whole. Furthermore, the prototype of a mixer and its location in the container depends mainly on the diameter and height of the container. Therefore, first the effects of the container dimensions on the prototype were studied before selecting the container dimensions. After due consideration, the following dimensions were selected

Height: 3.6 in

Diameter: 8.4 in

Mixing weight: 6 lb.

1.2 Sub Heading 2

$Ve = \pi r^2 * h$

Ve= Spherical volume

Π= pi

r= radio

$Ve = \pi 4.2in^2 * 3.6in$

$Ve = 55.41769in^2 * 3.6in$

$Ve = 199.50369in^3$

From the Solid Works model and Autodesk inventor, the volume of mixing fluid was found to be due to the shape of the container. The capacity of the container was found to be approximately 3 liters.

2.3 FEATURES AND SELECTION OF SHAFT DESIGN:

The function of the vertical shaft is to carry out the rotation movement of the propeller, for the selection of the shaft material the following factors are taken into account: corrosion resistance, adequate durability, toughness to withstand radials and hardness to withstand the torque used. The choice of material for the shaft is stainless steel.

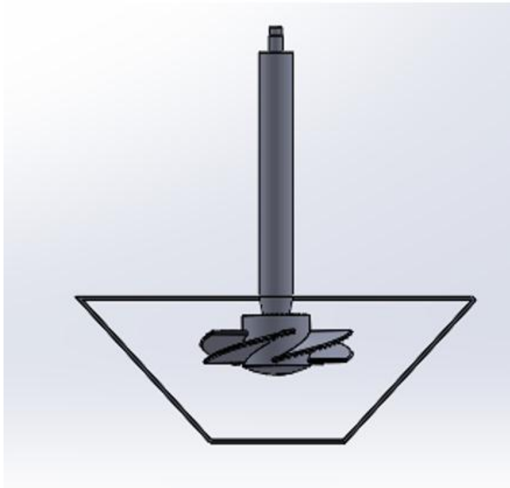

Fig-2 Mixer shaft and propeller

2.4 CHARACTERISTICS OF THE PROPELLER

The trowels were chosen from different types, the choice of these was for their reason of use, the trowel for kneading and the propeller for mixing.

The propeller used to give movement to the mixture was made of stainless steel that allows a better process.

2.5 ENGINE CHARACTERISTICS

Therefore, a single-phase 12-volt HP motor is selected to run at rpm

Engine characteristics:

50 W

60 RPM

12 Volts

5,870995 lb/ft

4.166 A

The horse power (Hp) is calculated using the following formula.

The RPM was reduced to be run with the mixer and torque needed. The torque formula.

F = Frequency.

π = pi.

RPM = R

ω = Angular frequency.

T = Torque.

P = Power.

ω = Angular frequency.

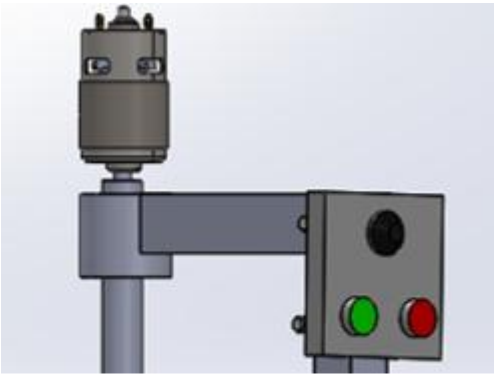

Fig-3 Motor and buttons

2.6 SPEED CONTROL

The circuit made in the program LabVIEW that designs systems, with a graphic visual programming language. It was mainly used for RPM reduction, by means of an Arduino UNO microcontroller card, the reduction was previously calculated with researched formulas and applied obtaining a stable and concrete result.

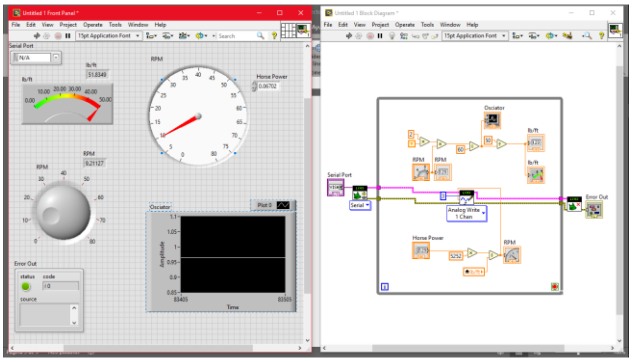

FIG-4 Circuit of Reduction

2.6.1 SPEED CONTROL CIRCUIT

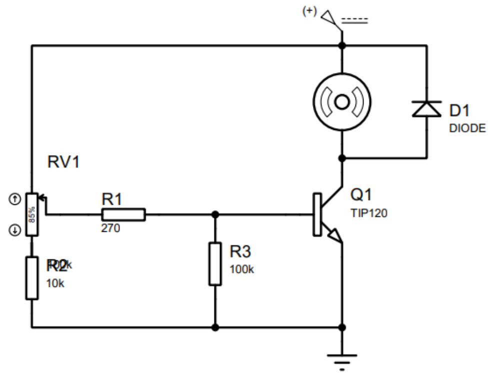

FIG-5 Electronic circuit

2.6.2 REQUIRED MATERIAL

- Power source 12V (can be a battery)
- 100K potentiometer Ω
- 12V engine
- Silicon Diode
- Tip120
- 10K Resistance Ω
- Resistance 100k Ω
- Resistance 270 Ω

3. BEARING CHARACTERISTICS

The advantages for which the ball bearing was chosen were the following:

- High operating speeds
- They require little maintenance and are easy to design

- Increase radial load capacity

- They have low axial capacity due to the collisions of the balls with the ring grooves.

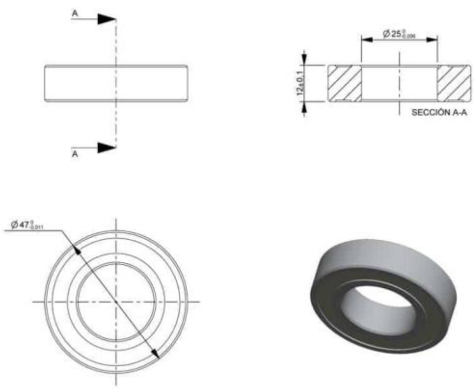

FIG-6 Bearings

4. RESULS

The results are shown in fig.7 when performing the applied finite element test to observe the load which was only applied to the propeller since we wanted to see the effort at the base of the blade, reaching a maximum effort of 250lb/ft so in these conditions there will be no failure in the material.

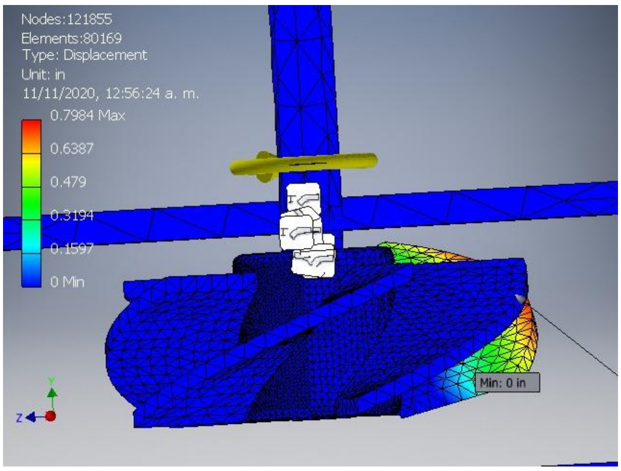

FIG-7

5. CONCLUSIONS

Finally, with the tests it was demonstrated that the project, fulfills its function that is to make a homogeneous mixture with greater quality and is processed in less time. Concluding that the materials and dimensions are correct, with respect to the calculations developed analytically.

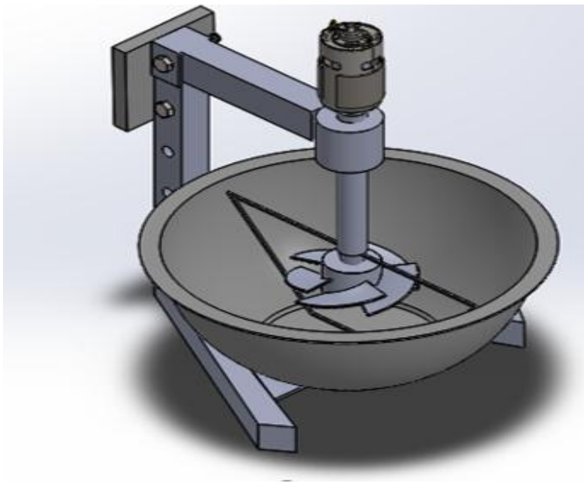

Fig-8 Mixer

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José Luis Hernández Corona candidate for a PhD from the autonomous university of Tlaxcala, research professor in the area of industrial maintenance, desirable profile before the PROMEP, responsible for the CA of industrial maintenance at the Technological University of Tlaxcala.

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