“AUTOMATING THE PROCESS OF FEEDING A CRUSHER MACHINE GLASS RECYCLED”

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Summary. - The project detailed below it is automation and adequacy of a recycling crusher machine glass, this is about achieving a diminution of solid waste, which can be reused to create new objects made of the same material (glass).

I. Overview

The objective of this project's main purpose operating the shredder recycled glass, this is accomplished by implementing a conveyor belt which in turn this will speed controlled by a frequency converter also implement a rocking reception glass bottles, properly classified by color as well as her mouth and removed plastic cover.

To perform these couplings of the band, a structural redesign of the machine glass crusher is also required, and then variables are analyzed as operating power, load capacity of both the grinder motor as the load capacity of the hopper; besides that a redesign of the rotor (blades) was performed, which should be analyzed in both dimension, number of blades, such ideal material and welding.

All these analyzes were performed with the determination to provide synchronized operation and machine glass crusher and

conveyor belt implemented this so that there is no overload glass grinding machine, which could potentially damage machine parts.

A. THEORETICAL.

Glass Recycling.

When it comes to recycling such waste glass is not highly polluting for the environment, but can be recycled to 100%, this material is found routinely in consumer packages of food, drink, medicine and other items made of this material, which play a life after providing a service. With what is the recycling of this type of material, after some selection by the glass color enters the crushing process, achieving a disintegration into small particles which can be accepted in their entirety to a new blend of material for creation of new containers or glass objects created by.

B. Glass Crusher Machine.

For proper operation and fit of restorations made to the shredder, such as automation, a redesign of the machine which has been incorporated into a conveyor belt is made better food; this conveyor belt is properly synchronized to the capacity of three elements, main engines, the crusher hopper and the conveyor belt.

I. Structural and mechanical redesign of the glass crusher.

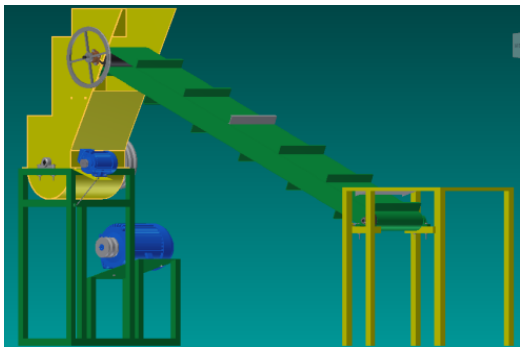


Figure 1: Crusher redesigned.

Elements of the crusher.

• Blades
• Screening
• Rack

Which have been analyzed considering several factors according to the type of material to be ground, the dimensions of crushed glass to be obtained and the amount of product to be ground.

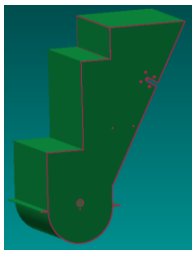
A. Sizing of the parts that make the machine.

For this purpose an analysis of the pieces that form the crusher and undertake the function is performed on the machine, and the type of material used for each of the pieces.
Each of these will be calculated according to the function they fulfill in the machine and charges shall be subject, from that point the parts of the different systems which are coupled to the final dimensions.

B. Material Hopper and machine environment.

Because loads encountered machine structure must be strong enough to not be damaged both internal and external, as well as considering you do not have an exaggerated weight. For appropriate material which is sought and which has been used is ASTM A36 steel. In most of the steel, the A36, has a density of 7850 kg / m3. A36 steel bars, plates and structural shapes with thickness less than 8in (202.2 mm) has a minimum yield strength of 250 MPA (36 ksi), and a limit of 410 MPA minimum breakage (58 ksi).

Figure 2: Crusher Hopper



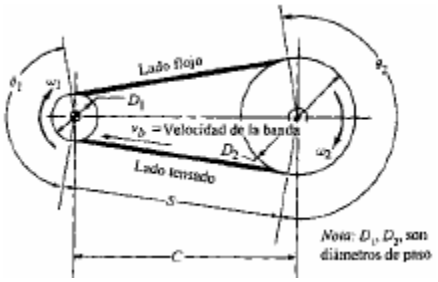
C. Power crusher machine.

Despite its empirical nature, the method of Bond is still the most widely used for designing circuit size reduction. Being essentially three reasons: first, there are a vast quantity of information available for industrial equipment, and is continuously increasing; Second, the method is quite satisfactory for initial calculations even when designing a circuit, the power specifications and specific product may rarely occur with sufficient reliability to justify more elaborate methods and finally, the method and its adaptations provide simple methods for measure the efficiency or performance of the machine.

D. Calculation of the transmission bands.

The use of these bands is very efficient and economical to replace when damaged.
In this case to determine the speed of the web, the following equation is used.

Figure 3. Geometry of the impeller of the band



Equation 1:

$$V_b = R_1 \times \omega_1 = R_2 \times \omega_2$$

Where:

V_b: Belt speed.

R_1: Radio of the motor pulley.

R_2: Radius of the pulley attached to the tree.

ω_1: Angular velocity of the pulley coupled to the engine.

ω_2: Angular velocity of the pulley coupled to the shaft.

Next is to determine the length of the band for which we use the following equation.

Equation 2:

$$\boldsymbol{L = 2 * C + 1.57 * (D1 + D2) + \frac{(D2 - D1)^2}{4 * C}}$$

Here variables that are granted in part dimensions such as diameter of the pulleys used and "C" distance between centers is used.

E. Shredding rotor speed.

To determine this rate, there is no clearly defined mathematical solution, with the passage of time has done theoretical and practical study of the impact velocity of the rotor, when this input receive bottles broken and the zipper rubs against creating smaller particles. The impact velocity is calculated from the following equation:

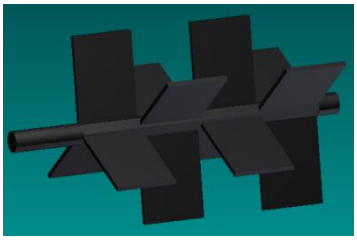


Figure 4: Blades

Equation 3.

$$V_i = 1.27\ (w)\ (R_i)$$

Being:

V_i = Impact speed

W= angular speed

R_i = radius of the tip of the blades or impact radius.

Its speed of impact is determined 14,3 m/s.

F. Approximate length of the band (Lc).

***Equation* 4**:

$$Lc = 2a + 1{,}57(d2 + d1) + \frac{(d2 - d1)^2}{4a}$$

Where: a= approximate distance between centers [mm]

G. Present distance of the band.

By the above method is based the calculation of the actual length, the following equation:

***Ecuación* 5**: $a° = a - \left(\frac{Lc - L°}{2}\right)$

Where:

a= approximate distance between centers [mm]
Lc= approximate length of the band [mm]

L*=longitud seleccionada de la banda [mm]

With these calculations the actual distance between centers is determined, which gives us that is 560mm.

H. Number of bands (Z).

$$\textbf{Equation 6}: Z = \frac{P.C2}{P1.C1.C3}$$

Where:

P= working power [kW]

C1= correction factor for the arc of contact of the band

C2= load factor

C3= development factor (considering the bending of the band).

PN= power transmitted by each band [kW]

Giving solution to this equation can be concluded that the number of specific bands is 2 bands.

I. Conveyor Belt.

The conveyor belt will be responsible for carrying out the function of feeding bottles into the shredding machine, is attached correctly both in the hopper of the machine and the receiving table.
This is composed of a synthetic fiber which is flexible enough to turn around the drums, and must also be robust to withstand the weight of the bottles.
This has a total size of 5 m, which has 12 divisions' buckets.

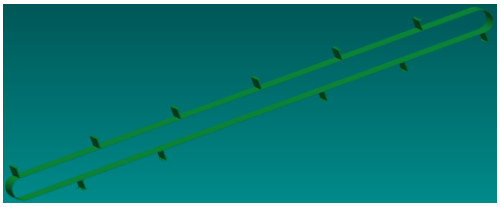


Figure 5: Conveyor Belt

J. Buckets.

These are composed of an aluminum material as this is a very lightweight material of sufficient strength and simultaneously to support the return of the bottles due to the inclination of the conveyor. These buckets have a length equal to the width of the band 37 cm. To attach a special bolt these buckets very little contact with the drums used.

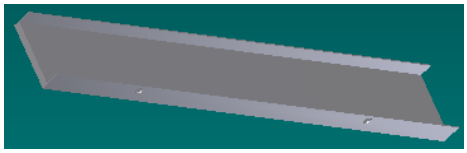


Figure 6: Buckets

K. Receiving table

This table is composed of a square tube for A36, which is adapted for anchoring to the bearings on which the drum rotates the spool shaft as well as having a small hopper that allows bottles and go throwing these will fall by inertia to the conveyor belt.

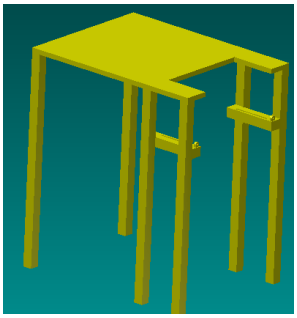


Figure 7: Receiving table

L. Drums motor and tail

For these drums was conducted in a size of 11 cm in diameter, in relation to the envelope of the band 37 cm in width, they were covered with one type of rough stripe which creates traction for movement conveyor belt.

Figure 7: drums

M. System voltage conveyor.

This system is used to give the optimal tension to the band, where the tension can support the weight of the bottles at the same time does not believe too much contradictory movement strength.

Figure 8: Tension system

N. Capacity of Transportation Band.

The variables to consider are the specific weight of the material to be transported, the same body type, height and speed of the band.

Equation 7:

$$Cu = 0{,}0151 * a^2 * d * v/30$$

Where:

- a: bandwidth (cm)
- d: specific weight of material (tn/m^3)
- v: belt speed (m/min)

II. Process Control System crushing.

We can start by turning on the disposer motor which is independently connected to control movement of the conveyor belt with a control on / off.

Figure 9: Start / stop

Then we turn on the inverter which we indicate on your screen if there is no error before you can start the feeding process; then we can start by choosing the preset speed which were set according to the type of glass and crushed, as is its size and thickness.

Apart from these speeds there is a manual speed control, which can be used according to the experience of the user.

Figure 10: Cabinet de Control

Once completed these preliminary steps you can put up with the 3-position switch, back /

off / on, then start the grinding process; if you experience a problem in the course of the process the drive is set for protection and apart from some drawbacks such protections exist in the control panel emergency stop.

III. Conclusions:

• Implementation of the band respectively conveyor controlled speed, a good way to grant power to the shredder, and shred the bottles to come to his docile manner grinding process.

• The pre-configured for the movement speed of the conveyor are senses when breaking process, allowing a good crushing without causing an overload of the shredding machine cylinders and thus cause possible rupture of the blades.

• The design of the structure of the receiving table is suitable for holding the tail pulley, so a good belt tension does not suffer a deviation at the time of entering operation is achieved.

• With automation it was possible to obtain a simpler way to feed the machine with sufficient robustness of the structure both inside and out, no tests show that a deformation of any party giving the machine.

Recognition:

I thank:

First and foremost God, for every day of life granted me.

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IV. BIOGRAFÍA

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