

Aluminium Can Recycling System

Rohan Chinchkar¹, Mangesh Khandare², Suraj Tawale³, Sunil Bhagale⁴, Gouri Bodhe⁵

¹UG Scholar, Mechanical Engineering Department, TAE Pune, Maharashtra, India

²UG Scholar, Mechanical Engineering Department, TAE Pune, Maharashtra, India

⁵Professor, Department of Mechanical Engineering, TAE Pune, Maharashtra, India.

Abstract - The main focus of this paper is to reduce the scrap volume of aluminium can and use it for recycle purpose properly. Now days there is widely usage of cans have been done in hotels and canteen and for their storage large volume of space is required. This research paper includes design and structure analysis of can crusher. Many researchers who have done work on design and analysis of aluminium can recycling system but still there are so many areas of scope regarding this design and analysis. Microcontroller makes up the backbone for this project. This paper involves different processes like design, fabrication and assembling procedures. There are different types of the can crusher machine in the market, the completion of the new model provides a more practical usage than previous one.

Key Words: Design, Structure analysis, crusher machine, Fabrication

1. INTRODUCTION

The main purpose of the paper is to get idea of design and fabrication. The design is an environment friendly and uses simple properties such as mechanical single slider and pneumatic system. The main aim of research is to get knowledge of designing, mechanism and forces analysis are increased. We planned to create a can crushing machine that will reduce the volume of aluminum cans by approximate eighty percent. It can be placed anywhere in park, restaurant, canteens, etc. in today's life most of the food items are packed in cans. Cold drinks and other beverages are also comes in cans. Commercial establishments like cafeteria and bars, have to deal with leftover cans. Storage is often a problem and cans consume lot of space, thereby increasing total volume of trash. The transportation cost is also high for moving such a huge number of cans. Thus this machine will help to recycle and maintain eco-friendly environment also. This project involves the process of designing the different parts of the crusher machine considering the forces and ergonomic factor for people to use. This project mainly about generating a new concept of can crusher that would make easier to bring anywhere and easier to crush cans. After design has completed, it was transformed to its real product where the design is use for guidelines.

2. PROBLEM STATEMENT

Before crushing scrap aluminum can occupy more space, so we need to reduce the volume of their aluminum cans. Conservation of energy and Proper use of recycle material. Avoid the load on garbage for better environment.

3. LITERATURE REVIEW

There are few papers available on aluminium can recycling system which having information about different types of recycling methods.

Stefan Tabacu[1] studied Axial crushing of circular structures with rectangular multi-cell insert The axial crushing of circular structures with rectangular insert was investigated. Literature available experimental data were used to validate the numerical models of the structures investigated. Shadab Husain, Mohammad ShadabSheikh [2] studied Can crusher machine using scotch yoke mechanism. The amount of waste coming is in a tremendous quantity. Aluminium cans and Tin plate cans are one of the important products which are being recycled on an increasing scale. For carrying out this recycling can crushers are used. Ryoichi Chiba [3] studied Solid-state recycling of aluminum alloy scarf into c-channel by hot extrusion. In this study, we have investigated the possibility of the solid-state recycling of aluminum alloy machining scarf into c-channels using hot extrusion. Shaymaa Abbas Abdulsada [4] studied the aluminum recycling industry is mature and well developed. Since 2001 the production of secondary aluminum in the US from recycling has actually exceeded that of primary aluminum from smelting. Chongqing Wang [5] studied Separation of aluminum and plastic by metallurgy method for recycling waste pharmaceutical blisters a hydrometallurgical method was employed for recycling waste pharmaceutical blisters (WPBs); leaching WPBs using hydrochloric acid solutions was conducted to separate aluminum from polyvinyl chloride (PVC) plastic. Shakila Begum [6] studied Recycling of Aluminum from Aluminum Cans studied High purity salt flux composition and additive composition, which is used in the melting of scrap aluminum such as found in used beverage containers, have been optimized in this investigation.

4. Material Selection and Design Parameter

The main aim of this is to study the complete design of Automatic can crusher machine. In this design calculation and material selection procedure parameters have been taken into consideration from design data book, thesis, journals to carry out this project.

Table -1: Material Selection Chart

Product	Material
Pneumatic cylinder	Aluminium
Frame	Mild steel
Furnace(Body)	Cement, clay, aluminium drum
Solenoid valve (Body)	Stainless steel
Conveyor belt	Silicone and Polyethylene

4.1 Double-acting Cylinder

A double-acting cylinder has a two-port on the cylinder, which is located at both ends of the cylinder. With the double-acting cylinder having two airports this would allow the cylinder to move in both extend and retract directions. Basically only one port of the cylinder is pumped with compressed air and the other port is used as an exhausted. The double-acting cylinder can also be used like a single-acting cylinder as long as there is no spring return is required. The only down fall to a double-acting cylinder is that air compressed going through the tables is not calculated right, and that may cause the piston rod to be more vulnerable to bucking and bending. Max Power Transmitting Capacity 7 bar. It needs 12volts dc supply for actuation.



Fig -1: Double acting cylinder

4.2 Solenoid Valve

If pneumatic cylinder are chosen to be used for the project, a device would be need to control when air need to enter and exit the cylinder. To do this a solenoid valve is going to be need for the project. A solenoid valve is electromechanically operated valve, which is controlled by an electric current that flow a solenoid and switches the solenoid from on to off. In the case of this project it will be an air valve solenoid which will turn air on and off when need to operate a component for the project.



Fig -2: solenoid valve

4.3 Belt Conveyor

A belt conveyor is the carrying medium of a system. There are two main industrial classes of belt conveyors; those in general material handling such as those moving boxes along inside a factory and bulk material handling such as those used to transport large volumes of resources and agricultural materials, such as grain, salt, coal, sand and more. Here we used 130*600 silicone and polyethylene belt for crush can handling. Conveyer lift them crusher to furnace.

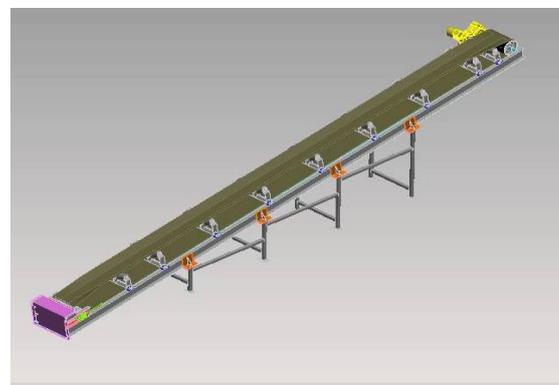


Fig -3: Inclined & declined belt conveyer

4.4 Furnace Design



Fig-4. furnace

Furnace is use for melt the aluminum crushed can, in which furnace heat for about 10 minutes before placing crushed aluminum can inside of it. The temperature in the furnace will need to be above 1220 degree Fahrenheit (660 degree Celsius).once the crucible is glowing orange, the furnace is hot enough to melt aluminum.

4.5 Frame

We have selected standard L section frame of material mild steel. The frame is supported due to possibility of vibrations are more Therefore, for foundation purpose pad plates are provided in between two legs a support of angle is given to avoid splitting of edge. Hinge of male type is fabricated and female is welded in frame and slotted plate known as table plate welded with male hinged accept on frame. Below the table plate toe angle are welded on legs.

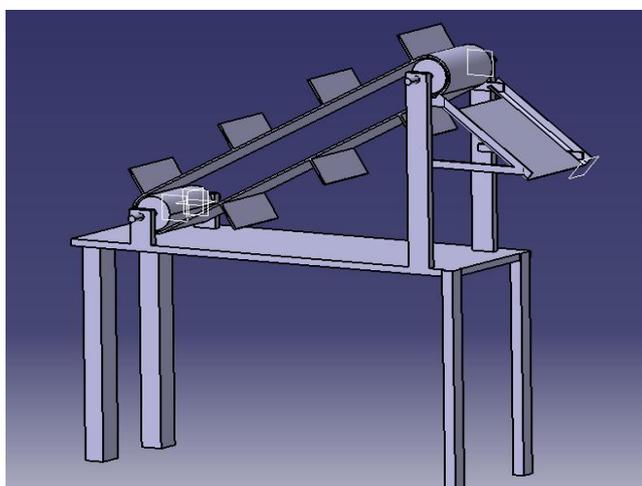


Fig-5- 3D model of frame

On this „S“ shaped brackets are mounted, these brackets are used as bearing housing. In this brackets bearing are fitted. Bearing arbor is fitted which is main part of the machine and whole accuracy depends on it. The shaft is made according to IS-C-45 on centre lathe machine in workshop and alignment of the shaft is supported between the centre lathes during fabrication

5. DESIGN

In this design and calculation procedure parameters have been taken into consideration from design data book, thesis, and journals to carry out this project.

5.1 Design of can crusher



Fig-6. Design of can crusher

The material used for the cylinder is aluminum, which is having specification of 50 diameter, 100mm in length and permissible load (ft) 180N/mm². We have selected 50mm diameter cylinder so as to get proper force intended on can and it get crushed ,here is the calculation carried out:-

$$\text{Thickness} = \frac{D}{2} \left(\sqrt{\frac{ft+p}{ft-p}} - 1 \right)$$

$$t = 0.68\text{mm}$$

Therefore,

$$t = 3\text{mm}$$

The outer diameter of the cylinder,

$$\begin{aligned} \text{Outer diameter } D_o &= D_i + 2(t) \\ &= 50 + 2(3) \\ &= 50 + 6 \\ &= 56\text{ mm} \end{aligned}$$

Therefore, Force generated by cylinder

$$F = P \times A$$

$$A = 3.14 / 4 \times D^2$$

$$A = 3.14 / 4 \times 50^2$$

$$A = 1964\text{ mm}^2$$

$$F = 2.45 \times 1964 = 4808 \text{ N} = 490 \text{ kg}$$

5.2 Design of weld joint

Checking the strength of the welded joints for the safety. The transverse fillet weld welds the side plate and stiffness plates, the maximum load which the plate can carry for transverse fillet weld is,

$$P = 0.707 \times S \times L \times f_s$$

Where, S = size of weld, L= contact length =25mm

The load of shear along with the friction is 30kg = 300N

Hence, Equation becomes,

$$300 = 0.707 \times 3.4 \times 25 \times f_s$$

$$\text{So, } f_s = \frac{300}{0.707 \times 3.4 \times 25}$$

$$f_s = 5 \text{ N/mm}^2$$

since the above calculated is smaller so permissible value f_s is taken as 21 N /mm² which is very safe .

6. CONCLUSIONS

The above design procedure is been adopted for the fabrication of fully automatic can crusher machine which will make the product durable for the long time as well as make it efficient and also helps to understand the concept of design. Thus with the help of this design we can fabricate an automatic can crusher machine to simply reduce the volume of cans as well as to reduce the human fatigue.

REFERENCES

- [1] Stefan Tabacu, "Axial crushing of circular structures with rectangular multi-cell insert" 2015.
- [2] Shadab Husain, Mohammad Shadab Sheikh "Can crusher machine using scotch yoke mechanism" 2014. Mechanical Engineering Student, Anjuman college of Engineering and technology, Nagpur, India.
- [3] Ryoichi Chiba, "Solid-state recycling of aluminium alloy swarf into channel by hot extrusion" 2013.
- [4] Shaymaa Abbas Abdulsada, "Preparation of Aluminum Alloy from Recycling Cans Wastes" 2013 University of Kufa, Collage of Engineering, Iraq.
- [5] Chongqing Wang, "Separation of aluminum and plastic by metallurgy method for recycling waste pharmaceutical blisters" 2014.
- [6] Shakila Begum, "Recycling Of Aluminum from Aluminum Cans" 2013.