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The Dual Stroke Can Crusher

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Abstract- **In this study, the dual stroke can crusher is crush the empty cans and it is designed for crushing aluminium cans only. This device used for crushing aluminium cans for easier storage in recycling bins thereby giving an extra space by flattening of cans. The single slider crank mechanism is the backbone of this project. This project is about designing and fabricating the aluminium Can Crusher to crush the can and transfer it to anywhere. The special feature of this project is automatic removal of crushed can from the crushing site and also automatic feed of new cans to be crushed without human intervention.**

Keywords-- **Can Crusher, Ram, Two electric motors and 12-V DC battery.**

I. Introduction

A beverage can is a metal container designed to hold a fixed portion of liquid such as a carbonated soft drinks, alcoholic beverages, fruit juices, teas, herbal teas, energy drinks, etc. Beverage cans are made of aluminium (75% of worldwide production) or tin-plated steel (25% worldwide production). Since we use aluminium so frequently (75% of worldwide production) it is important to recycle aluminium. Recycling aluminium not only helps to keep the landfills clear but it also saves energy. Recycling 40 aluminium beverage cans saves the energy equivalent of one gallon of gasoline. Using recycled material for new aluminium beverage cans uses 95%less energy and produces 95% less greenhouse gas emissions than making a can from new materials. An aluminium beverage can, once recycled, can be back on the store shelf in as little as 60 days. Aluminium produced from scrap uses only 5% of the energy that producing aluminium from ore does. The aluminium can today is the most recycled of any beverage container. Aluminium is durable, flexible, lightweight, strong and recyclable. 75% of aluminium ever produced is still in use. Aluminium building components can be repeatedly recycled back into similar products with no loss of quality. 95% of aluminium in buildings is recycled [5].

Aluminium recycling is the process by which scrap aluminium can be reused in products after its initial production.

The process involves simply re-melting the metal, which is far less expensive and energy intensive than creating new aluminium through the electrolysis of aluminium oxide, which must first be mined from bauxite ore and then refined using the Bayer process.

Recycling scrap aluminium requires only 5% of the energy used to make new aluminium. For this reason, approximately 31% of all aluminium produced in the United States comes from recycled scrap. Aluminium doesn‘t occur naturally in the earth‘s crust, it has to be extracted from its ore – bauxite – which is mined and then melted in a very energy-intensive process. Although great care is taken to rebuild the land after mining, changes do occur as a result of mining that are detrimental to the surrounding environment. It takes 80-100 years for aluminium can to decompose. Compared to mining and smelting, recycling aluminium drink cans is far less energy intensive. Recycling aluminium requires only 5% of the energy and produces only 5% of the CO_2 emissions as compared with primary production. A recycled aluminium can saves enough energy to run a television for three hours.

More than 100 billion aluminium cans are sold in the United States each year, but less than half are recycled. A similar number of aluminium cans in other countries are also incinerated. Aluminium cans are one of the easiest materials to recycle. New drinks cans appear on the shelf just six weeks after recycling. A single aluminium can is said to, when recycled, saves about as much as oil as would be poured into it to fill up.

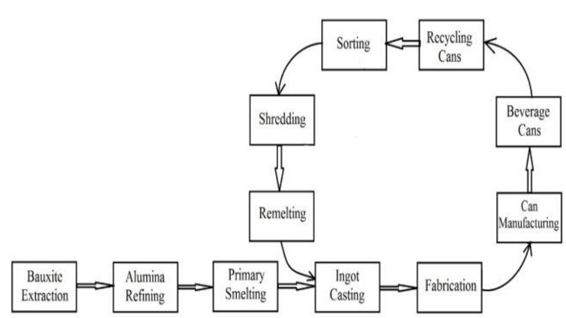

Fig: 1 Recycling of Aluminium Cans

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II. LITERATURE SURVEY

Executing a research is necessary to obtain all the information available and related to the topic. The information or literature reviews obtained are essentially valuable to assist in the construction and specification of this final year project. With this grounds established, the project can proceed with guidance and assertiveness in achieving the target mark. [5, 8]

2.1 different types of existing can crushers:

The most common types of crusher these days are basically used for volume reduction. The design of these types enable them to crush follow the types of crusher and then crush as look as possible or destroy.

Fig.2: Manual single can crushers

Single can crushers available in the market use a simple mechanism to crush a can, however the crushed can needs to be removed manually and also new can needs to be placed.

This poses two problems:

1. Lot of time and energy of operator is wasted in removing the crushed can from the system and placing a new can.
2. The operator‘s fingers or hand can be hurt by the crusher during removal of crushed can and replacing it with a new one.

Fig.3: Manual multiple can crusher

Multiple can crushers provide an advantage over single can crushers that many cans can be crushed without the need to remove crushed can as they fall automatically due to gravity. But the problem faced is application of high force at lever due to lesser mechanical advantage.

Fig.4: Pneumatic single can crushers

Pneumatic can crushers use automation reducing human intervention further. However, the use of air compressor, valves and pipelines make the equipment more expensive. [8] After going through the various products available in market and studying their relative merits and demerits,

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Our aim in designing the can crusher is to:

1. Make it **electrically operated** to eliminate the stress on human as in case of manual crushing.
2. Provide crushing action in both the strokes thus making it a **dual stroke** can crusher.
3. Provide **automatic falling of crushed cans** and **automatic feed of new cans** to be crushed so as to keep the crushing area free from human intervention thus providing safety to the operator.

III. Problem Statement, Scope Of The Project Andscope Of Work

A) Problem Statement:

In today's times, Cold drinks and other beverages are packed in cans. Commercial establishments like cafeterias and bars, have to deal with these empty or leftover cans. Storage is often a problem as these cans consume too much space, thereby increasing the total volume of the trash. As canned beverages and foods are frequently consumed even in homes, these cans can take up a lot of storage space. The transportation cost is also high for moving such huge number of cans. Even if people footstep on the tin after finishing their drink or try to crush it using hands, the tin does not always look symmetrically flat and it looks messy.

This condition of the tin sometimes leads to sharp edges due to tearing of tin that can harm or injure people who collect these used cans. Furthermore, people always throw the can here and there. These conditions lead to polluting the environment and surroundings. So the problem statement is to design and fabricate a can crushing mechanism which crushes the can symmetrically reducing the volume approximately by 75%.

B) Scope of the Project:

The main objective of the can crusher is to crush an empty aluminium can into the smallest unit possible. This project is limited to designing the crusher components that are critical which includes shaft design. The crusher will be designed to handle beverage cans only. The components will be designed such that the material is available locally and it can be manufactured easily in Yeola.

The material that we will be using for this project is mild steel due to easy availability and easy machinability considering design for manufacturing (DFM). In addition, we will also use many machine shop tools like lathe machine, drilling machine, cutting machine and welding equipment. For cost cutting, we tried to use as much as materials scrapped or which are available at low price.

C) Scope of Work:

Literature review on the knowledge of mechanism design, Study of existing designs and selection of a new design which will eliminate drawbacks of existing models. To design using machine design principles and draw the parts of a can crusher using CAD software SOLID EDGE. Develop the machine using various machining processes like turning process, drilling process and cutting process. Fabricate the machine using welding equipments.

IV. Constraints, Methodology And Design

A) Constraints:

- Design must have a continuous can feeding mechanism.
- Only one Can should be crushed at a time.
- Can must be in good condition when supplied to the device.
- 75% volume reduction must be achieved.
- Automatic feed for Can Crusher
- Crushed aluminum can must immediately fall into the bin without human intervention.
- Arrangement for the aluminium can to slide from hopper to the crushing area.
- Maximum space occupied by machine must be125×95×30 cm
- Aluminium can bin must hold 10 uncrushed cans
- Must be electrically operated

B) Methodology:

In designing and fabricating this tin can crusher, a flow of methods had to be used for the design to crush the tin. First of all, a process planning had to be charted out. This acts as a guideline to be followed so that, the final model meets the requirement and time could be managed. This would determine the efficiency of the project to be done. Regulating and analysing these steps are very important as each of it has its own criteria.

C) Concept Design:

The design project for compacting of empty beverage cans thought interaction of single slider crank mechanism. The input is given electrically by motor effort i.e. by two motors; two small sprocket of the chain drive are rotated. This torque is then transformed to the bigger sprockets which amplifies the torque so that a large amount of torque is developed. This sprocket is then connected to the crank which transfers this torque to the ram.

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The ram slides through the guide way provided and the cans are loaded through the hopper. As the large amount of force is gathered at the ram, the ram compresses the can to make it flat and reduce its volume to a very small amount. A small opening is provided at the end of guide way so that the compressed cans are easily dropped in the bin provided at the bottom. The first input for our design was the speed of the small sprocket which is 30 RPM and the force required to crush the empty beverage can which will be discussed in the design section in the report. The most important part and objective of our design is to provide a device for compacting empty beverage cans of aluminium requiring minimum of power and yielding a low noise level. The main component in the project is the ram which is going to interact / crush the can.

For power transmission from lever to crank of slider mechanism and torque multiplication, a chain drive is selected. The advantages of chain drive are:

(1) Transmit large power,
(2) High efficiency,
(3) stable speed ratio,
(4) Long life, and
(5) Reliable.

The disadvantages are:

(1) High requirements in manufacturing and assembling,
(2) Expensive, and
(3) Unsuitable for long distance transmission.

Since the advantages suppress the disadvantages in our case, we selected chain drive over belt or gear drive. [9]

Here 2 chain drives are used providing the following advantages:

1. Connecting rod does not interfere with crank shaft due to provision of separate crank.
2. Use of 2 chain drives distributes the torque equally among themselves making crushing action better due to symmetrical distribution of forces and torque.

V. Working

- Two motors power the small sprocket thereby transmitting power to the large sprocket from smaller sprocket, at the same time amplifying the torque.
- The large sprocket transmits the power hence torque to the crank attached to it.
- The connecting rod forces the ram into the guideway.
- Ram then crushes the can to make it as much as flat.
- The crushed can falls due to gravity into the bin via the opening provided in guide way below the crushed can.
- After the piston returns to its opposite position, new uncrushed can falls into the guideway from hopper thus providing a certain degree of automation.

VI. Economical Consideration

Assuming 75% reduction in volume.

4 crushed cans occupy the same volume as 1 uncrushed can.

Let a truck can carry a maximum of x uncrushed cans.

Let 'm' be mass per can (crushed or uncrushed).

Therefore a truck can carry maximum of 'x' m weight.

Let f be the fuel charges to carry 'x' m weight through some distance.

To carry 4x uncrushed cans, we require 4 trucks as 1 truck can carry a maximum of 'x' uncrushed cans.

Let FC be the fixed cost per truck which includes investment on truck, its maintenance costs, road tax, driver and cleaner salary, octroi, state permits and toll fees etc.

Thus (Total cost=FC+f) for x cans.

For 4x cans we need 4 trucks as maximum cans (uncrushed) carried by a truck are x.

Thus total cost for 4x cans become=4FC+4f...... (1)

Now, after crushing of all the cans to 25% of original volume,

Since x uncrushed cans can accommodate in a truck, 4x crushed cans can take the place.

Thus weight of load per truck becomes 4xm increasing the fuel cost to say nf. (Assuming linear variation) where n<4.

Thus total cost for 4x cans become=FC+4f....... (2)

Comparing (1) and (2) the cost of transporting in crushed cans reduces by a huge amount

(3FC + (4-n)f) thus saving money.

Much work in the project is constrained because of lack of essential resources and their high-cost.

- Instead of two motors a single motor can be used for crushing thus eliminating the provision for assembling two motors.
- Sensors can be used to calculate the number of cans crushed per minute or per hour
- The crushed cans can fall onto a conveyor belt which will carry the crushed cans to the truck
- Multipurpose crusher can be thought of which can crush cans of various sizes, plastic bottles etc.

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VII. CONCLUSION

In our project we carried out the study of the current can crushers and the various mechanisms employed and also the associated drawbacks. Overall the project was very enriching in terms of design process along with manufacturing knowledge. The knowledge gained while solving and understanding the complexities of our project would help us in our professional life.

Percentage reduction in volume found experimentally is 75.37% which is quite considerable.

Savings in transportation of crushed Cans is

(3FC + (4-n)f).

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