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Fabrication of Aluminium Can Crusher by Hydraulic System

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Abstract: *Nowadays in India, recycling is one of the areas which are rapidly increasing day by day. Amount of waste coming is in tremendous quantity. Aluminium cans are one of the important products which is being recycled on an increasing scale. For carrying out this recycling can crushers are used. For recycling of these cans, manual operation is being carried out in industries, which is a time consuming process and ultimately it leads to the reduction of production rate. In order to crush the cans in a less time, we are designing a can crusher machine using a hydraulic cylinder having one side cushioning ability. A can crusher machine is used for crushing aluminium soda cans for recycling purpose and also for easy storage in recycling bins. The Cylinder is reciprocate horizontally by a hydraulic pressure to crush the different shapes cans , this is the principle which we are using in our can crusher.*

Keywords: *3/4Direction Control Valve, Actuator(Single Acting Cylinder), Empty Cans, Pressure Relief valve, Pressure Gauge, Centrifugal Pump, Funnel, Reservoir*

I. Introduction

The main purpose of the project is to get knowledge of "Design and Fabrication of aluminium can crusher". The design is an environment friendly and uses simple properties such as Hydraulic pump with a cylinder to crush the cans simultaneously. In order to reduce the waste, we planned to create a can crushing machine that will reduce the volume of aluminium cans by approximate eighty percent. This machine primarily usage is to save space and for recycling. It can be placed anywhere in park,restaurant, canteens, etc. in today's life most of the food items are packed in canned. Cold and hot 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 ecofriendly 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.

II. Literature Review

Kevin W. Schell et.al 2002: The electric aluminum can crusher is an appliance for crushing aluminum beverage cans Suitable for use in households and commercial establishments. The crusher has an electric motor rotating a first crusher wheel and a second crusher wheel mounted on a spring biased Support arm via a chain drive. Aluminum cans are inserted into a feeder chute having a discharge opening adjacent the junction of the crusher wheels. The feeder chute has a Sensor, preferably an electric eye disposed on an interior wall of the chute, which detects the passage of a can through the chute and turns the electric motor on for a timed interval. As a can exits the feeder chute it is crushed between the crusher wheels and is discharged from the crusher. A pair of guides retains the can between the crusher wheels. The Support arm may be retracted to clear any jam between the roller wheels.

John S. Fletcher et.al 1991: The can crushing device disclosed herein comprises two parts. One part uses a relatively narrow bar to bend inwardly the middle of the can, preferably one made of aluminum. This step also tilts the ends of the can in hardly, thereby making it more susceptible to be more easily crushed into one compact, relatively flat piece. This second step is effected by a second part which comprises a base portion on which the partially bent can is positioned and an upper movable portion which is pivotally connected to the base portion. 12 Claims, 5 Drawing Sheets.

SeijaSinkkonenet.al 2004: Four samples of scrap raw materials for an aluminium recycling plant were screened for the occurrence of persistent halogenated aromatic compounds. The samples contained waste from handling of electric and electronic plastics, filter dust from electronic crusher, cyclone dust from electronic

crusher and light fluff from car shredder. In our screening analyses, brominated flame etardants were observed in all samples. Polybrominateddiphenyl ethers (PBDE) were identified in all samples in amounts of 245–67450 ng/g. The major PBDE congenersfoundweredecabromo- and pentabromodiphenyl ethers. 1,1-bis(2,4,6-tribromophenoxy)ethane, hexabromobenzene, ethyl-pentabromobenzene, tetrabromobisphenol-A, pentabromotoluene and dimethyl tetrabromobenzene were observed in all scrap samples. The concentrations of PCBs, PCNs (polychlorinated naphthalenes) and nona- to undecachlorinatedterphenyls in some of these scrap samples were remarkably high.

H. M. El-Zomoret.al 2013: Recycling of aluminum beverage cans is an important issue due to its economic and environmental effect. One of the ignificant factors in aluminum cans recycling process is the transportation cost from the landfill space. An automatic compression baler (ACB) machine has been designed and built to densify the aluminum beverage cans. It has been constructed using numerous fabricated components. Two types of control methodology have been introduced in this ACB machine to achieve its goal. The first is a semi-automatic system, and the second is a mechatronic system by using a Programmable Logic Control (PLC). The effect of single and double pre-compression for the beverage cans have been evaluated by using the PLC control. Comparisons have been performed between the two types of control methodologies by operating this ACB machine in different working conditions. The double precompression in PLC control proves that there is an enhancement in the ACB performance by 133% greater than the direct compression in the semi-automatic control. In addition, the percentage of the reduction ratio in volume reaches 77%, and the compaction ratio reaches about four times of the initial volume.

SenthilKannan et.al 2016: The paper is about fabrication of mechanical crusher which would help to crush the used juice cans, paint cans and punched sheet metal waste. This paper aims to design a crusher that could be installed anywhere and would aid crush of used wastes. This paper involves the process of designing the crusher considering forces required for crushing and ergonomic factor that an operator needs. The design of this machine is such that it would require optimum load to crush metals and will not strain the user or operator. After the completion of design process, it is manufactured and transformed into a machine that would help in waste management. The crushing of used cans will also ensure that the cans are not used beyond the self-life of the metals. Therefore this paper will prove to be a useful asset in many ways. We have designed the crushing machine using Modelling software's. The crusher is designed based in the simple principle or a mechanism which is Crank and Slotted Lever Mechanism where the rotary motion from the motor is converted into reciprocating motion by the crank which is in-turn connected to the piston that crushes materials. The Designed components were then assembled and analyzed using an analysis software and the required dimensions of the crusher for the optimum performance have been found. These data's were then transformed into a real time model by manufacturing it. The designed crusher was then checked and the crusher effectively crushed all the components with ease and with reduced human effort.

SathishPaulrajGundupalliet.al 2016: A crucial prerequisite for recycling forming an integral part of municipal solid waste (MSW) management is sorting of useful materials from source-separated MSW. Researchers have been exploring automated sorting techniques to improve the overall efficiency of recycling process. This paper reviews recent advances in physical processes, sensors, and actuators used as well as control and autonomy related issues in the area of automated sorting and recycling of source-separated MSW. We believe that this paper will provide a comprehensive overview of the state of the art and will help future system designers in the area. In this paper, we also present research challenges in the field of automated waste sorting and recycling.

HanifiCanakciandet.al 2016: This work presents an investigation of the effect of waste aluminum beverage cans strips on strength and swelling properties of lean clay. Waste beverage cans (WBC) were cut into 5 mm strips and mixed with soil in 2, 4, 6, 8, and 10 % (dry weight of soil) before use. Three standard tests were carried on the prepared samples: compaction, free swelling, and California Bering Ratio (CBR).Test results showed that WBC significantly affected the compaction characteristics, swelling and strength properties of the Clay.

W.J. Bruckard et.al 2009: Salt cakes, which are nominally waste products derived from aluminium dross melting furnaces, are complex mixtures of some 20 different compounds made up of many different elements. Normally they are regarded as waste products and they are disposed of in toxic waste dumps. However, it is shown here that some components are readily recoverable as high-grade products for recycling or sale and that the residues thus generated can be non-toxic. Recoverable components include metallic aluminium,

salt (halite (NaCl) and sylvite (KCl)), alumina-containing compounds, and possibly hydrogen gas. Metallic aluminium is soft and malleable and is not reduced in size by crushing and grinding, whereas the other components in salt cake are soft and brittle or are readily dissolved in water. Hence the coarse metallicaluminium can be readily recovered by crushing and screening and the finer metallic aluminium can be recovered by fine grinding and screening, froth flotation, or possibly electrostatic separation. Aqueous acid or alkaline leaching has also been proposed to recover aluminium metal from salt cake. The halite and sylvite are easily extracted by leaching ground salt cake with cold water and filtering off the saline solution. This solution can be sent to solar evaporation ponds where the water is evaporated and the dry salt harvested for recycling to dross treatment furnaces or other markets. Some of the water-insoluble or oxide aluminium compounds present are soluble in Bayer-type leach solutions and could possibly be sent to a Bayer-type leach plant for production of high-grade alumina for aluminium production. Alternatively, because the oxide aluminium compounds are inert they could be sent to a non-toxic dump. The possibility of integrated flowsheets to recover more than one product in a single plant is also discussed.

PouyaGhadimi et.al 2014: The manufacturing industry is shifting towards sustainability as a business strategy to maximize added value with minimum resource consumption. An increasing number of publications ighlight the importance and ongoing development of general methodologies to achieve the aforementioned goal. However, the focus has been mainly on separate management of the material flow, process control and energy consumption. Moreover, only limited industrial applications have been reported to show the real achievable benefits for industries. This paper presents a roadmap for improving the energy efficiency of a manufacturing plant, through increasing transparency in material and energy flows to derive detailed feasibility studies of improvement measures and applicability. Final results illustrate the importance of the integrated material and energy flow to guarantee achievement of the main production objectives in addition to maximizing the energy saving potentials.

III. Experimental Work

Single Acting Cylinder

This machine is basically works on the principle of hydraulic based circuit which reciprocate the Single Acting Cylinder to crush the cans.In these the Cylinder is placed horizontally.The cylinder has a piston rod which is inside the cylinder which reciprocatesforward when hydraulic pressure is given.And it reciprocate backward when hydraulic pressure get release.It has one port for return and forward flow.

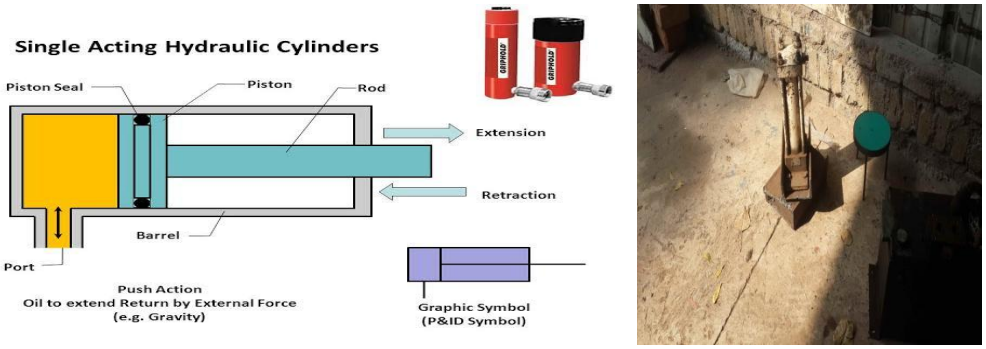

Fig No.1. Single Acting Cylinder

Funnel

Funnel is the part of our project,which is attached to the cashing of the cylinder.Funnel is conical in shape.Its upper part has large diameter and lower part has small diameter.which is mainly made of mild steel.In these type of funnel various types of cans are store. Which can fall down one by one when a bunch of cans are crushed?

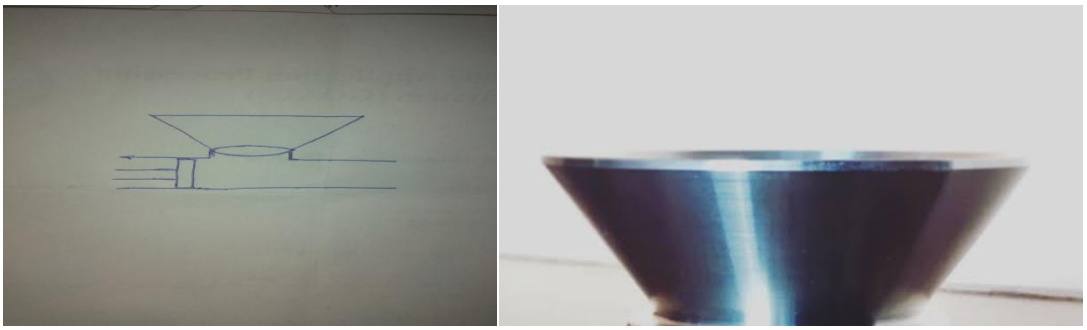

Fig No.2. Conical Funnel

Hydraulic Power Pack

Hydraulic power uses pressurized fluids to run machinery.Hydraulic power pack to avalve in another machine.Hydraulic power packs are stand –alone devices,as opposed to a built-in power supply for hydraulic machinery .Some power packs are large. Stationary units and others are more portable.They have a hydraulic reservoir ,which houses the fluid,regulators that allows users to control the amount of pressure the power pack deliver to valve ,pressure supply lines and relief lines,a pump and a motor to power the pump is 1 HP.

Fig No.3 .Dassembled Hydraulic Power Pack.

Fig No.4 Assembled Hydraulic Power Pack

IV. Design Procedure

The aim of this is to give the complete design information about single acting hydraulic cylinder circuit.In this the explanation and some other parameters related to the project are included.With references from various sources as the journal.Literature review has been carried out collect information related to this project.The working of the project picture has been made and its image format is taken and uploaded here.

Diagram

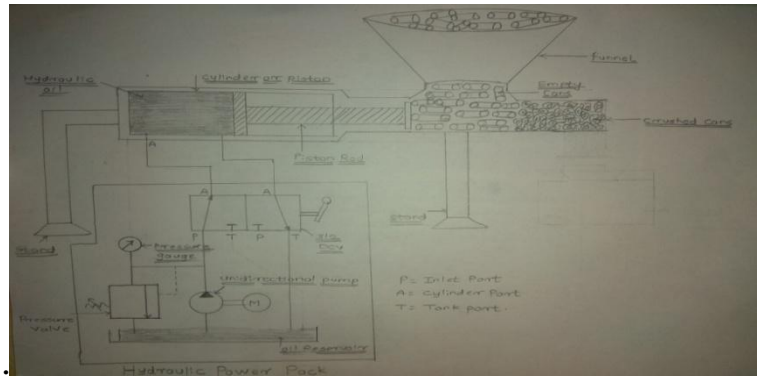

Fig No. 5. Hydraulic Can Crusher

V. Working

In Experimental Setup we are using a hydraulic power pack which include pressure relief valve,unidirectional centrifugal pump, Pressure gauge,3/4 DCV, Oil reservoir,Single Acting Cylinder with piston rod, Funnel.For Crushing a different shapes of cans we use a single acting cylinder (Actuator) which can carried extension and retraction by hydraulic oil. For operating SAC we use 3/2 DCV. 3/2 DCV has three port namely inlet port 'P',Tank port 'T',and Cylinder port 'A'. It has two position of its spool.In first position of spool of 3/2 DCV oil under pressure flows from P to A and T is closed. When oil flow with under pressure the piston rod extends forward with high pressure and crushes the all cans simultaneously. In second position of spool of 3/2 DCV,oil under pressure flows from A to T and P is closed. Then the cylinder get retract to its original position. The crushing cans get thrown out of the can compartment.These process going continuously when we pressurize the hydraulic oil again and again

Before Crushing **After Crushing**

Fig No 6 Empty Cans

Fig No 7. Crushed Cans

Advantage

The recycling of aluminium generally produces significant cost savings over the production of new aluminium,evenwhen the cost of collection,separation and recycling are taken into account.Over the long term,even larger national savings are made when the reduction in the capital costs associated with landfills,mines and international shipping of raw aluminium are considered.

VI. Fabrication

Hydraulic Components

- **Centrifugal Pump**
- **Pressure Relief Valve**
- **Pressure Gauge**
- **Reservoir(Tank)**
- **3/4 DCV**
- **Single Acting Cylinder(Actuator)**
- **Funnel**

VII. Conclusion

If we separate all the cans from the scrap we can crush it and obtain more profit. As well as the space consuption of can is reduced and human efforts is also reduced. From the above study, it is observed that by arranging different hydraulic components can be made automatic one to crush the Cans as well as plastic bottles solely to reduce the volume. Thus human efforts can be reduced as well as time also, because sorting system is installed there to separate the bottles and cans to reduce the human fatigue.As above results shows that the volume can be reduced to a large extent i.e. near about seventy percent volume can easily be reduced, thus transportation .volume can be increased and transportation cost can be reduced to a large extent and these can be reuse.

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We feel great pleasure to present the Dissertation entitled "**Design and FabricationAluminium Can Crusher**". But it would be unfair on our part if we do not acknowledge efforts of some of the people without the support of whom, this Dissertation would not have been a success. First and for most we are very much thankful to our respected Guide **Prof. Rizwan Shaikh** for their leading guidance in this project. Also they have been persistent source of inspiration to us.We would like to express our sincere thanks and appreciation to project co-ordinator**Prof. Faisal Ansari,** HOD **Prof. Karan Sharma** and Principal **Dr. Muhammad Ramzan**for their valuable supports. Most importantly we would like to express our sincere gratitude towards our **Parents, other Family Members and Friends** for always being there when we needed them most.

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