Review and Modeling of Aluminium Can Recycling System Using Pneumatic System

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Abstract - *This paper includes working principal of Aluminium Recycling System. Aluminium is most widely used to make cans in a food industry after the steel and it is most economical material after the steel. Modeling and simulation of a system is created in CATIA R20 version. System includes Hopper, conveyor belt, motor, Driving and Driven pulley, Crusher, Furnace etc. Hopper is to store the aluminium cans. This paper consist all the modeling of a component. This system consist pneumatic arrangement to give direction to the cans to place in proper position. System includes material handling system for transportation of cans. This system consists of pneumatic arrangement for crushing the aluminum.*

***Key Words*: Motor, Conveyor Belt, Furnace, Crusher, Battery etc**

1. INTRODUCTION

This system includes conveyor belt for transportation of cans. The material of cans is aluminium which is ductile material. Aluminium is widely used in industry for making a component which is used in our daily life like Home appliance, Sheet metal working, making of gears etc. It has good elasticity and fatigue failure properties. This system used in food industry. It consist Crusher for crushing a cans normally cans are made of metal like steel, aluminiun, plastic, etc. Recycling of aluminium it increases profit of a company. It also helps to the environment. For a designing of a crusher properties of material which are going to crush in a crusher should be known. Another main component in the system is furnace. Furnace works in high temperature. All the cans are drops in a furnace to melt the Cans. It also includes material handling system which is used transport the cans from lower level to higher level. It uses inclined belt conveyor to pick up the canes and hopper is used to store the cans. Opening of hopper is circular in shape to give proper direction to the cans. Modeling of a system is essential requirement of the project because it gives proper layout of the system. The space Requirement of the system is understand by modeling of the system. This system increase the rate of recycling, especially the rate currently present in the rural areas.

1.1.Methodology

The methodology followed for above experiment was breaking down the various processes which are as follows:-

1. Crushing
2. Material Handling
3. Melting
4. Casting

1.1 Objectives

1 Also to reduce the dependence on natural resources like bauxite for the production of aluminium.

2 During the whole process of aluminium recycling there is a lot of emission of (GHG's), we are trying to minimize it as much as possible.

The setup consisted of can crusher, conveyor, furnace and the cast. Initially the can is crushed is using the crusher which comprises of the pneumatic cylinder and the can then drops onto the conveyor which carries it towards the furnace. The conveyor forms the most essential part of the material handling system. A motor powered using a battery is used to control the speed of the conveyor belt essentially controlling the rate at which material is to be handled. The conveyor drops it into a furnace where it melted into molten aluminium at about 623 °C and then the dross formed in the molten liquid is separated and then the molten aluminium is poured into the cast to obtain aluminium ingots. The Working of a system is simple and easy to design and understand. By this system we give the help to the environment. By recycling the aluminium cans which are waste product of human being. Aluminium has mechanical properties like tensile strength, rigidity etc.

2. CAD MODEL

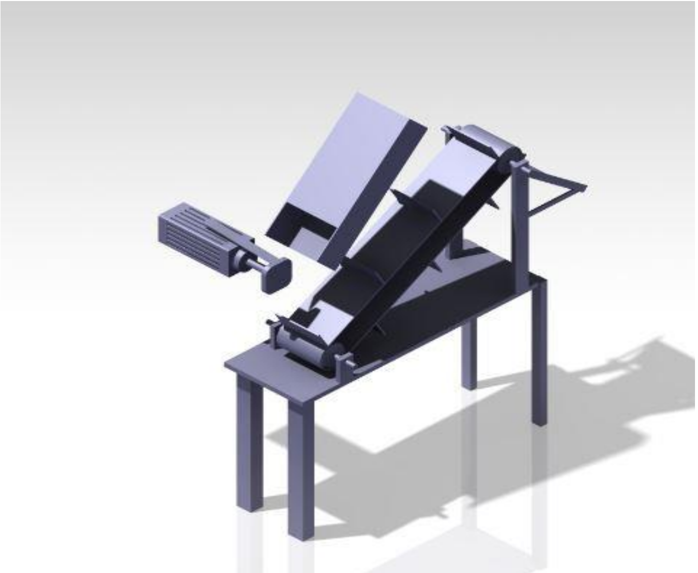

Fig No-1 CAD MODELING

3. LAYOUT OF A SYSTEM

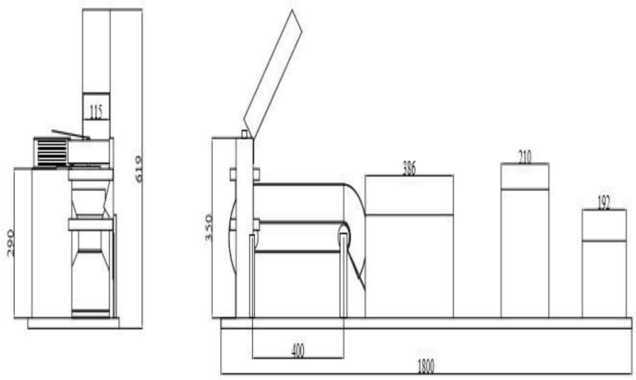

Fig No 2- Layout of System

5. DESIGN PARAMETERES REQUIRED FOR A PNEUMATIC SYSTEM

Cylinder force (kgf)

F = Cylinder force in N.

D = Diameter of piston in cm

D = Diameter of piston rod in cm.

p = Operating air pressure in “bar”.

f = spring force in Kg.

fr = frictional resistance.(Though in case of static thrust, the frictional resistance is zero.)

6. CRUSHING UNIT

The can crusher is the most vital part in the whole setup. The design specification of the crusher was decided upon certain factors which are-

- Stroke length according to the length of the can to be crushed so as to allow the crusher to easily accommodate a can before crushing

- Also to ensure that the can produces the least amount of energy to obtain the volume reduction of can required after crushing.

Also the compressor available to us operates from 1 to 10 bar pressure so that was also taken into consideration

7. WORKING PRINCIPLE

The compressed air at 4 bar pressure from the compressor is used as the force medium for crushing operation. There is pneumatic double acting cylinder, control valve and used. The air from the compressor enters the control valve. A double acting cylinder was used to ensure automatic retraction after crushing i.e. to revert the direction of cylinder. The controlled air from the control air enters the cylinder. In one position the air enters to the cylinder and pushes the cylinder to crush the can. The control valve is again used to revert the direction of the cylinder. The can crusher consists of a double acting cylinder. A rectangular billet is used for distributing the force evenly in to the can.

8.CRUSHING UNIT

Fig No 3- Crushing Unit

9.MOTOR SELETION

Specifications

- RPM: 30 at 12V
- Voltage: 4V to 12V
- Stall torque: 28 Kg-cm at stall current of 1.3 Amp.
- Shaft diameter: 6mm
- Shaft length: 22mm
- Gear assembly: Spur
- Brush type: Carbon
- Motor weight: 143gms

Fig No 4- Motor

10.CONVEYOR BELT ARRANGEMENT

Fig No 5- Conveyor belt

The conveyor has a 30rpm 12v dc motor. This motor is powered by 12V dc battery. The motor is actuated using a 1 way switch. As the switch is actuated the power is transmitted to the motor through the battery. The motor drives the metal shaft. The metal shaft is connected to the Roller pulley of the conveyor by a roller bearing. The roller bearing transmits the motor power to the PVC pipe without much friction. The fabric cloth is wrapped around the two PVC pipes. These two pipes act as the roller for the conveyor belts. The fabric cloth has wooden planks on it. A motor of 30 rpm has been selected to meet the speed requirements of material handling and to also ensure the rate of process is not slowed down. Initially during the project a motor of 10 rpm was selected but it wasn't able to keep up with the speed required. Hence we switched to a 30 rpm motor which ensured a good speed for material handling and also didn't hamper the overall recycling time.

11. The results are given in accordance with the following process:-

11.1 Crushing

The crushing of the cans takes place in the crusher. The crushing time of the crusher is 16can/min including the placement of the cans in the appropriate area.

11.2 Material handling

The material handling is done by the conveyor which carries the material from the crusher to the furnace. The conveyor is powered by 30rpm 12V dc motor.

11.3 Melting

The material is carried to the furnace by the conveyor. The crushed cans are dropped into the furnace. The heating time for the furnace is 40min. The capacity of the crucible is 18cans.The material of the crucible is stainless steel. The melting point of the crucible is 1340 degree Celsius. The melting of the cans takes 20 minutes.

11.4Casting

The cast is made up of mild steel. The melting temperature of the mild steel is 1100 degree Celsius. The molten metal is poured in the cast. The cooling time for the ingot is 15mins. The dimension of the cast billet is 650mmx650mm.

TABLE NO 1. Crushing Time

Can no	Crushing time (sec)	Original length (mm)	Crushed length (mm)
1	9	167	56
2	8	167	56
3	9	167	56
4	8	167	56
5	9	167	57
6	7	167	57
7	9	167	57
8	9	167	56
9	9	167	54
10	9	167	55
11	10	167	57
12	8	167	58
13	9	167	56
14	9	167	56
15	9	167	55
16	8	167	54

12. CONCLUSION

Even half a pound of aluminium in the shape of ingots goes for a price of Rs. 1500 which makes the whole process of recycling very much economically viable which is the main application of our system. Also to provide small time scrap dealers with a recycling unit which can enable them to get more value for the scrap the collect.

13. REFERENCES

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