Medical Blister Recycling Machine

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Abstract:- This paper titled "Medical blister recycling machine" focused on the recycling of aluminium waste like medical blisters, aluminium foils etc and reusing this aluminium as a useful product.

Our survey in the regard in the society, revealed the fact that most of the peoples are throwing away the product like medical blisters, aluminium foil etc to the surrounding as waste after the use, which may result in the increase of aluminium concentration in soil and water bodies. So, large parts of both the terrestrial and aquatic ecosystems are affected.

There is significant cost reduction in the recycling of aluminium when comparing with the production of new aluminium. Even when the cost like cost of collection, cost of separation and cost of recycling are taken into account over the long term. Also larger national savings are made which reduces the capital cost that is associated with the mines, landfills, international shipping of aluminium etc.

Keywords:- *Medical blister, Recycling, Aluminium, Crusher, eddy current separator, electric furnace.*

I. INTRODUCTION

This paper proposes a medical blister recycling machine which is cheap, easy to use and reduces the pollution caused by aluminium waste in the environment.

The positive contribution of aluminium to the modern living condition increases the demand heavily. As a result, the second most widely used metal is aluminium in different forms like medical blisters, aluminium foils, aluminium cans etc. these are the most recycled consumer product in the world. Aluminium has wide application on air, road, sea transportation, food and medicine packaging, constructions, electronics and electrical application etc. aluminium has excellent recyclability, high scrap value and low energy needs during recycling. These properties of aluminium increase its application in different fields.

When aluminium products are wasted or threw away, the resulting demand must be replaced by the new aluminium products. And it is more energy consuming than the recycling. Also it will produce more pollutants of all kinds including toxic liquid effluents, air borne emissions and solid wastes that are produced during mining and industrial processing. Primary aluminium production entails strip mining bauxite ore, refining it into alumina using fuel oil and other chemical inputs, transporting it vast distances, and smelting it into aluminium ingot using large quantities of electricity. New hydroelectric dams are often built to produce electricity for aluminium smelters and these are damaging river ecosystems and displacing indigenous peoples in many regions of the world.

Toxics agents are also released in to the water and soil during the bauxite ore extraction and when processed for refining in to alumina. Study shows that five tons of caustic red mud waste are produced, along with a host of other pollutants including NOx and SOx (which are the main agents or contributors for acid rain and smog) toxic fluorides and volatile hydrocarbons and other industrial effluents, when a ton of aluminium produced for a single year.

To avoid these problems the only solution is recycling of used aluminium. Recycling of aluminium provides significant saving in energy in different fields. It requires only ninety five percentage less energy and only produces ninety five percentage fewer GHG (Green House Gas) emissions, when comparing to the manufacturing of new aluminium. This data can be concluded as the GHG savings equivalent to taking 900000 cars off the road for a year. Medical blister recycling machine is a small scale machine which can be used to recycle aluminium products like medical blister, aluminium foil, aluminium cans etc in lower cost.

II. LITERATURE REVIEW

Similar concepts have been published by V Gente Etal about Separation of waste pharmaceutical blisters (WPBs) into plastic and aluminium, and it was investigated for the recycling. (Gente Etal. 2003, 2004) studied cryo comminution and separating electrically the medical packaging blisters,

effectiveness of size reduction is improved by cryo comminution process and it also promotes releasing of aluminium from plastic.

Medical blister recycling machine was introduced in European countries in 19th century. But these machines are used in industrial level or in large scale were tons of raw materials are recycled at a time.

In this type of large scale Medical blister recycling machines, the separation of aluminium from other material is done by a process which is carried out in vacuum. Also, here blowers and different types of valves and other accessories are used to control the flow of the particles or the aluminium powder through the passages.

In our design we are introducing a small scale Medical blister recycling machine which can be used in the locations like hospitals , small villages etc. In this machine Eddy current separator is using as a separating unit to separate aluminium from other materials. Cost and floor space is very less for the eddy current separator when it is compared with vacuum separator which is used in large scale machines.

Also, most of the passages for the transfer of particles are restricted to vertical direction which utilizes gravitational force for its movement. When we compare this machine with large scale machine, it requires only one operator for its working, while the other requires about twenty operators.

III. REQUIREMENT STUDY ANALYSIS

A. Methods for separation of aluminium and plastic

- *Separation of aluminium and plastic by metallurgy method*

Here recycling of waste pharmaceutical blisters is employing by a hydrometallurgical method. To separate aluminium from PVC (Poly Vinyl Chloride) plastic, the waste pharmaceuticals are leached using hydrochloric acid solutions under fixed conditions. The properties like temperature, hydrochloric acid concentration, reaction time, liquid to solid ratio and leaching behavior were investigated. And it is proved that when these factors increase, the recovery of aluminium also increases. The recovery of aluminum is up to hundred percentage under the optimal condition and it results the complete separation of plastic and aluminium. Fourier transform infrared spectroscopy is used to identify the purified PVC plastic.

Hydrometallurgical method, which is an environmentally friendly technique and is used for the economic analysis which confirms the feasibility of the recycling of waste pharmaceutical products.

- *Separation of aluminium-plastic laminates in post-consumer Tetra Pak with mixed organic solvent.*

Blend of benzene-ethyl alcohol-water organic solvent is the separation reagent used in this process. The volume proportion of different components in the separation agents and separation process was taken to optimize with the help of triangle coordinate figure analysis. Efficiency, total mass loss of product and separation time determines the separation temperature of aluminium plastic laminates. Low usage of solvent at certain temperature results the best performance in cost efficient separation, within certain range of volume proportion of the three components in the solvent agent and for certain time. Also similar solubility parameters of solvent and polyethylene adhesives are also the key factors for separating plastic-aluminium laminates. Such concept of multi solvent process which is based on combined system will be an important application in the recycling field.

- *Eddy current separator*

ECS (Eddy Current Separator) is a technique used to sort metals which has the capability to separate nonferrous metals from dry recyclables. Nonferrous metals include aluminium, copper etc.

The components of eddy current separator are a conveyor system and a high speed magnetic rotor system which is installed at one end and that end will be the discharge end. This rotor magnet is placed inside an outer drum which drives the conveyor belt. The rotor magnetic drum will revolve at three thousand rpm during its operation while the outer drum rotates at the same speed of conveyor system. When the magnetic rotor rotates or spins at high speed, the conducting metals induces an electric current, this electric induced in the metal particles will produces a magnetic field and this will be opposite in direction to the magnetic field created by magnetic rotor. So, a repelling force is experienced there which splits the metals from nonmetals. The metal will fall to a splitter plate and the other particles like glass, plastic and dry recyclables will fall freely over the rotor. This is the separating process in ECS.

- *Electrostatic separation*

Electrostatic separation technology is used for the recycling of metals and plastics from wastes. It is also defined as the selective sorting of solid species by means of solid species by means of utilizing the forces acting on the polarized bodies in an electric field. The adjusting of electric and co-acting forces will affect the separation process. The desired separation is closely controlled by the factors like potential, polarity, temperature and conditioning of the surface particles. The electrode arrangement of electrostatic separator determines the design and operation recommendations, roll speed, high voltage and rate of feed for typical industrial application.

B. Medical blisters

Medical blister is a term used to describe pre-formed plastic and aluminium packaging used in pharmaceuticals. Basically there are two types of pharmaceutical blister packages. In one variety the cavity is created of clear thermoformed plastic, and the lid is constructed of clear plastic or a combination of plastic, foil, and paper. The other case the package contains foil as an essential part of both webs, and its cavity is formed by cold stretching.

The four basic components of pharmaceutical blister packages are the forming film, the lidding material, the heat-seal coating, and the printing ink. The most common blister

package is made of a foil, paper, film, or multi material backing that is adhered to a sheet of thermoformed plastic bubbles. Forming films account for approximately80–85% of the blister package, and lidding materials make up15–20% of the total weight of the package. Because the forming film and the lidding material form an integrated package, they must match precisely.

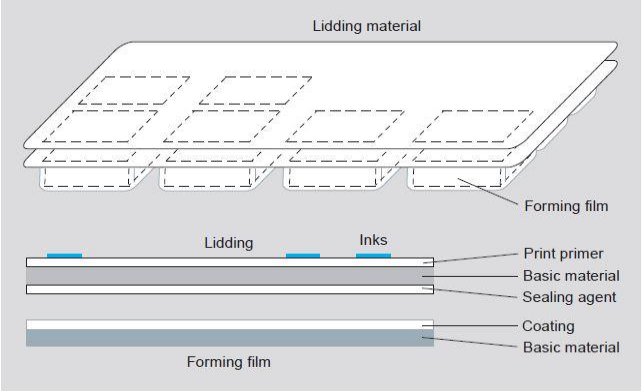

Fig 1: Basic components of blister packaging.

C. Advantages of aluminium recycling

Recycling of aluminium is a general or common process that has been practiced around the world since 1900s, it is a very important process and the advantages of aluminium recycling are listed below:

- *Energy saving*

Aluminium is the second most widely used metal in different form, beverage containers are the largest product used in daily life by people which is an aluminium product and the second most application of aluminium is in automobile field. Most of the scrap products from these applications are recycled back. Recycling of aluminium provides significant saving in energy in different fields. It requires only ninety five percentage less energy and only produces ninety five percentage fewer GHG (Green House Gas) emissions, when comparing to the manufacturing of new aluminium.

- *Prevents depletion of precious commodity*

Bauxite ore which is mined from earth's crust is converted to the aluminium metal. So, when the recycling is increased and the production of new aluminium is reduced, then it will reduce the mining and other related processes. Study shows five percentage of the total bauxite ore mining in the world is prevented by aluminium recycling in each year.

- *Satisfies the increasing demand*

Need for aluminium product increases in a large amount as the population rate increases. In the present situation, application of aluminium is more when compared to other metals. So, to meet the demand of aluminium, there must be a continuous aluminium production. At this situation mining only cannot meet the demand. So, recycling of aluminium comes in to bridge the gap. Today, aluminium manufactures uses approximately sixty five percentage of the new extracted aluminium to meet up their manufacturing demand. Therefore recycling of aluminium scrap is necessary.

- *Reduction in the emission of carbon dioxide*

As the result of increased environmental awareness and due to the numerous advantages, aluminium recycling is practiced widely all over the world. More than approximately 90000000 tons of toxic carbon dioxide from being let free in to air is prevented by the aluminium recycling in every year. Recycling of a single aluminium beverage can prevents carbon dioxide emission that equals a single kilometer car ride and it saves adequate energy to power a television for approximately about two to three hours. Today, every country has the responsibility to do whatever it can to reduce carbon emission. This means that if all countries focus on the reduction of carbon dioxide emissions there will be little concern about global warming.

- *It never wears out*

Aluminium is an infinitely recyclable metal. So, it can be recycled again and again over a long time without losing its qualities. Because of this properties most of the manufacturers uses aluminium in most of their products. Aluminium is a light weight metal, versatile and can be used in a number of applications

- *Landfill reduction*

A big problem facing by the economies is the waste management, especially the solid waste management. It is the main problem facing by many countries in the world today. Depositing in ocean, burying in huge holes dug in ground are the method used to dispose the waste. By the recycling of aluminium, the aluminium concentration or the aluminium content in the total waste is reduced and it will save the space that would be needed for burying the aluminium waste and can be used for other purpose.

As a result, recycling of aluminium is very important to the environment and the people all over the world. It is essential for all world economies to embrace recycling of solid waste and reduce carbon dioxide emission.

IV. OBJECTIVES

Main objective of the project is to create a recycling machine to recycle aluminium wastes like medical blisters, aluminium foils, aluminium cans etc, and reusing this aluminium for useful products.

➢ *Objectives can also be parallely achieved are*

- To achieve high safety
- To reduce man power
- To reduce the work load
- To reduce the fatigue of workers
- Less floor space
- For small scale use
- Less Maintenance cost

V. METHODOLOGY

➢ *The main stages/processes involved are*

- Crushing unit
- Eddy current separator
- Electric furnace

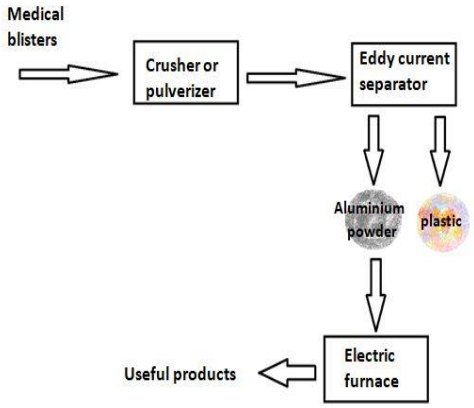

Fig 2:- Methodology

A. Crushing unit

Crusher is the mechanical device used to convert the aluminium blisters into powder form. Here, multiple numbers of cutting blades are fixed in a shaft and the power is transmitted from an AC motor with the help of a v belt.

The powder obtained from the crushing unit will be a mixture of aluminium and plastic and it is taken by a conveyor belt to the eddy current separator for the separation.

B. Eddy current separator

ECS (Eddy Current Separator) is a technique used to sort metals which has the capability to separate nonferrous metals from dry recyclables. Nonferrous metals include aluminium, copper etc.

The components of eddy current separator are a conveyor system and a high speed magnetic rotor system which is installed at one end and that end will be the discharge end. This rotor magnet is placed inside an outer drum which drives the conveyor belt. The rotor magnetic drum will revolve at three thousand rpm during its operation while the outer drum rotates at the same speed of conveyor system. When the magnetic rotor rotates or spins at high speed, the conducting metals induces an electric current, this electric induced in the metal particles will produces a magnetic field and this will be opposite in direction to the magnetic field created by magnetic rotor. So, a repelling force is experienced there which splits the metals from nonmetals. The metal will fall to a splitter plate and the other particles like glass, plastic and dry recyclables will fall freely over the rotor. This is the separating process in ECS.

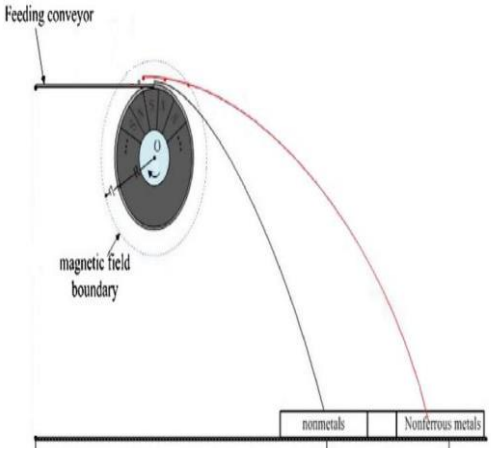

Fig 3:- schematic diagram of eddy current separator

C. Electric furnace

Here**,** electric furnace is used for the melting of aluminium powder which is separated from the eddy current separator.

Electric furnace mainly consists of coils and a casing. Nichrome wire is the coil used inside it. Nichrome is generally used in electric heating devices like iron box and water heater. Typically, Nichrome is wound in coils with a certain electrical resistance, and when current is flowing through it the joule heating produces heat in it. Temperature inside varies from 500-800º C. At this temperature the powdered aluminium is converted to molten form. And this melted aluminium can be converted in desired shapes using suitable dies.

VI. CONCLUSION

A prototype which exhibits the expected results is designed and developed. This machine can be used in hospitals and other local areas to recycle the aluminium waste in those places which results decrease in dumping of aluminium waste in surroundings and the environment is protected from the pollutions caused by aluminium waste.

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REFERENCES

[1]. Chongqing Wang, Hui Wang, Younian Liu "Separation of aluminum and plastic by metallurgy method for recycling waste pharmaceutical blisters" Journal of Cleaner Production 102 (2015) 378-383.
[2]. BingbingWan, WeipingChen,TiwenLu, Fangfang Liu, Zhenfei Jiang, Mengdi Mao " Review of solid state recycling of aluminum chips" Resources, Conservation & Recycling 125 (2017) 37–47.
[3]. X.G. Hu , Q. Zhu , S.P. Midson , H.V. Atkinson , H.B. Dong , F. Zhang ,Y.L. Kang "A Review on Recycling Aluminum Chips by Hot Extrusion Process" Procedia CIRP 26 (2015) 761 – 766.
[4]. Jujun Ruan , Lipeng Dong , Jie Zheng , Tao Zhang , Mingzhi Huang , Zhenming Xu "Key factors of eddy current separation for recovering aluminum fromcrushed e-waste"waste management (2016).
[5]. Article: pharmaceutical blister packaging,part 1Rationale and Materials by Ron Pilchik.
[6]. Jirang CUI, Hans J. Roven "Recycling of automotive aluminum"trans. Non ferrous met. Soc china 20 (2010)2057-2063.