International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 07 Issue: 09 | Sep 2020 www.irjet.net p-ISSN: 2395-0072

Design and Modelling of Automated Waste Management System with Crusher and Pneumatic Compactor

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Abstract - *Waste management can be the serious problem across the globe as rapid boom in population, urbanization and industrialization. Due to waste will be collectively dumped on open lands which causes primary health troubles, various sorts of disease-causing bacteria and viruses. Waste management and segregation is a much-needed procedure to avoid hazardous health issues, industrial problems, so as to preserve our environment. Hence automatic waste segregator is used that could segregate waste automatically.*

In current work the waste segregation of hospitals, blended household, educational institutions, laboratories, large and small-scale industries into various additives for smooth processing of later ranges for reusage, recycling or disposal methods. The mechanical waste segregator is designed to segregate the waste into ferrous and nonferrous material. The ferrous consists of the metallic waste is segregated by the use of electromagnets and nonferrous consists of the low and heavy density plastic, tissue papers, sanitary napkins, herbal waste and natural waste is segregated through air blowers use of air compressor.

The segregated waste will be gathered in a respective accumulating chamber then it will be crushed by the usage of crusher which help in reducing the volume of the material or which assist in lowering the amount (quantity) of material, will recycled efficiently and crushed waste is supplied as a raw material for industries.

For smooth transportation the crushed waste might be compacted tightly by the usage of pneumatic compactor (bale pressor) which makes the waste into bricks which may be further reused or recycled in the industries.

***Key Words*: Solid Waste, Blower, Electromagnets, Crusher, Pneumatic Cylinder.**

1. INTRODUCTION

It has been seen that the human work for errands that requires unique devotion has dropped down drastically because of different reasons, it is important to locate an automated framework to help facilitate the assignment. It has been additionally being recognizable that the region of developing urban locales are requesting compulsory pre-isolated waste as and when it leaves from the source point (Household, hospitals, educational institutions, laboratories, large and small-scale industries and so on.), so a framework to back out the procedure is required utilizing automation.

In India, rag pickers assume a significant job in the reusing of urban strong waste. Rag pickers and conservancy staff have higher grimness because of diseases of skin, respiratory, gastrointestinal tract and multisystem unfavorably susceptible clutters, in addition to a high prevalence of bites of rodents and other vermin. Dependency on the rag pickers can be reduced if isolation happens at the wellspring of municipal waste generation.

Solid waste management is an emergency for a significant number of areas as the population will rapidly increase. As the population increases waste management is a biggest problem in the country. So that the space for disposal of waste material is lacking in the areas. Municipal authorities are looking for the space to provide a better solid waste management system to avoid disposal of waste in open lands especially in urban areas.

Solid waste emerges from human activities, households, large and small-scale industries, agriculture, herbal waste, development and demolition waste. If the solid waste coming out is not properly segregated for reusable, it will have a negative impact on the hygienic conditions in urban areas and pollute the air and surface and ground water as well as soil and crops. A clean and proficient system for assortment and removal of solid waste is consequently crucial for any network. For the most part, the requests on the solid waste administration framework increment with the size of the network and its per capita pay. The amount and synthesis of strong waste rely upon how

built up the network is and the condition of its economy. Consequently, modern development and higher per capita salary produce progressively squander, which, if not appropriately controlled, causes natural corruption. Investigating the different wellsprings of waste, it is deprived to build up a gadget to be good with these sorts.

2. METHODOLOGY

Manual solid waste segregation is a very tedious and very time-consuming work. Considering the need for automatic solid waste segregation especially in hospitals, household, educational institutions, laboratories, large and small scale industries, where large amount of garbage is produced on daily basis, an idea is proposed where the solid waste is segregated automatically and collected in a respective accumulating chamber then it will be crushed by the usage of crusher or waste might be compacted tightly by the usage of pneumatic bail pressor which may be further reused or recycled in the industries.

The mechanical waste segregator is designed to segregate the waste in ferrous and nonferrous material. The ferrous consists of the metallic waste is segregated by the use of electromagnets and nonferrous consists of the low and heavy density plastic, tissue papers, sanitary napkins, herbal waste and natural waste is segregated through air blowers.

This project report explains in depth the design principles and fabrication process of the automatic solid waste segregation. This project is a one type of model, for the separation of blended houses, laboratories, hospital and industrial waste into different components for later stages of reusage, recycling, incineration or disposal methods. Using basic mechanical concepts, principles and ideas, a crude system is designed on paper for segregation, upon further research and refinement of the basic idea the improved design on paper emerged. The design was generated as a soft model using mechanical software. Based on the software model the necessary tolerance and material required is estimated and based on these values the final model fabrication began.

The main aim is to design, fabricate and test the automated process of segregation with minimal human intervention. The process is designed to segregate waste using various mechanical principles with help of electrical devices. The objective is to design, fabricate and test an automated waste segregation system which minimizes human intervention in the process of waste segregation with increased speed and accuracy for small and large-scale industries, educational institutions, laboratories and households.

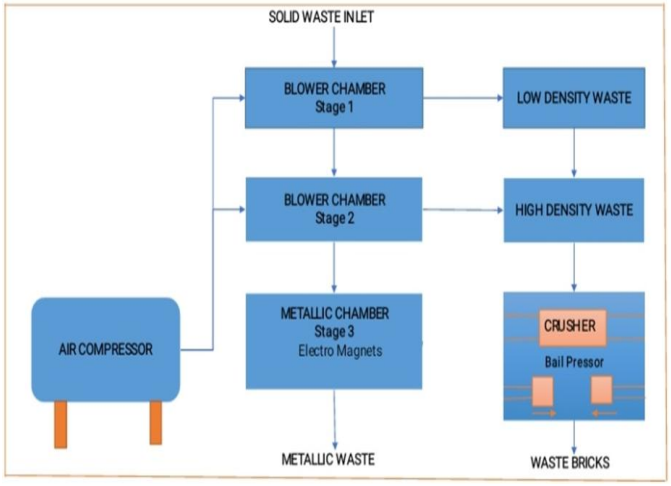

Fig-1: Flow Diagram of Automated Waste Segregator

The above fig shows the flow diagram and working procedure of automated solid waste segregation system. In which waste will be gets separated and collected in the respective accumulating chambers and the separated waste will be crushed by the usage of crusher and for smooth transportation crushed waste will be compacted with the help of pneumatic cylinder called bale pressor, which produced waste bricks can be supplied as a raw material for industries.

The above two basic ideas were implemented in the form of the following stages

a) Stage1-blower chamber for low density waste

b) Stage2-blower chamber for high density waste

c) Stage3-magnetic chamber for metallic waste

In stage1 the blower chamber consists of one blower for low density waste is inserted in corresponding slot. Through the air compressor the high-speed air passed into the blower, which uses the simple principle of blowing away the low-density particles from an incoming charge of solid waste material falling vertically downwards. The main aim behind using blower is to sort the solid waste in as less time as possible and without using handpicking or hand sorting or any kind of physical tangible operations. The charge of low-density waste that is blown away is collected in a chamber provided in the next section.

Similar to stage1 in stage2 also another blower for high density waste is inserted in corresponding slot.
Through the same air compressor, the high-speed air is passed into the blower, which uses the same principle of blowing away the high-density waste particles from an incoming charge of solid waste material falling vertically downwards. The charge of high-density waste is blown away is collected in a chamber provided in the next section.

In stage3 the magnetic waste separator operates on the principle of magnetic attraction of ferro metal pieces towards electromagnets. The idea is to segregate the ferro metallic waste by using electromagnets for attracting the metal particles. As we pass electricity through a metallic bar, it gets magnetized and attracts the incoming metal waste at bottom of the main section. As soon as the current passage stops, the magnetic power of the metal is lost, henceforth, dropping the metal waste in to the collection chamber. This separates out the ferrous material from solid waste.

The segregated waste will be gathered in a respective chamber then it will be crushed by the usage of crusher which help in reducing the volume of the material or which assist in lowering the amount (quantity) of material, will recycled efficiently and crushed waste is supplied as a raw material for industries.

For smooth transportation the crushed waste might be compacted tightly by the usage of pneumatic bail pressor which makes waste into bricks which may be further reused or recycled in the industries.

2.1 MATERIAL SELECTION

The material selection process is the basic step for all the engineering projects and design application. Selection of material can be done based on mechanical properties, chemical composition and so on.

Material selection process is very important because engineers have to plan for any potential consequences that certain materials may present. Thus, material selection process helps to select the material having best properties, good performance and expected output.

Material selection process is used to determine that the material which is used to manufacture product is going to with stand extreme loads acting on it and to get best performance of product.

2.1.1 SHEET METAL

Sheet metal is a metal sheet which is produced by the mechanical process into slim, level pieces. It is one of the basic structures utilized in metal working and it very well may be cut and twisted into an assortment shape.

Sheet metal work is the procedure of metal working that structures new items from different kinds of sheet metal. It incorporates the different procedures engaged with heating and modelling metal sheets.

STAINLESS STEEL

Table-1: Chemical Composition of StainlessSteel304

Material	Composition	
Stainless steel 304	Carbon (C)	0.08%
	Manganese (Mn)	2.00%
	Silicon (Si)	0.750%
	Phosphorus (P)	0.040%
	Sulphur (S)	0.030%
	Chromium (Cr)	18.00-20.00%
	Nickel (Ni)	8.00-10.50%

MILD STEEL

Table-2: Chemical Composition of Mild Steel Material

Material	Composition	
Mild steel angles	Carbon	0.23%
	manganese	1.50%
	Sulphur	0.045%
	Phosphorous	0.045%
	silicon	0.40%
	Carbon equivalent	0.42%

3. DESIGN AND MODELING

3.1 DESIGN

Design is nothing but planning or giving a specification for the object or system going to implement. Design also includes the implementation process or activity, specification of prototype, process, results of the plan.

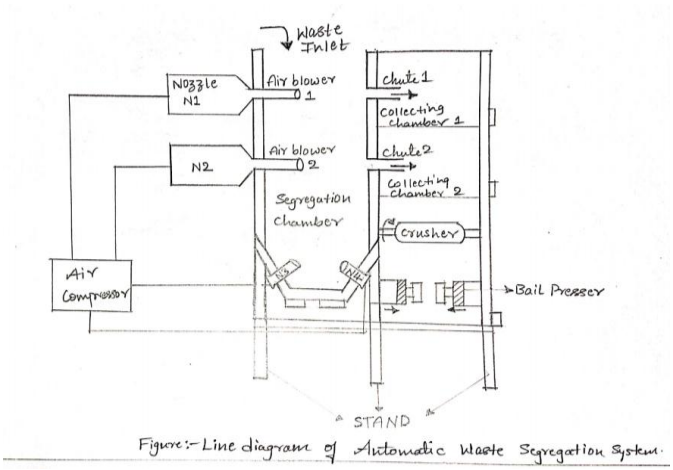

Fig-2: Basic Design of Automated Solid Waste Segregation System

Basic Design of Automated Solid Waste Segregation System. The fig shows the basic design idea of automated waste segregation system and number of parts which consists. The part number, part name, quantity and material of each part is given in the table called Bill of Material. Each part which is going to use for the model is also briefly explained below.

3.2 MODELING

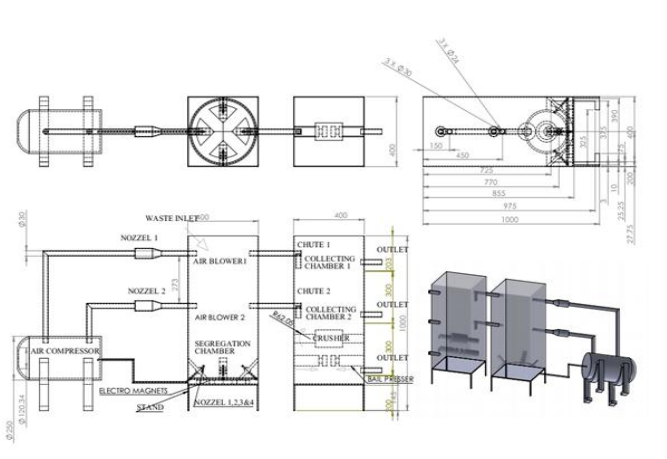

Fig-3: Orthographic View of Automated Waste Segregation Assembly

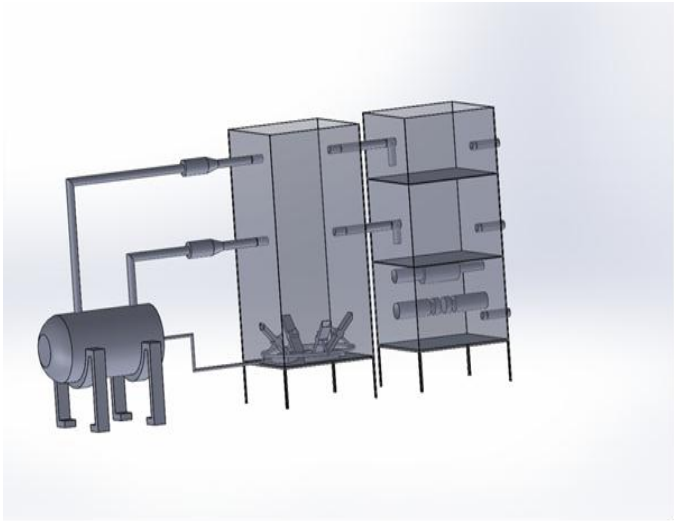

Fig-4: Assembled View of AWS System

4. COSTING

Table-3: Proposed Cost Estimation

Material	Quantity of each material	Cost of each material
Stainless steel	64 kg	11520.00
Mild steel	36 kg	1800.00
Air compressor	1 (17CMF)	30000.00
Electromagnets	2 (12V)	1890.00
Pneumatic cylinders	2	2400.00
HDPE pipes	200m	8400.00
Fasteners	-	1500.00
Pressure switches	2-3	1200.00
Crusher	1 (with 2 gears and 1 motor)	10000.00
Miscellaneous	-	2000.00
Labor cost	-	5000.00
Total cost		**75710.00**

5. APPLICATIONS

Implementation of the automated waste segregation system at various sectors like household, educational institutions, laboratories, hospitals, small and large-scale industries, playgrounds, parks so on will reduce the man power work and also considered as a safe design.

1. Household management
2. Educational institutions
3. Laboratories
4. Hospitals
5. Parks and playgrounds
6. Small and large-scale industries

The study of waste management in these various sectors makes that the proposed project is a more application oriented. In this project segregation of solid waste in to ferrous material like metallic waste and nonferrous material like plastic, papers and natural waste is done. After segregation in the same system the waste can be crushed to reduce the volume of the waste and compacted in to a waste bricks which can be used as raw materials in the industries. So, for the above-mentioned sectors this proposed system made into a more applicable.

6. CONCLUSIONS

"Automated Solid Waste Management System" is the proposed project in which the solid waste material is segregated as two different waste materials, namely ferrous material and nonferrous material. Ferrous material refers to metallic waste and nonferrous material refers to low density and heavy density material waste like plastic, tissue papers, sanitary napkins, herbal waste and natural waste.

Segregation of solid waste is more essential as the amount of waste being generated today in various sectors like hospitals, blended household, educational institutions, laboratories, large and small-scale industries so on causes immense problem.

Here we are going to segregate the solid waste collected from different sectors and tests have been conducted with stages and we have come up with following results:

Test:

When solid waste charge in to a main chamber, it contains three different stages where solid waste is segregated.

Stage1: In this stage low density nonferrous material waste is segregated through the air blower and the segregated waste is collected in to a respective chamber, which is fixed in the collecting chamber section.

Stage2: In this stage heavy density nonferrous material waste is segregated through the air blower and the segregated waste is collected in to a respective chamber, which is also fixed in the collecting chamber section.

Stage3: In this stage at the bottom of the model electromagnets were fixed. When solid waste is charged in to a chamber the electromagnets starts attracting all the metallic waste from solid waste. So, the metallic waste gets segregated and which is collected through the exit door in a respective outlet.

After segregation of solid waste, the crusher is fixed in a collecting chamber section. Where the segregated waste can be crushed by the usage of crusher which help in reducing the volume of the material or which assist in lowering the amount (quantity) of material, will recycled efficiently and crushed waste is supplied as a raw material for industries.

For smooth transportation the crushed waste might be compacted tightly by the usage of pneumatic bale pressor which also fixed in the collecting chamber section. Which makes the waste into bricks which may be further reused or recycled in the industries.

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