



A CONCEPT ON FABRICATION AND TESTING OF WASTE SEGREGATOR MACHINE

Sonu P. Singh¹

¹(Mechanical Engineering Department, VIVA Institute of Technology, India)

Saurav V. Singh²

²(Mechanical Engineering Department, VIVA Institute of Technology, India)

Mithilesh J. Singh³

³(Mechanical Engineering Department, VIVA Institute of Technology, India)

Pratik Raut⁴

⁴(Mechanical Engineering Department, VIVA Institute of Technology, India)

Abstract: *The waste management system in the country is not proper, in order to provide a proper waste management system we need to manufacture a machine that can sort the various waste constituents from garbage which can be further processed and recycled to reduce the overall waste. So to achieve this, we are manufacturing a waste segregator machine which is capable of separating wastes such as metals, non-metals, plastic, etc. The design is the basic step for manufacturing of the machine if the design is proper and safe the manufacturing goes smooth. We are manufacturing the machine to obtain the goal of separating the waste which can be used by small scale as well as large scale industry effectively, which would directly add into benefit for the society. The manufacturing the machine which would be easy to operate and simple in construction. In short it would be affordable if produced in numbers.*

Keywords –waste segregator machine, safe, effective manufacturing, affordable, waste management.

1. INTRODUCTION

Rapid population growth, urbanization and industrial growth have led to severe waste management problems in the cities of developing countries like India. The large quantity of waste generated necessitates a system of collection, transportation and disposal. It requires knowledge of what the wastes are comprised of, and how they need to be collected and disposed. Recycling of waste, energy generation and employment opportunities from waste management also have immense potential. However, it has been widely observed that the Municipal Corporations in India do not have adequate resources or the technical expertise necessary to deal with the problem. Successful waste management requires the participation of citizens, local governments, and private entrepreneurs.

Waste segregation is the process in which the different constituents of waste are separated and to achieve this waste sorting machine is used. This will help us to sort the various elements present in the waste like plastics, metals, bricks and stones and other substances out from the garbage, to improve the reusing and recycling of waste. At the same time, the separated waste materials can be further re-processed into useful resources. So, the main purpose of the automatic waste sorter is reduction in processing and turning waste into treasure.

1.1 PROBLEM DEFINITION

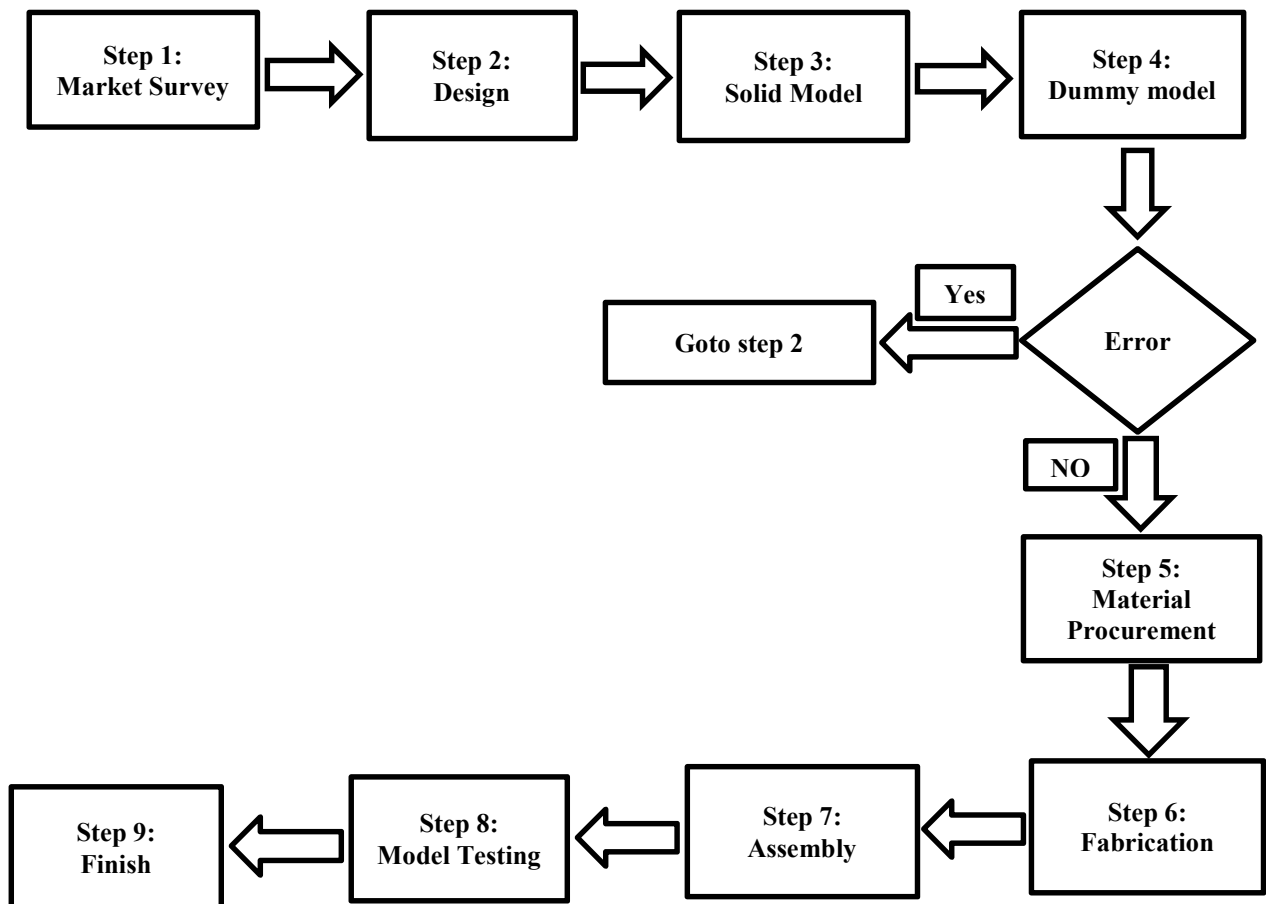
As the waste management system in India is not effective which leads to environment and health issues. As India is price based market so the main obstacle in designing is the product cost, its compactness, efficiency and also its reliability.

- Separating the different metals found in waste.
- Separating plastic from the waste.
- Recycling of waste
- Use of organic waste
- Disposal of harmful waste
- Separation of electronic waste

All the above mentioned problems are affecting the daily life of human being and results decrease in life. Therefore above mentioned problems should be eliminated by designing a mechanical system.

2. PROPOSED METHODOLOGY

Steps to be followed while manufacturing



Step 1: Market survey

This is basically done to how and where we can find parts like electric motor, L-Channel, conveyor belt, bearing, blower, pulley, M.S plate, M.S Square tubing etc.to manufacture the machine and machining operations required while manufacturing.

Step 2: Design

After completing the market survey we begin with the design of waste segregator machine. Here we calculated the dimensions and tolerances of different parts of the system like conveyor belt, conveyor structure, shaft, bearing, pulley, V-belt, roller, bag opener etc.

Step 3: Solid Model

According to our design calculation we made a solid model of our machine.

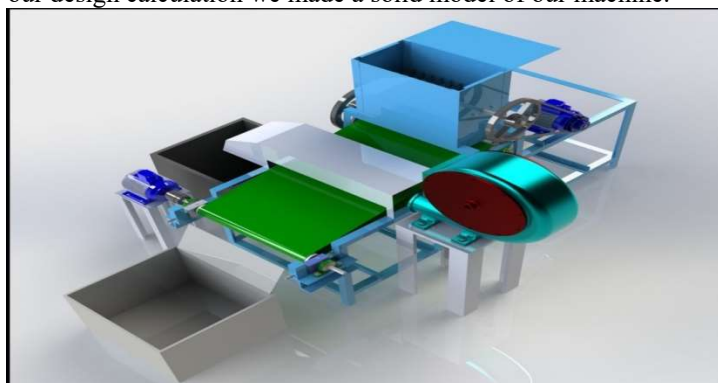


Fig.: Solid Model.

Step 4: Dummy Model

Dummy model is basically a replica of the solid model to check the feasibility of the machine. It was built up of wood (acting as frame), plastic (acting as bins) and paper (acting as conveyor belt) to a suitable scale proportionate to the actual one. After making this model, we got the idea and errors which was rectified and necessary changes were done in the respective dimensions and design was finalized.

Step 5: Material Procurement

After knowing the technical parameters of the machine like type of motor to be used for driving the machine, magnet for eddy current separator, bearing for giving a frictionless motion, blower for creation of air flow, pulley for power transmission, conveyor belt for transmission purpose, bins for collection of waste, M.S sheet for body of machine, L- channel for frame or stand, plastic roller for eddy current separator etc. we procured material.

Table: Part List

Sr. no	Item Name	Quantity
1	Drive motor	3
2	Neodymium magnets	20
3	Linear Bearing	6
4	Blower	1
5	Pulley	4
6	Conveyer belt	1
7	Bin	4
8	MS sheet	25kg
9	L channel	45kg
10	Plastic roller	1
11	Metallic roller	1

Step 6: Fabrication

Manufacturing the machine as per the dimensions and specifications mentioned on the engineering drawing sheet begins here. Cutting operation was done by sawing, shearing, lathe turning, lathe milling etc.

Manual bending of M.S. sheet for bag opener was done, welding of the entire structure etc. work were done.

The parts which were manufactured are as follows.

Conveyor:

Initially we started with the making of conveyor base which comprises of L-channels and 2 rollers were mounted on either side of the conveyor.

Bag Opener:

At one end there will be a bag opener for opening the garbage bag which will be fed into it. There are number of blades mounted on a shaft of bag opener at a predefined distance and orientation.

Eddy current separator

At the end of main conveyor belt, we placed a hollow roller made up of PVC pipe to get better results and inside it there is a shaft passing through the hollow roller and the shaft is concentric to the roller. The roller and the shaft are moving at different speeds with the help of two different induction motors.

Roller is the core component of eddy current separator composed of 20 pairs Neodymium permanent magnets around by the PVC drum mounted on the shaft. The permanent magnets were alternately configured by S-N-S direction.

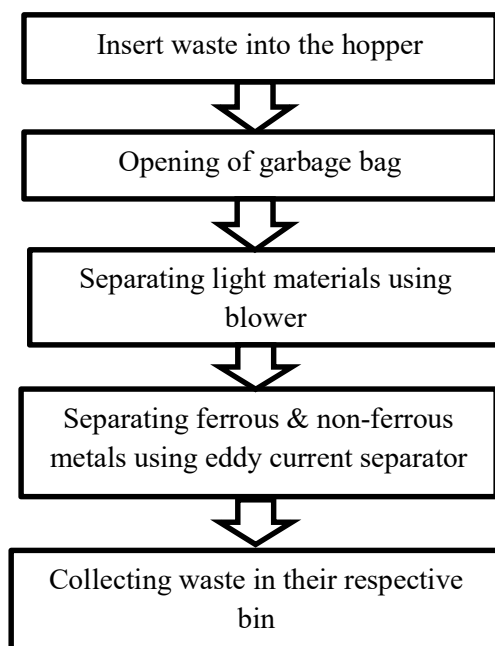
Step 7: Assembly

All the parts which were manufactured are finally assembled according to the design specifications.

Step 8: Testing

Now, the machine was tested and some minor changes were made to achieve our objectives of manufacturing the machine and then results were recorded multiple times.

3. WORKING



First the plastic bag containing different constituents like plastic, paper, ferrous, non-ferrous, wood, etc. are dropped into the bag opener. The bag opener is only used to open the plastic bag. After opening the plastic bag all the waste present in it will fall on the conveyor.

The conveyor will move all the waste towards the blower and all the materials like light plastics; paper will be blown off by the blower. The blown material will be collected in a collecting bin. The remaining waste will move towards the end of the conveyor, here we have our eddy current separator.

Here with the help of eddy current separator, ferrous (due to attraction of the magnets) and non-ferrous materials (due to wedge or repulsive force created by the magnets) are separated apart. Due to the wedge action, non-ferrous metal will be thrown off and collected in respective bin and because of the magnetic effect of the eddy current separator the ferrous metal will stick to surface of the conveyor belt and will be collected in respective ferrous bin.

The remaining waste like hard plastic, wood, etc. will be collected in between the ferrous and non-ferrous bin. By this way all the constituents will be separated from the waste.

4. RESULTS AND DISCUSSION

Based on the eight step methodology implemented in the previous chapter, the results obtained are listed below:

Result Table

Type of solid waste	Total Waste (in %)	Waste segregated (in %)
Paper	11.7	11.5
Light plastic (polythene bags)	4	3.9
Ferrous materials	35	35
Non-ferrous materials	22.5	20
Solid Plastic	15	15
Wood	11.8	11.8
Total	100	97.2

5. CONCLUSION

With drastic change in urbanization and rise in industries, India is facing voluminous waste management challenge. There is no adequate plan or system to sort, recycle or reuse the waste being generated. So we have successfully manufactured a machine which is capable of segregating different constituents present in the waste like paper, plastic, ferrous, non-ferrous, wood etc. Our machine is efficient, compact in size and most importantly affordable by any small scale industry or even by any housing society. Thus, by active citizen participation one can built small but effective waste segregating machine which is capable of segregating the waste.

1. Separation of ferrous, non-ferrous, plastics, wood etc. from the waste.
2. Designing a compact and affordable machine.
3. The recycled waste can be further sent for recycling.
4. Decreasing the chances of hazardous condition for land and labour.

REFERENCES

- [1] P Baishya, S B Singh, and D K Mahanta, 2015, "Fabrication And Testing Of Dry Waste Sorting Machine," IRJET.
- [2] M O Rahman, A Hussain, and H Basri, 2013, "A Critical Review On Waste Paper Sorting Techniques," IJEST.
- [4] S B Singh, B Roy, and A H Chaudhary, 2016 "Design Of Municipal Dry Waste Segregating Machine Using Conveyor," IJRSET.
- [5] Khalfan, 2002, "Optical Paper Sorter," United States Patent.
- [6] Gschweilt, H., and Heinz, K, 1988, "Method for Sorting Waste Paper" European Patent

- [7] B G Petrucci, 1977, “*Waste Sorting Machine*,” United States Patent.
- [8] Pehlivan E., 1995. “*Examine of the Recyclable Materials*”, Yıldız Technical University, Institute of Science and Technology, Master Thesis, stanbul
- [9] Cascadia Consulting Group, Inc., 2004. Statewide Waste Characterization Study, pp. 90-105.
- [10] Dubanowitz, A.J., 2000. “*Design of a Materials Recovery Facility (MRF) for Processing the Recyclable Materials of New York City’s Municipal Solid Waste*”, Department of Earth and Environmental Engineering, Columbia University, pp. 10-27.
- [11] State Institute of Statistics of Turkey (SIS), 1993. Environmental Statistics, Household Solid Waste Composition Survey
- [12] State Institute of Statistics of Turkey (SIS), 1994. Municipal Environmental Inventory, Fundamental Environment Indicator
- [13] State Institute of Statistics of Turkey (SIS), 2001. Environmental Statistics, Household Solid Waste Composition Survey
- [14] State Institute of Statistics of Turkey (SIS), 2004. Municipal Environmental Inventory, Fundamental Environment Indicator
- [15] Metin, E. And Eröztürk, A. and Neyim, C., 2003. “*Solid Management Practices and Review of Recovery and Recycling Operations in Turkey*”, Waste Management 23 (2003) 425-432.