

# Automated Waste Transfer System using Dedicated Corridor in Cities



Ankur Gupta, S.Muthulakshmi

**Abstract-**The Waste disposal techniques have become quite old for the modern period lately. The transfer of waste from the waste bins in the localities through the use of compactor trucks needs to be changed. It stands low on the efficiency scale. This can be improved by Channelizing waste through a separate corridor. The idea is to channelize the waste underground by using belt conveyor systems. The waste collector bins in the localities will be joined to the main conveyor heavy duty belts by small conveyor belts to move the waste. This waste will be taken to the waste processing plants by the belts fixed underground. The waste collector bins will be equipped with the pressure plates and will be connected to the network. As soon as the bin is full, it will send the information to the control centre. The operator at the centre can empty the bin by clicking a button. This will help to live monitor the waste and move it as soon as possible. The waste which is channelized can be easily segregated at the end where it enters the waste processing plant. Segregation of the waste will allow us to reuse the recyclable materials which most of the time are dumped in the landfills. The idea is to eliminate the Compactor Trucks as they cause pollution and congestion. Also many a times, waste materials are dropped out from the truck while carrying them to the processing plants which affects the riders behind it. The smoke from the trucks is dark and sooty which are the main causes for the lung diseases. Whereas the belt driven system will work on electricity. This energy can be harnessed by renewable energy resources or by power plants where the efficiency is the highest.

The concept of underground tunneling in a well-planned layout is needed for laying of the sewer lines as they require heavy earth digging. Hence this underground waste transfer tunneling system can also be well established during the sewer line excavation work and can be implemented for the new smart cities which are going to be built. The efficient functioning of this system will save fuel, energy, time and creates an ecofriendly environment by cutting the carbon footprint.

**Keyword:** Waste disposal techniques, separate corridor, conveyor systems, Segregation, recyclable materials, landfills

## I. INTRODUCTION

In today's time, there are several methods of waste disposal but the starting of waste disposal begins with the collection of waste. This method is getting old school. There needs to be some change in this method to make it efficient and reliable. These are the current method of waste transportation is inefficient and takes a lot of time.

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Also it is not good because many times what happen is that the transportation fails and leads to waste pile ups at the junction of the colony and market. We are making an efficient and reliable system here which will work in all the conditions and pressure regard less of the human resource.

The method is to create a dedicated channel or passage for waste to be transported from one place to another. The underground method of waste transportation is the technology of the future which has to implemented now because the future is here. With rapid urbanization, the country is facing massive waste management challenge. Over 377 million urban people live in 7,935 towns and cities and generate 62 million tons of municipal solid waste per annum. Only 43 million tons (MT) of the waste is collected, 11.9 MT is treated and 31 MT is dumped in landfill sites. Solid Waste Management (SWM) is one among the basic essential services provided by municipal authorities in the country to keep urban centers clean. However, almost all municipal authorities deposit solid waste at a dump yard within or outside the city haphazardly. Experts believe that India is following a flawed system of waste disposal and management. The key to efficient waste management is to ensure proper segregation of waste at source and to ensure that the waste goes through different streams of recycling and resource recovery. Then reduced final residue is then deposited scientifically in sanitary landfills. Sanitary landfills are the ultimate means of disposal for unutilized municipal solid waste from waste processing facilities and other types of inorganic waste that cannot be reused or recycled. Major limitation of this method is the costly transportation of MSW to far away landfill sites.

So the future is in immediate need of an eco-friendly technology for the correct way of disposing the waste. The corrective measure begins with the Segregation of waste. Automatic belt driven waste management is the need of the present time to solve this issue. Our existing system is inefficient and incapable of handling waste. Most the waste is dumped into the landfills because there is no time and way organized by the government to process it.

## II. PROBLEM STATEMENT

Waste management is visibly a burning problem in India at the moment, and also all over the World. The problem with our waste management starts with the inefficiency of work which is happening now. As we know that the waste is collected by the sweepers and then it is dumped into the main colony dustbin.



Then the big garbage collector truck comes up and puts in all the waste. Now the other problem comes up which is the transportation. The pickup of the waste is generally delayed and the waste gets piled up. This leads to the air and land pollution in the particular location.

The problem reaches its extremity during monsoon seasons. Also the waste is not segregated. All kinds of waste gets mixed up and they land up into a landfill. This takes away the last chance of segregation in order to recycle. The metals and plastics need to be separated for recycling. Many times the waste from the truck falls while being carried along. The minute particles fly in the air and create disturbance for the people who are riding at the back. Adding to this, these garbage trucks create a lot of road traffic hindrance in the city. (They mostly come to pick up the waste during the morning hours and create jam which affects the transportation.) These trucks are not maintained and the smoke from these vehicles is highly toxic. So, besides these, there are many more problems which come up as – breakdown of the vehicles, inefficient workers, working environment etc. The objective is to channelize the waste in a common path where after it can be processed for recycling and better disposal. This can be done by using a tunnel structure underground. We can put up the conveyor belts in the tunnel. The belts in the tunnel will be in sections. These tunnels will be connected to the main dustbins at the colony. These dustbins when full will empty the waste into the tunnel in which the conveyor belt is fixed. The conveyor belt will carry forward the waste to the main processing plant. This will eliminate the usage of the dumping trucks and compactors. The garbage collectors will collect the waste from the houses and throw them into the Dustbin. They will segregate the waste while throwing. The garbage bins will have different sections in it. The sections will be of biodegradable waste, glass-ware and metals and plastics. This will happen in every colony. As soon as the bin gets filled up, the bin will send a notification to the control center that its full. Then the system will check whether the conveyor belt is empty in that area. Then it will empty the trash in the dustbin section wise, on that conveyor belt. For eg- glass, metal, biodegradable and plastics. They will be dropped on the belt in a sequence which will help to remain waste segregated. These segregated wastes will be carried and unloaded at the respective processing plants for recycling or treatment in the same sequence. This system of collection, segregation and transport to the processing stations will be set up under an optimized network in the entire city so that most of the area remains connected under this system. It will help in keeping the waste underground and the surroundings hygienic. Also it reduces the movement of garbage collector/compactor trucks in the city and in turn minimizes the traffic jams and air pollution. Most of the times the trucks are not on schedule leading to overflowing of the bins which leaves no place for the people to throw the waste.

### III. FLOW CHART OF PROPOSED APPLICATION

The garbage collectors will collect the waste from the houses and throw them into the Dustbin. They will segregate the waste while throwing. The garbage bins will have different sections in it. The sections will be of biodegradable waste, glass-ware and metals and plastics. This will happen in every colony. As soon as the bin gets filled up, the bin will send a notification to the control center that its full. Then the system will check whether the conveyor belt is empty in that area. Then it will empty the trash in dustbin on that conveyor belt in section wise. For eg- glass, metal, biodegradable and plastics. They will be dropped on the belt in a sequence which will help to remain waste segregated. It will be carried to the processing plant in the same way to more than one processing plants. This system will be used and set up in the whole city according to the nearest connection path so that most of the area remains connected by this system. It will help in keeping the waste underground and keep the surroundings hygienic. Also it will reduce the Movement of garbage collector/compactor trucks in the city. They are a major cause for Jams and Air Pollution. They are inefficient and most of the times are not on schedule. This leads to over filling of the bins which leaves no place for the people to throw the waste.

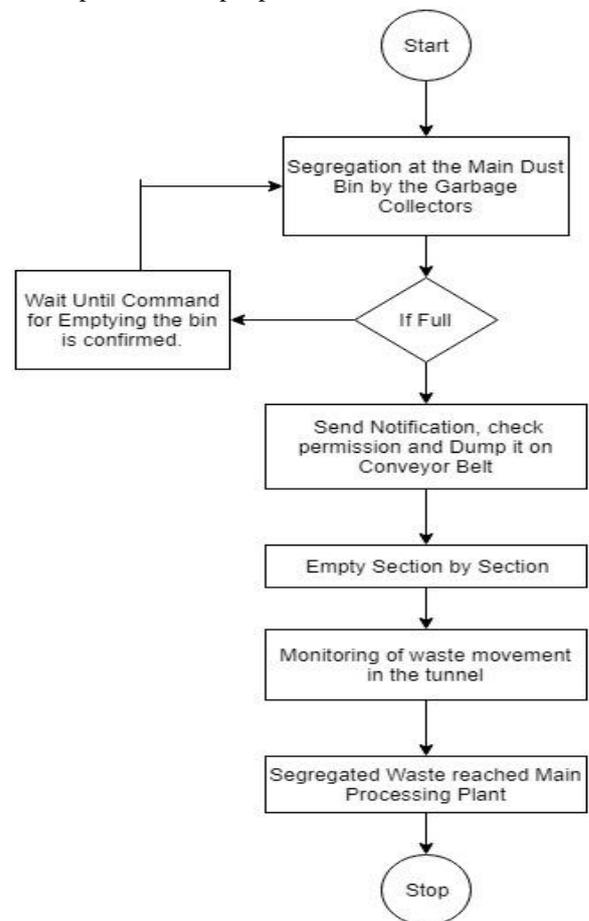


Fig 3.1:- Flow Chart

**IV. SYSTEM HARDWARE DESIGN**

Fully Automatic Conveyor Waste Management hardware components are abstracted as follows:-

*I - Segregation Bin:*

The objective of designing this bin is to begin waste segregation practice at source in the local community with easy handling. The workers will be collecting the waste from households or underground chute chambers in high rise Buildings and transfer the waste into the bins in the desired slots. The basis of the design and development of the segregation bin was to incorporate attributes in the final design which could overcome the key disadvantages of keeping too many receptacles for waste segregation. Waste management is visibly a burning problem in India at the moment, and also all over the World. Segregation of waste at source could simplify its management to a great extent in terms of ease and cost of disposal. The design of the bin is expected to deal with issues associated with waste segregation like lack of awareness and motivation among the community, to follow an organized and efficient system of disposal by segregating them before they throw it into the right kind of receptacle. The strength of the design lies in the simplicity of the model for segregated waste disposal by the common user. Being a single unit with multiple sections along the vertical for food waste and other recyclables, it saves space and ensures ease of operation. Currently available bin designs with color coding increases the cost and space and not suitable for all kinds of households which have already been experimented with two bin system. The underlying key facts of the bin design are the affordability, ease of handling, pollution control and flexibility in the number of sections which could be attached or detached based on the nature of waste produced locally. Generally these sections will be as follows:- Metals, Biodegradables, Non-Biodegradables. We can have color schemes as “Red” color for Non-Biodegradables, “Green” for Biodegradables and “Blue” for Metals. Bins near the hospital buildings may have another section for bio medical wastes with purple color. Thus is the flexibility of this smart bin model. The bin unit is a portable one and to be manufactured with locally available recycled materials.

*Specification of Segregation Bin- Smart, Solar-Powered Compacting Model*

- Capacity: 150 Gallons (~570 liters)
- Built-in Compactor (5:1 Ratio)
- Senses & Communicates Fullness
- On-board GPS for geolocation
- Enclosed design with hopper
- Durable & street-tough design



**Fig 4.1:-Existing Segregation Bin Model**

*II - Conveyor System:*

Conveyor systems are commonly used in many industries, including the Mining, automotive, agricultural, computer, electronic, food processing, aerospace, pharmaceutical, chemical, bottling and canning, print finishing and packaging. Although a wide variety of materials can be conveyed, some of the most common include food items such as beans and nuts, bottles and cans, automotive components, scrap metal, pills and powders, wood and furniture and grain and animal feed. Many factors are important in the accurate selection of a conveyor system. It is important to know how the conveyor system will be used beforehand. Some individual areas that are helpful to consider are the required conveyor operations, such as transportation, accumulation and sorting, the material sizes, weights and shapes and where the loading and pickup points need to be. A conveyor belt is the carrying medium of a belt conveyor system (often shortened to belt conveyor). A belt conveyor system is one of many types of conveyor systems. A belt conveyor system consists of two or more pulleys (sometimes referred to as drums), with an endless loop of carrying medium—the conveyor belt—that rotates about them. One or both of the pulleys are powered, moving the belt and the material on the belt forward. The powered pulley is called the drive pulley while the unpowered pulley is called the idler pulley. There are two main industrial classes of belt conveyors; Those in general material handling such as those moving boxes along inside a factory and bulk material handling such as those used to transport large volumes of resources and agricultural materials, such as grain, salt, coal, ore, sand, overburden and more.

*Specifications of Conveyor System-*

- variation in length (from a few meters up to a few kilometres)
- flexible in the application (in various parts of the installation)
- 200/300kg per feet.

- expandable
- Speed = 4m/s.
- mobile or stationary
- tripper systems to discharge material alongside the conveyor
- swivelling on wheels or rails
- belt weighing systems
- material flow control
- motion control
- belt misalignment switches



**Fig 4.2:- Conveyor Belt System**

### III - Underground Pipeline System:

India is one of the fastest growing markets for pipe and tunnel construction due to various infrastructure development projects underway across the country. Tunnels are required for hydroelectric power projects, for improving road and railway connectivity, expanding mass rapid transit systems, and improving urban water supply and sewerage. This Pipeline/Tunnel will be equipped with the belt system to carry forward the waste from the main big dump bin to the processing plant.

Specifications of Pipelines:-

- variation in length
- flexible in the application
- 200/300kg per feet.
- expandable
- durability = 80-100 years.

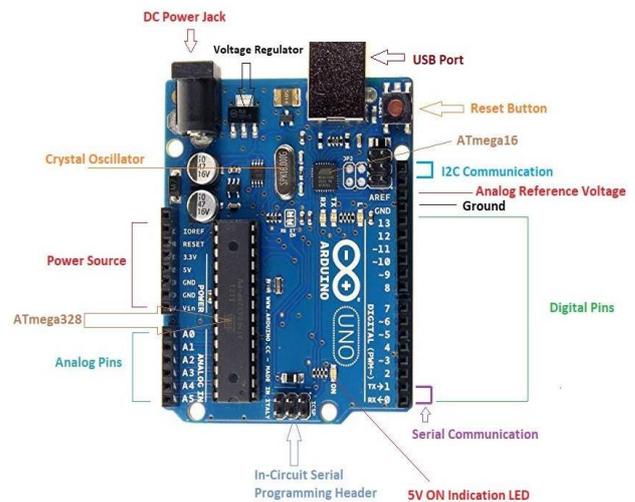


**Fig 4.3:- Underground Pipeline**

### IV - Processor System:

A system is needed to process the signals to convert it into code from the binary signals. The signal which is received is in the binary form. This Binary data is used and converted into useful information using a converting device.

The Arduino integrated development environment (IDE) is a cross-platform application (for Windows, macOS, Linux) that is written in the programming language Java. It is used to write and upload programs to Arduino board. The source code for the IDE is released under the GNU General Public License, version 2. The Arduino IDE supports the languages C and C++ using special rules of code structuring. The Arduino IDE supplies a software library from the Wiring project, which provides many common input and output procedures. User-written code only requires two basic functions, for starting the sketch and the main program loop, that are compiled and linked with a program stub main() into an executable cyclic executive program with the GNU tool chain, also included with the IDE distribution. The Arduino IDE employs the program avrdude to convert the executable code into a text file in hexadecimal encoding that is loaded into the Arduino board by a loader program in the board's firmware.



**Arduino UNO**

**Fig 4.4:- Arduino Processor Board**

## V. TRANSFER OF WASTE USING BELT SYSTEM

The improvement of the energy efficiency of belt conveyor systems can be achieved at equipment or operation levels. Switching control and variable speed control are proposed in literature to improve energy efficiency of belt conveyors. The current implementations mostly focus on lower level control loops or an individual belt conveyor without operational considerations at the system level. In this paper, an optimal switching control and a variable speed drive (VSD) based optimal control are proposed to improve the energy efficiency of belt conveyor systems at the operational level,

where time-of-use (TOU) tariff, ramp rate of belt speed and other system constraints are considered. A coal conveying system in a coal-fired power plant is taken as a case study, where great saving of energy cost is achieved by the two optimal control strategies. Moreover, considerable energy saving resulting from VSD based optimal control is also proved by the case study.



Fig 5.1:- Under Ground Pipeline and Conveyor

Basic Working

The conveyor belts will be fixed in the pipe sections and they will carry the waste to the processing plant. The waste will be dropped on the belt in the section wise. For example- If the three parts of the dustbin are containing different types of waste then they will be dropped on the belt in different sections. The first part of the waste will be dropped on the belt and the belt section will move ahead, So that when the second part of waste is emptied, fresh section of belt comes up to take the place. In the same way, other various parts of waste are emptied on different sections and this helps to keep the waste Segregated.

The efficiency of the system will be improved by using the software to move the belt in sections. The belt will not be used in a single stretch but it will be in sections. This will help us to move only the sections on which the waste is loaded. As the waste is carried forward, the latter part of belt will be switched off and former part of the belt will be switched on to carry the waste ahead. This will save huge amount of energy as the belts will not be moving free.

Conveyor belts will be moved with the help of electric motors. The energy conversion rate of these motors are higher than the trucks which run on diesel are used. They can be run easily on renewable energy sources such as Wind energy, Solar energy etc.

The Smart Bins will send the message to the control center that it is full and the rest operation will be carried over by the operating people in the Waste Transfer Management Center.

VI. ADVANTAGES

This technology can find application in a huge variety of fields. A detailed discussion of its various applications is given below.

1 - Under Ground Belt driven waste collection systems provide notable long-term cost savings. In order to operate, systems require personnel at the waste station and for maintenance but no manpower is needed in the actual collection and transportation of waste to the waste station. In addition, no waste trucks are needed to collect waste containers from residential areas, bringing savings in fuel costs and vehicle costs.

2 - While the initial investment cost for a Automatic Belt driven system is higher than that of traditional methods, the operating cost of the old system is usually considerably higher, and after the typical estimated payback period of several years, this system is considerably more economical than the conventional one.

3 - In addition to cost savings, Automatic Belt Driven waste management systems have environmental benefits. As there are no waste collection trucks circling around the residential areas, there are less fuel emissions, less traffic and fewer accidents. It has also been discovered that the waste collection points of this system encourage the users to recycle more efficiently. The inlets are never full and the fact that there are no unsightly piles of waste or unpleasant odours is beneficial for both the cleanliness and image of the area.

4 - Another benefit is that a pipeline-based waste collection system is very flexible and the system does not get congested even at peak times.

5 – This is not likely to get congested as the belt carries waste. This is the major drawback of Pneumatic Waste system as the waste is moved by air pressure. At peak time during high pressure, the light metal pieces cut the pipe carrying the waste creating a leak. It has to be repaired as soon as possible to keep the system working.

6 – This System is capable of working on the energy produced by itself when it transports waste efficiently. The waste at the plant can be synthesized to produce the energy.

7 – The Public Private Partnership (PPP) funding model can be suggested to initiate and implement this fully automated waste management project. It will provide platform for the government and also the private companies to prove and accomplish a new benchmark in the area of waste management. Involving both the parties will provide jobs and opportunities for workers.

8 –A chute system can be created in the big apartments and housing facilities which directly transfers the waste in the bin which will be installed in the basement of the building. Then it can be directly moved to the management plant through this system.

## VII. CONCLUSION

The fully automated waste management system will be effective in monitoring the sewage collection points and keep all the latest bins updated. Hygienic method of collection and transportation of waste is completely possible within a busy city with this robust management model. Reusable wastes are separated and other possible wastes are recycled. Remaining are reduced for safe disposal. Thus it proves to be a promising green technology in waste management for future smart cities of our country.

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