Scavenger - Embrace Hygiene

Presented by Team Internet

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Abstract

Economic growth produces prosperity and also waste as a by-product. The faster the economy grows, the more its peopleconsume, and the more waste they generate. When economicgrowth is sustained over a long period of time, municipal wastestarts to pile up at a faster pace. Therefore, Municipal garbageneeds to be efficiently collected, transported, recycled and safely disposed. One of the biggest problems that municipalities in developing countries face is insufficient and inefficient garbage collection, management and disposal. Estimates indicate that municipal solid waste in urban Indian has increased 50% over the past decade. The findings of a case study on Ahmedabad City, state that the city with a population of 59 lakhs of people, consisting of 65 wards, produced about 3500 tons of waste per day. However, the number of dustbins established is 700 with a capacity of holding only 2 tons of the waste produced. The garbage composed of 6% paper, 10% plastic, 69% food and 15% of other waste products. Though the government has spent about 350 crores/year on waste management in Ahmedabad city, our survey states that the waste hasnt been disposed effectively. Due to the ever-increasing waste and depleting resources, an efficient waste management system requires to be employed. As a solution to this problem we have designed a Smart Waste Management System which includes an efficient waste collection including an Advanced Dustbin Design, Innovative Sanitary Napkin Incinerator and Wireless Central Monitoring & Reporting System.

Smart Waste Management System

An effective waste management system involves a strategic deployment of waste collection bins with an effective waste disposal - monitoring system. The dustbin was designed taking into account parameters like typical composition of waste disposed by households, average Indian height and typical size of garbage collection vans based on a survey conducted by Ahmedabad Municipal Corporation. The aim was to design a cost effective dustbin with a robust notification system for real time monitoring of the status of garbage collection bins across the city. The data collected from the notification system would be backed up at a centralized location in the city. This data could then be analyzed to identify hot-spots that require more frequent garbage collection and devise efficient routes for garbage collection. In addition, the dustbins were designed to prevent it from overflowing and spillage of garbage by street animals.

Advance Dustbin Design

Dustbin Specifications The capacity of waste collection bin was assumed to be around 2 tons. Based on survey conducted by Ahmedabad Municipal Corporation, typical composition of waste disposed by Indian households comprises of 69% wet waste and 15% dry waste (recyclable and biodegradable). The average density of dry waste was assumed to be around 700kg/m^3 and that of wet food was assumed to be 800kg/m^3 which is closer to density of water i.e.1000kg/m^3. Based on this assumption, the total volume of dustbin was calculated to be around 2.5m^3. The width of dustbin was assumed to be around 1.5m. The height of dustbin was decided to be 1.4m and that of the opening was decided to be at 0.89m taking into account the average height of Indian women. Based on these two figures, the width of dustbin was calculated to be 1.4m. The coefficient of friction of waste food was assumed to be 0.6 and angle of repose for the garbage heap that would be formed was calculated to be around 30°. Allowing the variation of 20% in this assumed value of angle of repose, the range of angles for angle of repose was from 26°to 36°. Therefore the angle of the upper half of dustbin was decided to be 40°. The angle of lower half was appropriately decided to be around 105°. The figure below shows top view and front view of dustbin along with the schematic circuit notification system.

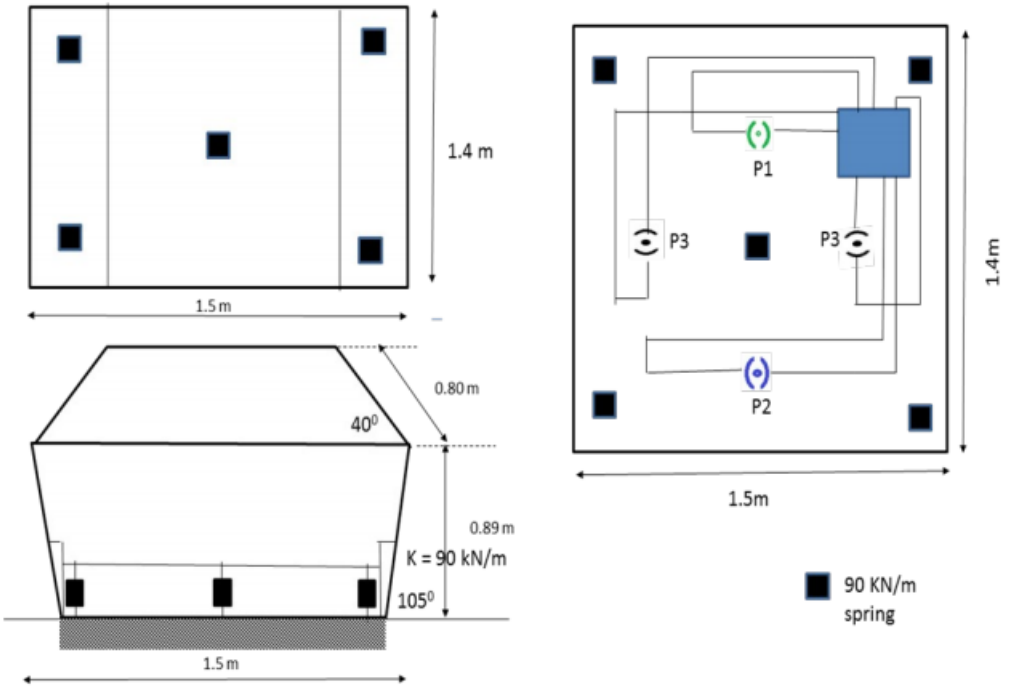

Figure 1. Design of the Dustbin - Top and Front View.

Central Monitoring and Reporting System

The notification system consisted of a simple electronic circuit situated at the bottom of the dustbin triggered by a spring mass system to alert the authorities about status of garbage in the bin for on-time collection of garbage. The components for the circuit consisted of digital signal processor, antennae, transmitter, ADC, filters circuits (capacitors), circuit board and switches. The physical set-up that triggers the circuit consisted of a metal sheet at the bottom of the dustbin suspended on four springs. The effective spring constant was calculated to be around 90kN/m taking into account the composition of typical waste. Allowing a variation of 20% in the value of density of waste, the compression of spring could vary from 2.4cm to 3.6cm. This range of values for spring displacement was mapped to three different predefined speed dial numbers in increasing order of priority. These speed dials would appropriately alert the authorities about the status and coordinates of dustbin based on data already programmed into the circuit. In the backend, the call logs received at the monitoring center could be backed up in a centralized database and then analyzed to improvise and optimize existing system of garbage collection.

Innovative Sanitary Napkin Incinerator

The aim was to design a cost effective Sanitary Napkin Incinerator with a clean and easy monitoring system for use in toilets of Residential colonies/ communities, Hospitals, Hotels & Restaurants, Public areas (bus station, railway station, malls, and theatres), Governmental and private institutions. Sanitary Napkins come under the classification of non-recyclable and non-degradable waste. The typical composition of an usual sanitary napkin consists of 5.34% Hot Melt Seal,1.67% Hot melt positioning seal, 13.06% Nonwoven fabric, 53.45% Cellulose pulp, 7.125% Super absorbent polymer, 11.4% Polypropylene back sheet and 7.95% Silicon paper of 25 micron 45 GSM. The general composition of a sanitary napkin includes 34% pulp, 11% Polymer and 55% blood. The Energy required to burn one used napkin of 18.4 gm weight is about 181.85 KJ. The generalized residue obtained after disposal consists of ash content of 9 gm/10 pads (which accounts to only 4% of weight) and Flue gas emission of 0.285 g/sec.

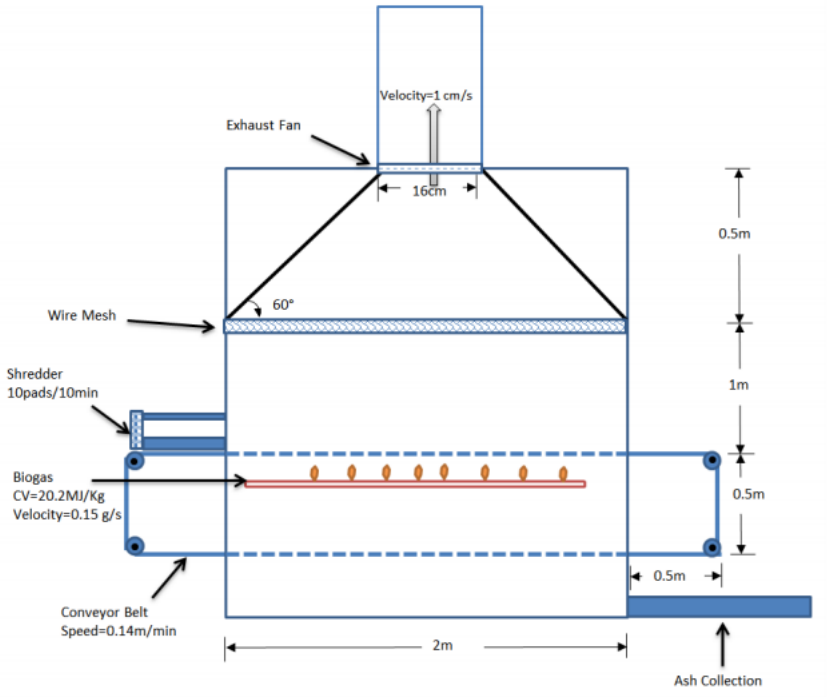

Figure 2. Front View of the Incinerator.

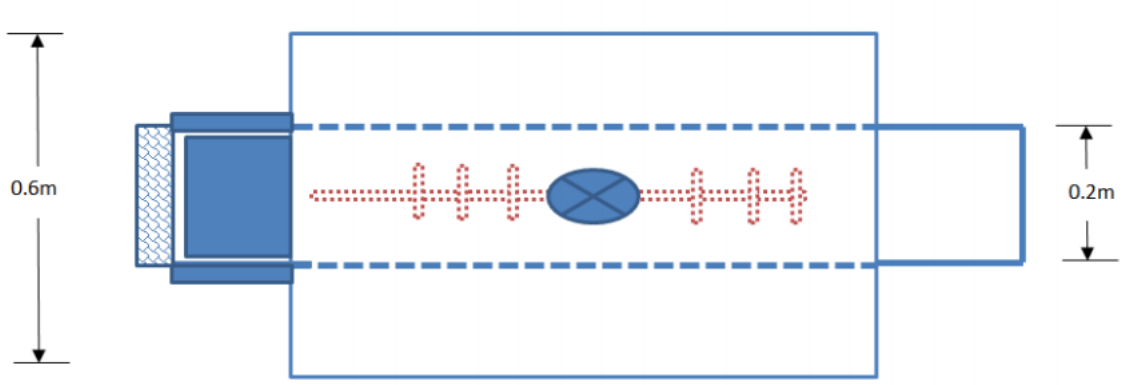

Figure 3. Top View of the Incinerator.

Design Specifications Taking into account necessary parameters, the incinerator is designed to be 3 m in height and 2 m in width. The diameter of the exhaust fan is employed to be 16 cm at the opening above. An assumption of appropriate segregation happens at source was made. A shredder is placed at the base of the incinerator which can shred a sanitary napkin at the rate of 10 pads/10 minutes. The shredder is used to increase the surface area for quick burning of the solid waste. A clean fuel, biogas is used to ignite the flames of the incinerator. The flame tubes are placed horizontally and vertically, in a cris-crossed fashion to increase the unit surface area for burning, hence enabling a faster conversion of the solid waste to fumes. The Calorific Value of the biogas used is 20.2 MJ/Kg and has a velocity of 0.15 g/s. A conveyer belt runs around the flame at a speed of 0.14 m /minute. The belt is designed to circumcise the incinerator at a distance 0.5 m away from its sides, in order to make room for air required for combustion. The Ash content produced accounts to a minimal of 9gm/10 pads which is approx only 4% of the total weight. The flue gases emitted as a by-product of the incineration travels with a velocity of 1 cm/s. A wire mesh at a height of 2m from the base withholds the ash fly that may be produced during the incineration procedure. Above the wire mesh a tapering of 60 °has been made to guide and direct the path of fuel gas produced to the exhaust fan. The exhaust fan further traps any ash residual and lets the fuel gases out after treatment. An ash collection tray is placed at the base of the conveyer belt to collect the residual produced. The tray is periodically emptied and treated for safe disposal. The front and top view of the sanitary napkin incinerator is as shown below.

A heartfelt thank you to my mentors and team members for the contribution to the project.