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A CONCEPT FOR ECO-FRIENDLY SANITARY SYSTEM IN INDIAN RAILWAYS

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ABSTRACT:

Controlled discharge sanitary system is a Eco-friendly sanitary system which focuses on ensuring the human waste matter from the railways not to be disposed on railway tracks. It generates the energy for the remote areas with the help of biogas plant. Thus this will keep the city, countryside, railway station premises and the railway tracks clean and hygienic. In this technique the faecal matter from the passenger trains will be stored in a retention tank and it will be discharged at a biogas plant adjacent to the railway track. The system is based on the principles of mechatronics. This paper explains about the process involved in maintaining the cleanliness in railways and energy generation through human waste and achieving the theme of Swaccha Bharat Abhiyan (Clean India).

Keywords- *Cleanliness, Hygienic, Mechatronics, Pneumatic System, Hdpe.*

1. INTRODUCTION

Idea of using eco friendly sanitary system on railways to eliminate spillage of toilet waste in Railway station area and populated area of city. This toilet system is designed to operate on the principle of high flush, through which the evacuation of toilet bowl is carried out by means of water pressure. It operates with a pressurized water bowl wash that covers 100% of the toilet bowl area. The toilet waste is transferred to the retention tank with a control amount of water.

Salient Features of eco friendly sanitary system:

- It is easily programmable & reprogrammable
- Less air, water & electricity
- Fully PLC controlled

OBJECTIVES:

- To ensure no faucal matter is disposed on railway tracks in order to keep the surroundings clean, odorless& hygienic thus taking a step towards Eco friendly Sanitary System.
- To generate energy source for the remote areas with the help of biogas plant.

2. LITERATURE REVIEW:

Research Designs and Standards OrganizationManak Nagar, Lucknow (2012):

Team of this organization explained about A controlled discharge toilet system retains the toilet waste and discharges when the speed of the coach is equal to or more than the designated speed and a preprogrammed number of flush cycles have been completed. This specification covers the design & general requirements including supply, installation & commissioning of controlled discharge toilet systems along with stainless steel inlays for ICF type and Low Cost SS (Stainless Steel) coaches and only pan for LHB type coach with FRP Modular Lavatory.

Indian Railways centre for advance maintenance Technology Gwalior (2014) team suggested that Discharge on track, besides creating environmental issues creates problem in working to workmen. A multi directional strategy has been implemented for adoption of Environment friendly toilets on IR passenger coaches.

K.Santhapriyan et al. (2015) explained about Indian Railways was being roundly criticized for creating an environment hazard by discharging toilet waste on tracks. Irrespective of the type of train or class they need improvement in cleanliness of toilets.

Existing System in Railways:

The traditional method of disposing human waste from train is simply to deposit the waste onto the tracks using what is known as a hopper toilet. This ranges from the toilets being a hole in the floor of the train, to a full flush system (possibly with sterilization). Now its replaced by bio toilets, this technique is shown in figure 1.1. It is an innovative for disposal of solid human waste in an eco-friendly, economically & hygienic manner by anaerobic reaction.

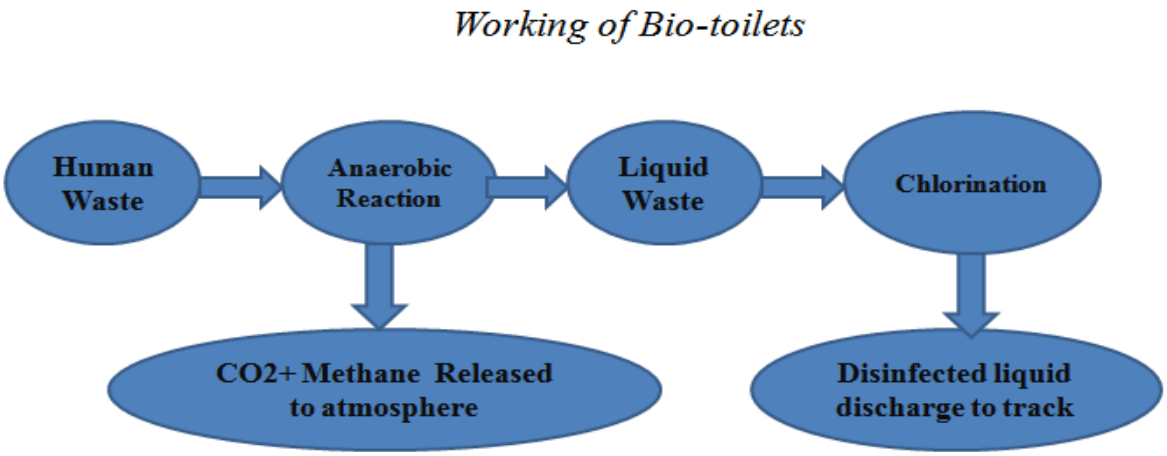

Figure 1.1: Working of Bio Toilets

Construction of bio toilets is with stainless steel and information about the retention tank is as follows :length =1150 mm, Width= 720 mm, Height = 540 mm, Total volume of tank = 400 lit, Empty Tank weight = 115 kg, Full Tank Weight= 415 kg and present status of bio toilet is shown in table 1.1.

Table 1.1.Present Status of Bio-toilets in Indian Railway

S,No	Year	No of Bio Toilets	No of Coaches on which these are fitted
01	2010-2011	57	31
02	2011-2012	169	67
03	2012-2013	1337	561
04	2013-2014	8024	2988
05	2014-2015	10159	3374
06	2015-2016	8641	2388
07	2016-Feb 16 2017	30000	12000

PROBLEM DEFINITION:

The issue of dealing with faecal matter is a significant problem area for IR and needs multi-dimensional efforts. Not only passenger services on Indian railways have become uncomfortable but also it has made unhygienic surroundings for the passengers on railway stations as well as for the people living adjacent to railway tracks.

The bio toilet which now a days implementing in Indian railways is having some drawbacks like after degradation of human waste, the two wastes will generates one is liquid waste which they will directly release to atmosphere and the gas waste which produce due to anaerobic reaction methane & CO_2 gases,they leave these gases to atmosphere directly hence they are concentrating on cleanliness not on the energy generation but as these two are wastages, dumping directly after degradation will cause some problems in the environment like increase in carbon percentage & wasting of energy that is methane without using it.

METHODOLOGY:

Figure 1.2 explains about the implementation of eco-friendly sanitary system to get clean, healthy environment along with energy from human waste. First collecting the human waste in a retention tank from individual toilets systems and storing the waste till the station in which dumping arrangement has been made, once station arrived the human waste which is collected is connected to the bio gas plant pipe system. Once the waste enters in to the plant then the anaerobic reactions will results in production of biogas.

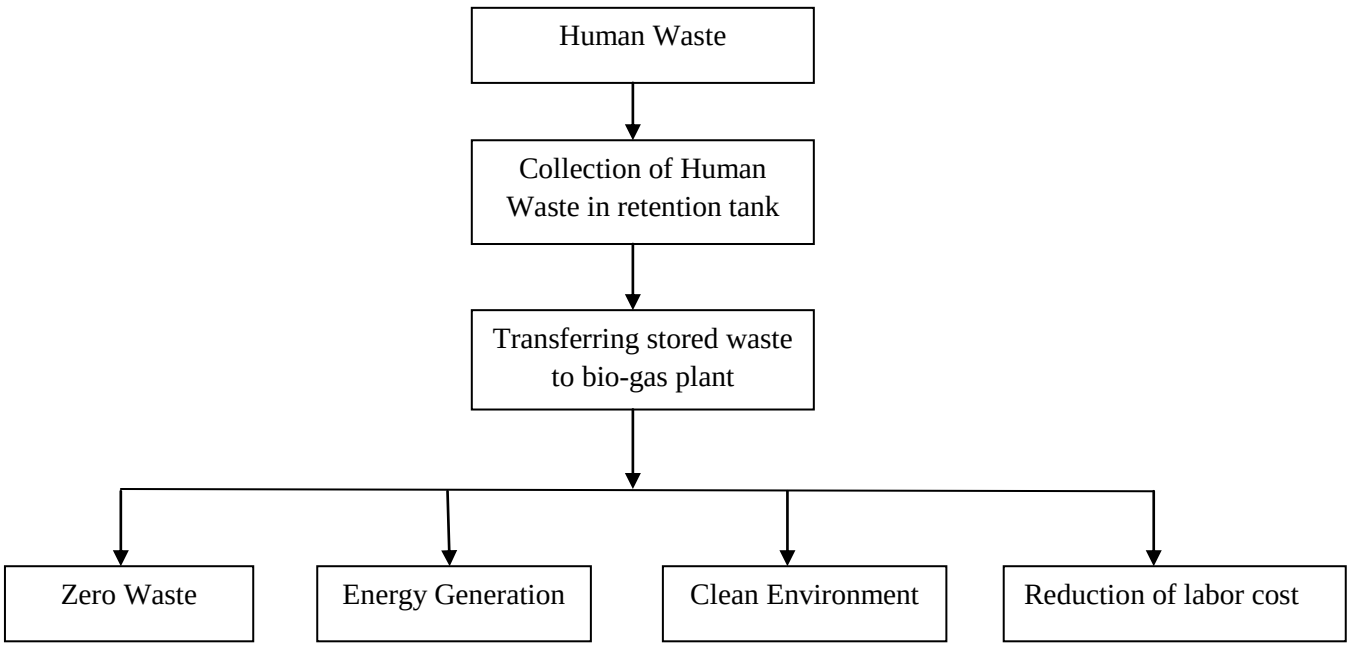

Figure 1.2 Methodology to obtain Eco-friendly sanitary System

System Design:

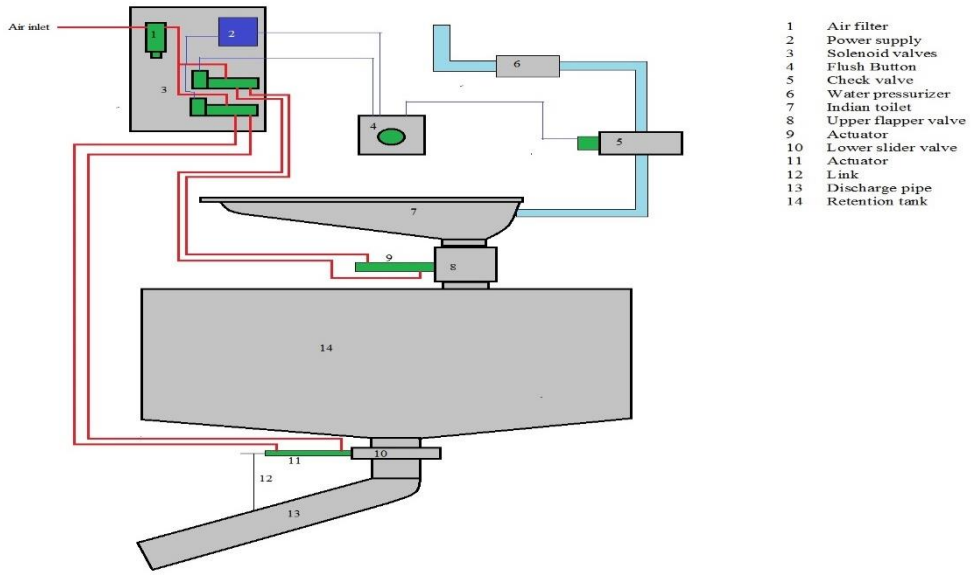

Figure 1.3: Design of Eco-friendly Sanitary System

Figure 1.3 explains about the system design of eco-friendly sanitary system. The system consists following parts**:**

- Air Filter
- Power Supply
- Solenoid Valves
- Flush Button
- Check Valve
- Water Pressurization
- Indian Toilet System
- Upper Flapper Valve
- Actuators
- Lower Slider Valve
- Link
- Discharge Pipe
- Retention Tank

Material used to create retention tank is HDPE (High Density Poly ethylene) HDPE is known for its large strength-to-density ratio. The density of HDPE can range from 0.93 to 0.97 g/cm^3 or 970 kg/m^3 ,It is also harder and more opaque and can withstand somewhat higher temperature 120 °C.

Working of Eco-friendly Sanitary System:

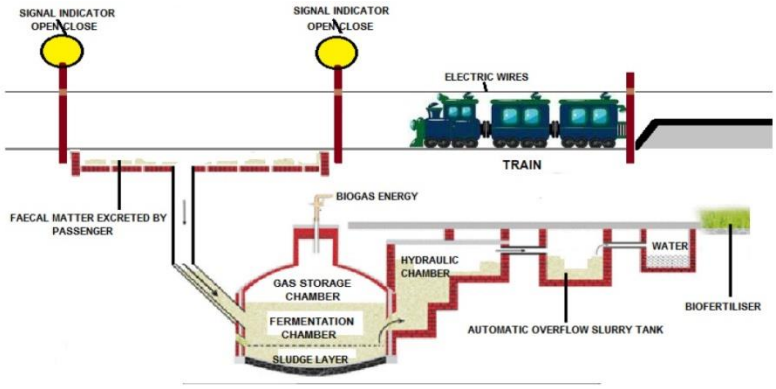

Figure 1.4: Working of Eco-friendly Sanitary System

- This system works on electrical & pneumatic pressure arrangement. The retention tank which stores effluent has two openings. These two openings activates by double acting pneumatic cylinders fed by feed pipe of air brake system. Upper opening opens every time the user operates the flush button, whereas lower opening at predetermined locations at the biogas plants. The solenoid/magnetic valves control the entry of pneumatic pressure in pneumatic cylinders attached to openings/slides.

- The pressurizer provided in sanitary system, delivers pressurized water through check valve to flush the waste. The system starts working on a single push of flush button switch.

- As the flush button is pressed the flow of water starts into the toilet bowl & the upper flapper valve which is connected between the toilet bowl & retention tank opens. All the toilet waste is transferred into the retention tank.

- At the end of each flush cycle the supply of water is stopped & the upper flapper valve is closed. Thus the toilet is sealed off from the retention tank preventing odor entering from the toilet room.

- At the biogas plant location the motorman opens the lower slider valve by using directions given on the electrical poles as shown in figure 04. The opening of the lower slider valve rotates the discharge pipe towards the channel of the biogas plant. The discharged waste gets collected in the biogas chamber because of channel's inclination.

3. RESULT & DISCUSSION:

Table 1.2 explains about the comparison of existing system with current idea in the Indian railway system by considering the important important factors which helps us to decide which technique is good to achieve "Swaccha Bharat Abhiyan".

Table1.2. Comparison of Bio-toilets & Current idea

S.No	Factors	Bio-toilets	Current Idea
1	Cleanliness of track	Incomplete	Complete
2	Nature of Disposal	Indirect Method	No disposal
3	Material used for Retention tank	Stainless Steel	HDPE
4	Weight of the system	More weight because of SS Material	Light Weight because of HDPE material
5	Protecting the Human Values	Less	More
6	Wastage deliver to the atmosphere	Disinfected liquid discharged to track	Zero Waste
7	Energy Generation	Not Possible	Possible with biogas plant

by implementing the current idea in the Indian Railway Sanitary System we can get the following results.

- Controlled discharge sanitary system resulted in clean and hygienic tracks, trains, stations and countryside.
- The discharge of human waste directly to biogas plant instead of atmosphere.
- Using this technique we can reduce the waste to zero.
- We can protect human values by adopting this system in railways instead of cleaning human beings waste by another human being.
- We can reduce the time &labor cost for cleaning the tracks hence this will help to increase the revenue of the Indian railway department.
- Replacing the material to construct the retention tank with HDPE instead of Stainless Steel which reduces the weight of the sanitary System along with reduction in the cost of the system.

4. CONCLUSION

As today bio toilets discharging wastes in degraded form also hazardous to environment, implementing modified technique gives better results in terms of cleanliness, waste reduction, weight reduction of tank, protecting the human values & by getting the energy from the human waste which results in leading the process towards Swaccha Bharat Abhiyan.

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