

Sewage Disposal System for Railways

Anushree Kohad¹, Bhawana Chabda², Drashpreet Kaur Suri³, Yashashree Gahane⁴

^{1,2,3,4}Yeshwantrao Chavan College of Engineering, (of Rashtrasant Tukdoji Maharaj Nagpur University)
Nagpur, India

Abstract – Indian Railways coaches are designed to dispose of the human excreta and water from toilets directly onto the tracks (open-chute toilet system), poses health hazards, raises environmental concerns and leads to water contamination. New technologies are being developed to tackle this. This paper explores one such technology i.e. Retention Tanks coupled with a technology called Station Monitoring System for automatic disposal of sewage most preferably at stations.

1. INTRODUCTION

Indian Railways is the biggest public sector enterprise in the Asian nation and connects the whole country. It is ill-fated that such a huge establishment does not have a specific dogma to the environment. It had its modest beginning in 1853 since then it has become the foremost mode of transport for the people of India even today. The enlargement of Indian Railways was conceded out by Robert Maitland Briton. He was an English railway engineer in India and was eventually appointed chief engineer for the Grand Indian Peninsular Railway and undertook to complete the strategic connection across the continent. This was accomplished in 1870. Opening the railway from Bombay to Calcutta was held in March 1870. By 1875, about 95 million were invested by British companies in India guaranteed railways [01]. British made ideal development of Indian Railways. They were never concerned with the people in general. The main thing to note is that in the first 55 years of operation of the Indian Railways, there were no toilets in trains. On July 2, 1909, an aggrieved Babu Okhil Chandra Sen lodged a complaint to the then Transportation Superintendent, Sahibganj [02]. After this, the railway authorities introduced toilets in all lower class carriages in trains running more than 50 miles in 1910. Today, trains running more than 150 kilometres have to provide toilets in all compartments. This led to the introduction of toilets in trains in India.

2. CURRENT SYSTEM

The existing system of sewage disposal from railways coaches as the "Drop Chute Toilets" or "Hopper Toilets" systems. The drop chute toilets that allow human excreta to fall directly through the said chute on the tracks below, or if the train happens to be crossing a bridge, then traffic or water bodies. This raw sewage is not just a major sanitation problem spreading infections, attracting vectors, and leaching into the groundwater table, but also an infrastructure problem since, in concentration, it

corrodes railway tracks. Passengers were discouraged from flushing or using toilets while the train is at a station or standing at a red signal.

A new kind of toilet using micro-organism to break down human waste product has been deployed in Indian trains. As many as 93,537 "bio-digesters"-as the toilets are called have been installed in mainline express and mail trains by the Indian Railways [03]. These are small-scale sewage-treatment systems installed underneath the toilet seat. Here human waste is decomposed to small pieces in the digester tank using specific high graded bacteria further converting them into methane and methane and water. After the process, only the water is let out on the tracks which are not harmful. This is how the Bio-digesters work.

3. ROUGH ESTIMATE OF THE AMOUNT OF WASTE DISPOSED

As per a report from 2016, the Indian Railways through its 9116 trains and 1.6 crore passengers generates around 300,000 litres of human waste from the 'open discharge' toilets and 8960 tonnes of solid waste across its terminal buildings all over the station. The volume of sewage discharged from every train would differ depending on the route, passenger capacity and the schedule of the trains.

According to a study by G.Raghuram of IIM, Ahmedabad, it is estimated that the total toilet usage is about 2 million times every day [04]. So per day usage comes out to be more or less 0.14 litres per day. Hence we can say that approximately 275000 litres of faecal matter are discharged daily from trains every day. The total investment is planned for the eight-year time frame (2007-2015) was tentatively in the order of Rs 350,000 crores. This was a significant increase from the planned Rs 60,000 crores (actually expected to cross Rs 80,000 crores) in the X Plan period of 2002-07.

These shocking figures bring out the atrociousness of the task of disposal of wastes from the railways. These figures tell us about the need for an improvement of the system that causes minimal harm to our environment.

4. LIMITATIONS OF CURRENT SYSTEM

Human waste contains a large number of germs that cause diarrhoea, cholera, typhoid, hepatitis, other water-borne diseases and parasitic infections and parasites like hookworm, tapeworm, roundworm and pinworm are

spread mainly through body waste that leads to spread of communicable diseases.

The Indian Railways dispose off human excreta into open throughout the length and breadth of the country due to which toilets are the biggest mobile source of environmental pollution by transporting the various harmful, deadly disease-causing micro-organisms by spreading them on tracks, rivers, streams etc.

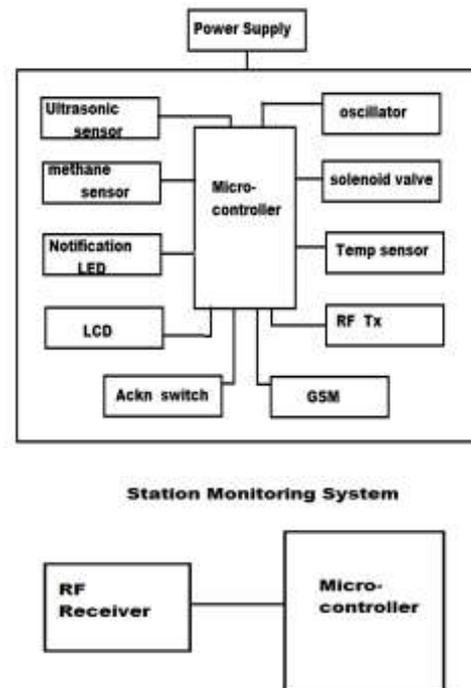
This technology, which was sold as a game-changer that would resolve the problem of un-decomposed of human waste on train toilets and tracks, does not seem to be working, according to the IIT-Madras. The sanitation specialists and varied studies—including commissioned by the railways—have discovered that the majority of the new “bio-toilets” on Indian trains are ineffective or ill-maintained and the water discharged no better than raw sewage.

The tests have found that the organic matter (human waste) collecting in the bio-digesters do not undergo any kind of treatment. Like within the septic tanks, these bio-digesters accumulate slush (human excretory product mixed with water).

5. PROPOSED SEWAGE DISPOSAL FOR RAILWAYS

The project incorporates an idea of retention tanks that will overcome the shortcomings of hopper toilet and bio-digesters. We know that human excreta can be used in many ways like Biogas production, fertilizers, hydrogen gas production, power generation etc. These retention tanks will collect the human excreta in the tanks that will be installed below every toilet in each coach. The tank consists of the ultrasonic sensor, methane sensor, and temperature sensor. These sensors will continuously monitor the waste level, methane level and temperature level, respectively. A station monitoring system will be installed in all the stations that will monitor the readings of the tank and then take a decision to dispose of the waste or not. The waste will only be disposed of at the stations. The collected waste will only be disposed of at the stations. Also, there are notification LED’s outside the train toilets that will show a red light when the toilets are full and green when empty. The waste from the stations will be sent to the power plants where it will be used to generate power or produce hydrogen gas or use the excreta as fertilizers etc. Thus, this method will not only dispose of the waste in an environmentally friendly manner but also harness the human excreta which is better than letting out the water on the rail tracks and methane in the air.

6. BLOCK DIAGRAM OF PROPOSED MODEL



7. DESCRIPTION OF PROPOSED MODEL

HARDWARE REQUIREMENTS:

- Microcontroller
- LCD Display
- Ultrasonic Sensor
- Methane sensor
- Temperature Sensor
- Solenoid valve
- GSM
- Monitoring System
- Notification LED
- Acknowledgement Switch

SOFTWARE REQUIREMENTS:

- Arduino

8. WORKING MODEL



9. OBSTACLES

There are some obstacles to the implementation of the aforementioned model.

Investment: High amount of investment needs to be done to restructure the tracks at big stations and to install the required models in the train toilets.

Time: A significant amount of time is required for the proper implementation of the model across the country. The enormity of the task needs to be considered before evaluating the effectiveness of the model.

Manpower: Huge amount of manpower is needed to accomplish the restructuring of the toilet system.

Maintenance: Contracts need to be given to privately own companies for the maintenance of the toilet system. This would ensure efficiency in the maintenance and keep the system in best conditions

10. ADVANTAGES

- Disposal of Human waste in an absolute Eco-Friendly manner.
- Waste goes to energy plants preferably have technological means of waste disposal which results in clean, renewable energy generation.
- One microcontroller multiple coaches that reduce power consumption.

- No manual work is needed.
- Sewage pollution control on the rail tracks.
- Safety from health hazards.

11. CONCLUSIONS

The aforementioned model is just a prototype of what the Indian Railways can adopt to tackle the ever-increasing problem of sewage and waste discharge from trains. Implementing this system will definitely need a huge amount of investment from the government's part. But what we need to look is that in today's world if we do not start caring for the welfare of nature then we will have a huge price for it in the future. So it is wise for us to spend a little more if at all it helps in nurturing and caring for the earth better.

If all goes well, there's hope for hygienic railway stations across the country

The authors can acknowledge any person/authorities in this section. This is not mandatory.

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