

# TO DESIGN EFFECTIVE RAILWAY SLUDGE MANAGEMENT

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**Abstract:** Recently Indian Railway Department fitted hopper system to trains for sludge management, due to this major problem is create regarding health and maintenance of track. Human excreta and water from toilets are directly discharging on railway tracks and platform. Many new technologies are being developed such as the bio-toilet system, control discharge toilet system (CDTS) system, zero discharge toilet system (ZDTS) system, to tackle this problem. We proposed such a new technology to suggest effective design of railway sludge management. In this system biogas is produced from human excreta and used for generation of electricity, pantry gas and manure for fertilizer purpose.

**Key words:** Design, Railway track and platform, Biogas, Electricity, Hopper, Bio-toilet.

## 1. INTRODUCTION:

Indian railways are being one of the largest transport networks in the world that are under a single governing body. It has been in existence since 1853 and is the chief mode of transport for the people of India even today. Now the Indian Railway coaches are designed to dispose of the human excreta and water from toilets by "Hopper system", which becomes very hazardous for health and environment.

In this system human excreta are stored in all retention tank from train toilets. When the railway stands on junction, all the human excreta is collected in a concrete pipeline which are laid near the track. Which is carry through it to the biogas generation plant. The biogas is produced using anaerobic bacteria from human excreta. These biogases are used to generate electricity, pantry gas.

## 2. LITERATURE REVIEW: -

Railways have been constantly working towards coming up with new technologies to tackle the mentioned problems. There are basically 3 different kinds of alternatives that have been developed so far.

(I) IR-DRDO Bio-Toilet System: - A bio-toilet is typically based on anaerobic decomposition of excreta. This chemical phenomenon will generate 55% methane and 45% carbon dioxide. They have the inlet for human excreta and outlet for methane. This toilet system is very eco-friendly. Now the problem with Bio- Toilets is it will

generate Methane gas and it is a combustible gas. If the gas generated is not directed properly it may displace oxygen from an enclosed railway compartment leading to cause a fire. Indian people having lack of awareness about using bio-toilets, they throw plastic and other material in the toilet which is not disposable so there are more possibilities of getting choke up of bio-toilets and failure the system.

(II) Control discharge toilet system (CDTS): -This system works on electrical & pneumatic pressure arrangement. The retention tank which stores effluent has two openings. These two openings activate by double-acting pneumatic cylinders fed by Feed pipe of an air brake system. Upper opening opens every time the user operates the flush button, whereas lower opening works. When the train catches a speed more than 30km/h speed. An advantage of this system is that, there is no restriction on the passenger for using toilets. Although this is a good way of tackling the sewage pollution in city areas where the train runs slow but the sewage is ultimately discharged onto the track itself after all. But in this system, the human excreta directly discharge on tracks, so this is not an environmentally friendly system.

(III) Automatic Train Discharge System (ATDS): - ATDS system, incorruptness the retention tank system. In this system the human waste is stored in retention tank and after this when a train stops on a platform for 10 to 15 minutes the driver discharges the sewage on to the canal underneath and the water system of the canal washes away the discharge either into a tank or to the city's sewage pipelines. This system is very good to avoid pollution on tracks but in this system construction of new tracks and platforms are needed. While there is some failure in this electronic system then all toilets can choke up and may crate bad odour.

## 2.1 CONCLUSION FROM REVIWS: -

Some of the systems are eco-friendly, but their installation cost is high. Such systems have many possibilities of getting failure easily. After installing or applying the system, they have no income source. The trains using these CDTS, ZDTS, BIOGAS systems choke up and are flammable so they are not safe to use in trains.

### 3. AIMS:

1. To control diseases producing from human excreta.
2. To produce a renewable energy from human excreta.
3. To design and prepare an effective sludge system.

### 4. OBJECTIVES:

1. To keep the railway tracks and platforms clean and clear.
2. Produce biogas from human excreta for generation of electricity.
3. To keep railway platforms air pollution free.
4. Eliminate the health problems of passengers, railway workers, railway staff, track man etc.
5. Minimizing the wastage of water for make the tracks clean.

### 5. PROPOSED WORK:

Our concept is based on collection tank system. After using the toilets by passengers, the human excreta get collect in designed tank. The tanks are then discharged when the train stops at junction. The pipes are laid underground near the track. To discharge the sludge from tank the flexible thick plastic pipes are connected to the underground pipes inlet and tank outlet. Then the sludge discharges manually by releasing the leavers. After releasing the sludge in underground pipe this pipe carries the sludge to the biogas generation plant by mechanical means. The settling tank is provided to settle the sludge and separate the water from it. The sludge is transfer from settling tank to the biogas tank. The bio gas generation process is started.

These are some modification in coaches. We need to fit a collection tank below the toilet. This tank is to be designed as to retain the sludge. Further which is to be connected to individual toilet. The material of the tank is stainless steel with 2.5 to 3mm thickness. The shape of the tank is rectangular and they have one vent pipe, one overflow pipe, and one outlet pipe and also it gives s-trap to connect toilet.

The current junctions is need to be redesigned. The underground pipeline needs to laid near the tracks for discharging the sludge into it. Also, we have to construct a biogas generation plant near the junction within distance of 500 m. In this plant biogas electricity generation has been process.

#### 5.1. CALCULATIONS:

The maximum number of coaches which can be attached to a train is twenty four (24) including Guard's Brake van, Parcel coach. The usual formation of a passenger carrying train is Engine, one parcel cum brake van coach

(one each at front & rear), general class coaches - 4, (As many passengers can travel - may be 300)

Sleeper class coaches - 11 (72 berths \* 11 = 792)

Third AC-4 or 5 (64 berths \* 4 = 256)

Second AC - 2 or 3 (46 berths \* 2 = 92)

First AC - 1 or NIL. (24 berths \* 1 = 24)

Total comes to - 1464 passengers

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. This is roughly about 22 toilet uses per day per coach. According to other researches, it is estimated that one person produces about 500 litres of urine and 50 litres of faecal matter in a year. So, per day usage comes out to be approximately 0.14 litres per day.

Therefore, Total passengers x per day usages in litres  
1464 passengers x 0.14 litres = 204.96 litres

In a Pune junction 35 to 40 passenger trains are coming. It means out of 35 to 40, 25 trains are will be discharging on junction. Therefore,

$$204.96 \text{ litres} \times 25 = 5124 \text{ litres.}$$

It Means 5124 litres human excreta are produced on a one junction.

According to our survey 1000 litres human excreta produce 700 litres biogas.

$$\text{Therefore, } 5124 \times 70 / 100 = 3586.8 \text{ litres.}$$

5124 litres human excreta produce 3586.8 litres biogas at one junction, after generating biogas it can be used as a pantry gas or for generation of electricity.

According to a study by G. Raghuram of IIM, one person produces about 500 litres of urine and 50 litres of faecal matter in a year. So,  $550/365 = 1.5$  litres,

It Means one person produces 1.5 litres urine and faecal matter. Assume 8.5 litres flush water.

$$8.5 + 1.5 = 10 \text{ litres.}$$

In a sleeper coach 73 passengers accommodate,

Therefore,  $73 \times 10 \text{ litres} = 730 \text{ litres.}$

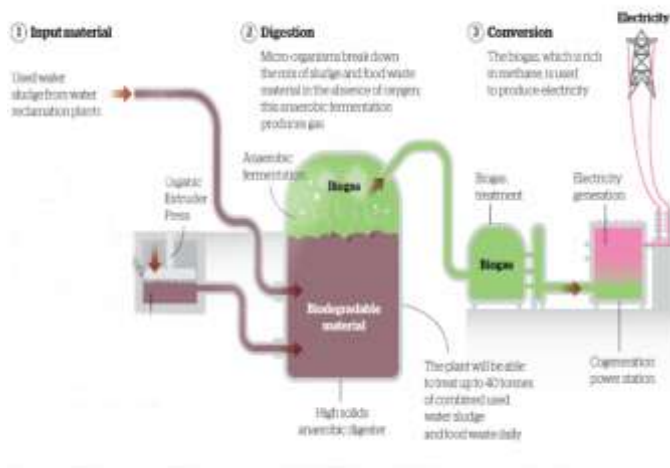
SO, we are providing 7 ft x 2 ft x 1 ft (395 litres) for two tanks per coach to store the sludge from toilets.

**6. OUTPUT PRODUCTS:**

1. Electricity.
2. Pantry gas.
3. Organic manure.

**7. ADVANTAGES:**

1. Electricity bills would be less due to using self-generated electricity.
2. Indian railway can earn money by selling the manure to the farmers at cheap prices.
3. Tracks and platforms will remain clean and clear.
4. More vacancies would be available.
5. Water consumption would be less to clean the tracks.



**8. LIMITATIONS:**

1. It is initial cost would be high.
2. Man power would be required.
3. In case of overflow the sludge will fall on tracks.

**9. CONCLUSIONS:**

The above-mentioned model is just a prototype of what the Indian Railways can adopt to tackle the ever-increasing problem of excreta discharge from trains. Implementing this system will definitely need a huge amount of investment from the government part as we have already pointed out. From this project we will stop use of conventional energy.

By this system passengers can use toilet when they want, even if the train stops on a platform. Further proposed

model is very useful for our Indian Railway. From this project Government can earn money for longer time.

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