

## DESIGN OF VACUUM CONTROLLED DISCHARGE LAVATORY SYSTEM (VCDLS) OF RAILWAY CAR

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### Abstract

Open toilet system is now under usage for Indian railways. Discharge from railway toilets were more acidic and highly corrosive in nature. 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. IR coaches have toilet system at the either end of coach that has hole on the floor through which human feces and urine is flush directly on the railway tracks which may cause environment hazard and unclean toilet causes bad smell which makes people uncomfortable and spreads various diseases. In order to overcome this problem Indian railways have incorporated Control Discharge Toilet System (CDTS), Bio-toilet developed by IR engineers and DRDO Bio-Technologists, Development of Zero Discharge Toilet System (ZDTS) by IIT Kanpur and Research Development and Standards Organization (RDSO) Lucknow, are some effort in this direction. Possible benefits are that minimum quantity of water will be used efficiently and disposal problem at yards. In order to make cleaning more effective and environment friendly

*Index Terms:* Corrosion, Coach, Chassis, Bogie frame, Carriage, Discharge, Lavatory, trigonal chopper, Flushing system, Indian Railways, Cleanliness, Comfort, Temporary storage tank, High volume storage tank,

### Nomenclature

mm-millimetre  
L-Length (mm)  
V-Volume (mm<sup>3</sup>)  
A-Area (mm<sup>2</sup>)

## 1. INTRODUCTION

Indian Railways represent the pride of an Indian. Indian Railways is an Indian state-owned and operated by the government of India through the Ministry of Railways. More than 40000 coaches has to operate 1, 60,000 toilets, on coaches speeding up 100kmph [1]. Due to the discharge from toilet, chassis and other steel components beneath the toilet gets corroded this reduces life time of railway coach. IR and DRDO jointly installed 5300 Controlled Discharge Toilet System (CDTS) in 1900 coaches since 2011 but ended in failure. Though CDTS keeps the station clean but after the train reaches speed of 30kmph it discharges waste on the run which may splash on the under carriage bogie frame. Generally illiterates people of India who misusing this system by

dropping diapers [2] and bottles in to CDTS causes failure in opening of discharge valves.

In order to overcome this failure the blockages inside tanks can be eliminated by Vacuum Controlled Discharge Lavatory System (VCDLS). Vacuum Controlled Discharge Lavatory System (VCDLS) retains the black water/toilet waste and discharges when the speed of the coach is equal to more than the designated speed and a pre-programmed number of flush cycles have been completed. This specification covers the design & general requirements including supply, installation & commissioning of controlled discharge toilet system along with stainless steel inlays for low cost stainless steel coaches.

### 1.1. NECESSITY OF TOILET

A toilet is a sanitation fixture used primarily for the disposal of human excrement and urine, often found in a small room referred to as a toilet/bathroom/lavatory. The hole in the floor also known as a drop chute toilet system where waste is deposited on the track is still in use in many parts of the world, particularly aboard older rolling stock. The principal drawback is that it can be considered crude or unhygienic –it litters railway lines and can produce health risks if the train is passing over a public waterway. Passengers may be discouraged from flushing or using toilet while the train is at a station.

### 1.2. OBJECTIVE

Cleaning the train toilet basin automatically with more pressure than head pressure of the normal toilet flushing. With less quantity of water, reducing water wastages, making efficient cleaning of toilet basin since water should be consumed efficiently in trains. Tertiary objective make comfort in using train toilets and enable the passengers to have good opinion about train management. Though CDTs keeps the station clean but after the train reaches speed of 30kmph it discharges waste on the run which may splash on the under carriage bogie frame. This may cause corrosion and reduce reliability of railway coach. At present dirty are not effectively cleaned which requires a large quantity of water for flushing. And also frequent cleaning of toilet is necessary and also requires more maintenance.

### 1.3. EXISTING SYSTEM

In rail transport, many passenger trains (usually medium and long-distance) have toilet facilities on board. These are often located at the ends of carriages. Toilets suitable for wheelchair users are larger, and hence trains with such facilities may not have toilets in each carriage as shown in Fig. 3. 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). The 'hole in the floor' (also known as a drop chute toilet) system where waste is deposited on the track is still in use in many parts of the world, particularly aboard older rolling stock. The principal drawback

is that it can be considered crude or unhygienic – it litters railway lines and can produce health risks if the train is passing over a public waterway. Passengers may be discouraged from flushing or using toilets while the train is at a station.

### 1.4. DRAWBACKS

- ★ Dirt's are not effectively cleaned
- ★ Large quantity of water is used for flushing
- ★ Frequent cleaning of toilet is necessary
- ★ More human effort is needed
- ★ Corrosion of railway coach
- ★ Unclean railway environment

## 2. METHODOLOGY

To design and fabricate the Vacuum Controlled Discharge Lavatory System (VCLDS). VCLDS system has an auxiliary storage tank accompanied with a trigonal chopper which crushes solid waste discharge and foreign bodies avoid blockages. A vacuum pump and sanitizing arrangement can be made to drain these wastes. In order to manage railway, toilet are the main problem. They can be rectified by introduction new Technologies to clean the toilet and reducing human effort.

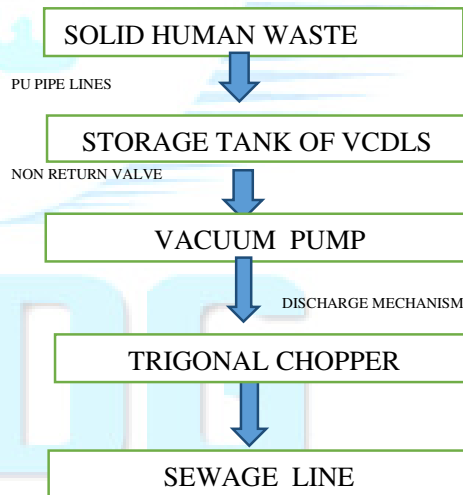


Fig.1 Solid waste collection and disposal system

### 2.1. SELECTION OF MATERIAL

1. Lavatory bowl
2. Universal retention tank (capacity not less than 45 liters)
3. Main storage tank (capacity not less than 2000 liters)
4. Polyurethane Tubes/ Push in fittings

5. Inlet flapper valve

6. Outlet slide valve

7. Shuttle valve

8. Ermeto type pipe fittings

9. Rotary lobe pump

10. Disposal tunings

## 2.2. SYSTEM INTERFACE

### 2.2.1 MECHANICAL INTERFACE

The system shall be mounted onto the coach without any rework. The normal structural tolerances of the lavatory and coach shall be sufficiently accommodated in the design of mountings

### 2.2.2 INTERFACE WITH PIPING ARRANGEMENT & CABLING

System components including the water and waste water pipework, All pipes and pipe connections shall be completely leak proof and made of SS pipes. Valves shall be located for easy accessibility for maintenance. It shall be possible to isolate different circuit for repairs without dismantling. All pneumatic hoses shall be wire braided, to protect from stone hitting and electric wiring shall be covered with conduits to protect from stone hitting. The conduits required for electric wiring above will be provided.

### 2.2.3 INTERFACE WITH UNDER FRAME

The interface of the discharge system fitted directly beneath the toilet bowl shall be designed to suit the underframe and bogie arrangement drawings. The size of the waste retention tank including inlet & outlet valves & discharge tube shall confine to the space available. Supplier shall give details of brackets required

### 2.2.4 WATER CONSUMPTION

Indian style toilets and 1.5liters European style toilets. It shall kept in mind that water supply available is by gravity flow at interface points and water pressurized flush-arrangement will have to be designed as per functional requirements.

## 3. WORKING METHODOLGY

In this case of railway toilet by VCDLS the water from the overhead tank is flushed along with the solid human waste and liquid discharges where past into the inlet valves and reaches Universal retention tank (capacity not less than 45 liters) where the solid waste stagnates for a while and then transfer to Main storage tank (capacity not less than 2000 liters).

This capacity of tanks may help the railway passengers using the toilet for a journey of 6 Hours(400kms). The discharge water during this shunt journey will be stored in these tanks can be effectively unloaded by a vacuum lobe pump arrangement. The valves which control the flows can be actuated electronically under a programmed control.

### PROPOSED SYSTEM

Everybody who travelling in train may subject to use the toilet which results in increase of solid and liquid waste discharge. These discharge effluents where flushed into the toilet basin where we are connecting a pipe which the means of gravity flows into universal retention tank. After it overflows this effluent flows into main storage tank through an inlet valve as shown Fig.2

Where the solid waste gets sediment to the base of main storage tank by means of gravity.

### 3.1. RETENTION /STORAGE TANK

Retention and storage tank are fabricated by using stainless steel by electric arc welding for the following dimension Dimension in m

TABLE 1

DIMESION VCDLS TANKS

S.NO	DESCRIPTION	DIMENSION
1	Universal retention tank	0.3*0.3*0.3
2	Main storage tank	0.9*2*5

### 3.2. TRIGONAL CHOPPER

Trigonal chopper is a mechanical equipment which has a planetary gear arrangement to operate three carbide rotary blades which rotates simultaneously. It has inlet through which solid

waste enters the chopper and smashed into fine pieces which ensures smooth discharge flow at discharge Terminate valve.

### 3.3.VACUUM LOBE PUMP

Vacuum is directly generated by the integrated rotary lobe pump as shown in Fig.3. The rotary lobe pump generates vacuum upto -0.8 bar, easily supplies long distances and discharges directly into the sewer. This allows for trouble-free designs with centralized control options, fewer parts and compact sizes.

#### Rotary lobe pump

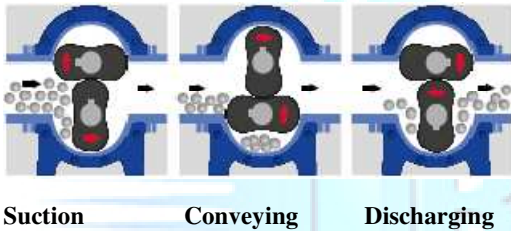


Fig.3 Rotary lobe pump

#### 3.3.1.VACUUM PUMP STATION FEATURES

- ★ Provides vacuum directly to the waste water pipe system
- ★ Discharges waste water into the sewer
- ★ Central control of the entire system
- ★ Platform compatible designs possible

### 4.RESULT AND DISCUSSION

Since toilet cleaning is the major problem in Indian railways, There is no other way that solving it using technological ideas. We have proceeded our project in order to overcome this problem.

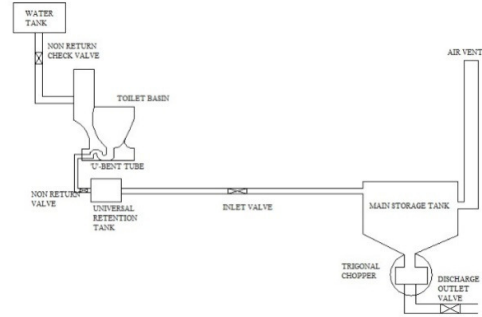


Fig.2 Block diagram for proposed system

### 4.1.PRACTICAL IMPLEMENTATION

We have done our project with all features as mentioned.

- ★ Solid waste handling is made effective
- ★ Sanitation and hygiene in railway premises is conserved
- ★ Man power for cleaning railway tracks is widely reduced

### 4.2.MAJOR APPLICATION

- ★ Mainly in railway wagons
- ★ In aircraft
- ★ In multi-axle Buses

### 5.CONCLUSION

Sanitation, Cleanliness of railway toilet can be effectively managed since solid waste is properly handle and wastage of water is reduced. Further the reliability of railway wagon can be increased notably. As for as the cleanliness is maintained, foul smell and spreading of diseases can be reduced much better. This makes the railway passenger's more pleasant and adorable.

### 6.ACKNOWLEDGEMENT

The author's gratefully acknowledge the technical support provided by The Research Centre, Department of Mechanical Engineering Jayalakshmi Institute of Technology, Thoppur, Dharmapuri, Tamilnadu, India.

We express our sincere thanks to our Honourable chairman Ln.C.SUBRAMANIAN,

At this high time for providing us with plethora of facility to complete my project with great successfully

We thank our beloved principal Dr.S.RAGUNATHAN, who has been a bastion of moral strength and source of incessant encouragement to us.

We take immense pleasure to express our heartfelt thanks to our Head of the Department, Professor Mr.V.MUNUSAMI M.E., (Ph.D), Department of Mechanical Engineering, for his constant support provided all through the course of our project.

This work would not have been materialized without the great guidance given by our guide, Mr.S.SRIDHAR, who had given a constant source of ideas and inspiration.

We thank our project coordinator, Mr.N.MAHENDRAN and review committee members for valuable suggestion for completion of the project successfully.

We thank our beloved class advisor , Mr.A.P.ARUNGANDHI, for his encouragement to do this project.

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