



Bio-Toilet used in Indian Railway

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Abstract: The disposal of human waste is a very big problem in high altitude areas. In non-glacier regions the waste is collected and used as fertilizer in the field. Incineration and chemical treatment of human waste has also been attempted to overcome the problem. However, all these methods are either unhygienic or not practically viable alternatives. Biological treatment on the micro-organisms, freezing of the substrate, non-availability of conventional energy sources and hilly terrains are some of the hurdles which need to be solving to make the process practically possible. The Bio-Toilet provided in railway. It secured the environment and make eco-Friendly. The aesthetic appearance of track should be good and nuisance from the human excreta on the track can be eliminated. The corrosion caused by the fecal matter can be minimized by using bio-toilet. By using bio-toilet we can purify the solid waste into the pure water by means of chlorination tank. We can be utilized this water for washing of track and bogies and the remaining sludge can be used as fertilizer for agriculture purpose. So this bio-toilet is very useful and essential for Indian Railways.

Keywords: Bio- Toilet, Human Waste Disposal, Indian Rail Toilet, Automatic Waste Disposal, Waste Processing.

I. INTRODUCTION

The disposal of human waste is very big problem in high altitude areas. In non- glacier region the waste is collected and used as a fertilizer in the field. Incineration and chemical treatment of human waste also has been attempted to overcome problem.

However, all this methods are either unhygienic or not practically viable alternatives. Biological treatment is an attractive approach for solving the problems, but decreased metabolic activities of the micro-organisms, freezing of the substrate non-availability of conventional energy sources and hilly terrains are some of the hurdles which need to be solve to make the process practically possible. DRDO has developed an innovative technology for disposal of human waste in eco-friendly manner at high altitude location where temperature drops to -40 or lower. The process culminates into treated effluent, which is free from pathogens and is also environmental friendly. During waste treatment colourless and odourless inflammable biogas (methane) is generated as byproduct, which can be used for various energy intensives activities likes cooking, washing. The technology has two major components, low temperature active inoculums and temperature-controlled bio toilet (digester).

SALIENT FEATURES

- Suitable for subzero temperature of Himalayan regions as well as glaciers.
- No dependents on limited on costly conventional energy sources.
- Easy to transport and install in hilly terrains.
- Maintenance free, continuous biological process.
- Eliminates the pathogens.
- Generate odourless and inflammable biogas.
- Economically viable.

II. LITERATURE REVIEW

Following literature review is observed for obtaining the base for the completion of the objective of this project work. Research work carried out by Research Designs and Standards Organization under the title Specification for "Retention Tank Toilet System with Chemical Treatment" gives the following details

Preamble: Retention tank toilet system with chemical treatment treats human waste so that solids are treated and entrapped in the filter. The liquids are made free from pathogen before being discharged. It is applicable to western and Indian style toilets of mainline broad gauge (BG) coaches of Indian Railways. This Schedule of Technical Requirements specifies the waste processing, discharge and interfacing of Western and Indian style toilets to be fitted on different types of main line broad gauge (BG) coaches on Indian Railways.

General Requirements: Generally, IR mainline passenger coach has 4 toilets, of either Western commode or Indian squat-pan types. Some coaches may have only 2 or 3 toilets. The number of toilets and their type (Indian or western) depends upon the coach type. Irrespective of coach designs the biological toilet system is required to meet the following objectives:- □ Clean, odourless, hygienic and aesthetically pleasing toilet. □ No discharge of unprocessed waste. □ No spillage of wastes on the bogie parts, under gear or track. □ Minimum life cycle cost to IR The toilet system should be simple to operate and safe for users. It should not contain any components, which are prone to pilferage. It should be robust, reliable and low-maintenance, and should require minimum ground facilities at the terminals or enroute stations for it's operation. The system should be able to handle normal waste and even some foreign objects thrown in (such as



bottles, caps, napkins, plastic bags & cups etc.) either by segregating or by processing the same. Any choking should be possible to be rectified on the spot without needing attention of maintenance depot. The water consumption shall be minimum, with 100% wash of the commode (max. 2.5 liter per flush for Indian type and 1.5 liter for Western type). The toilet system is required to suit the space constraints of different types of coaches. All parts of the system should be at least 225 mm above rail level (preferably 400 mm). The equipment should not impede free -movement of the bogies, nor the routine inspection & maintenance of various bogie/coach subassemblies.

Methodology for Design and Fabrication of Human Waste Disposal System for Indian Railway – A Review (IJSTE/ Volume 2 / Issue 07 / 2004)

The toilet system offered must be of a proven and established design. Documentary evidence along with certificate of performance (clearly specifying the operating conditions and design) of the toilet system supplied during last 5 years, should be provided by the tenderer, along with contact details of the users. The design of the toilet system should be suitable for application on various designs of Indian Railways passenger coaches. The tenderer may however make suitable changes in his original design to adapt the same to IR's requirements. This shall be done at the tenderer's sole responsibility and cost.

Documentation: The suppliers must submit documentary proof of the system being of proven design and for the various components and material used in the toilet system. The successful tenderer shall provide detailed drawings and specifications of the components critical to its proper functioning. Sufficient numbers of illustrative manuals shall be supplied for installation, commissioning, preventive maintenance and trouble-shooting. Consumables required for the system (including chemicals for cleaning, disinfections as well as waste processing) shall be informed. A list of spares to be kept by the maintenance points shall be informed with their costs. The tenderer shall submit the life-cycle costing for the toilet system offered by him, and include the following cost details :- □ Landed cost of the toilet system □ Annual recurring cost of operation □ Annual recurring cost of preventive maintenance □ Annual recurring cost of repairs

III. BIO-DIGSTER TOILET

Biological decomposition of human waste.

Bio-Toilet is an innovative technology for disposal of solid human waste in an eco-friendly, economical and hygienic manner.

A Bio-toilet is a complete waste management solutions which reduces solid human waste to biogas and pure water, with the help of a bacterial Inoculum.

IR-DRDO BIO-TOILET SYSTEM

- An environmental friendly toilet system Green toilet aims at Zero-deflection on the ground
- Discharge on track creates environmental problems as well as problem in working to w
- MOU has been signed with DRDO for joint technology development.
- The First Rake with bio-toilets developed with DRDO is running in Bundelkhand Express since 18th January-2011.
- 20 more rakes fitted with DRDO technology toilets have been allotted to Zonal Railways.
- Cumulatively approx.12000 coaches have been fitted with Bio toilet and approx. 30000 Bio-toilet fitted in coaches. (as on 31.01.2016).

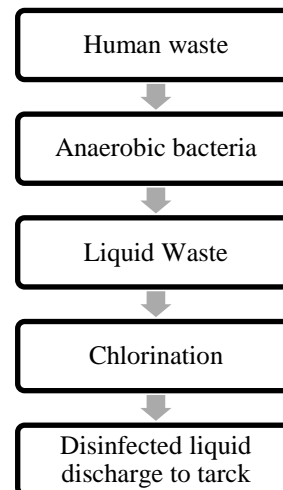
IV. IMPORTANCE OF BIO-TOILET

Bio-toilet aims at zero defecation on the ground. Discharge on track, besides creating environmental issues creates problems in working to workman's.

A multi directional strategy has been implemented for adoption of Environment friendly toilet on IR passenger coaches.

Bio-toilets are environment friendly and prevent damages to track due corrosion. It also improves aesthetics of Railway Station.

V. WORKING OF BIO-TOILET



When human excreta comes in contact with bacteria, it get converted into methane and water through a series of anaerobic bacteria digestion hydrolysis, acidogenesis, acepogenesis and methanogenesis. Faecal matter is space composed of carbohydrates, protein and fats.

In the first step, they are converted in simple suger, aminoacids and fattyacids. In the next step, this breakes to for carbonic acids, alcohols, hydrogen, water. In third steps aciticacid, hydrogen and carbondioxide are formed. In the last step methane, carbondioxide and water are formed.



MAIN PARTS OF BIO-TOILET TANK

- Stainless steel tank with 06 partition walls in side the tank.
- Poly grass mats for portation of bacteria in side the wall.
- Ball valve with handel for operation during emergency for operation during emergency for making toilet direct discharge in case of choking.
- SS fasteners in place of MS on tank cover.
- Stronger bonding of colonized rubber mat vertical walls.

VI. ADVANTAGES OF BIO-TOILET

- No bad smell in toilets from the tanks
- No Cockroaches & flies
- Fecal matter in the tank not visible
- Effluent is free from off odour and solid waste
- No maintenance required
- Reduction in harmful organic matter by 90%
- No requirement of adding bacteria
- No need of removal of solid waste

INSTRUCTIONS FOR PRESSURISED CLEANING OF BIOTOILETS:

The preventive maintenance schedule for maintenance of coaches being followed in IR and time schedule to be followed for maintenance of the IR-DRDO Bio-toilet system are issued by RDSO under guidelines for AMOC for Bio-toilets (DRDE type). Maintenance of the Bio-toilet systems and Guidelines for handling of Bacteria

- Visual inspection of complete toilets system including under slung Equipments .
- Toilet chute to be cleared in bio-toilets if there is choking.
- Checking the toilets system for any deficiency.
- Collection and transportation of sample from retention tanks to DRDE, Gwalior or any other nominated Govt. accredited lab as per the test scheme.
- Charging of chlorine tables and examination of chlorinator.
- Checking of following equipments/repair/replacement for proper functioning:
 - Flapper/slider/ball valve
 - Leakage in piping, flush system, pneumatics, tank etc. valves, pressurise, PLC, pneumatic valves, ball valves etc.
 - Charging of Bio-culture if required (based on test reports). Culture will be supplied by DRDE/IR (Issued by the RDSO document no. RDSO/2010/CG/CM1-03(Rev.1)

Guidelines for coaching depots for handling of Bacteria

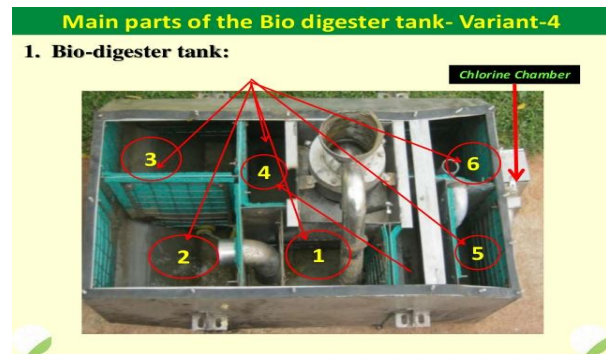
1. Wear gloves while handling bacterial culture
2. Store bacterial culture in containers with lid which can be closed
3. During transportation lids should be tightly closed.

4. During storage, lids should be kept loose so that the gas generated inside the container can escape easily otherwise container will get damaged physically.

5. Do not mix detergents/acids with bacteria at any stage during use.

6. Toilets fitted with bio digesters/ bio toilets should preferably be cleaned by pressurized water cleaning system so as to minimize the water usage.

7. Clean / sanitize hands with detergents/ soaps after handling of the bacteria.



VI. CONCLUSION

When human excreta comes in contact with bacteria, it get converted into methane and water through a series of anaerobic digestion-hydrolysis acidogenesis methanogenesis. Faecal matter is composed of carbohydrate, protein and fats.

The bio-toilet provided in trains. It secured the environment and make ecofriendly. The aesthetic apperience of tracks should be good and anisance from the human excreta on the track and can be eliminated. The corrosion cost by the fecal matters can be minimised by using bio-toilets.

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