

BIO - TOILETS SYSTEM

STC / NBQ



WHY BIO-TOILET SYSTEM IS NEEDED

- **Need for environment friendly toilet.**
- **Unacceptable hygiene conditions particularly at Railway stations.**
- **Preventing damages to tracks by way of corrosions.**
- **Improved aesthetic at Railway stations**
- **Eliminating manual scavenging.**
- **Reduction in consumption of water.**
- **Providing better working environment to track and other maintenance staff.**

INTRODUCTION OF BIO-TOILETS IN 'IR'.

- ❑ A joint MOU was signed between Indian railway and DRDO on 29.03.2010 to set up a JWG for technological development of DRDE bio digester used toilet for passenger coaches.
- ❑ Through this development 1st rake of with bio toilet run from 18.01.2011.
- ❑ IR Targeted to convert every coach by Dec'2018.

BIO DIGESTER TOILET

- ✿ It is a innovative techno-logy for disposal of human waste in eco friendly manner.
- ✿ These bio-toilets can function at any temperature between 0 to 60 degree c.
- ✿ In this technology **An-aerobic** bacteria is used for decomposition.

AN-AEROBIC BACTERIA QUALITIES

- ▣ **The bacteria does not require oxygen for its reproduction.**
- ▣ **Dominates and de-composes matter into liquid and gases.**
- ▣ **These bacteria once charged does not require replenishment for long time and system is maintenance free.**
- ▣ **Can withstand sub zero temperature and as high as 60 degree centigrade.**
- ▣ **Cold temperature does not effect the inside working.**

AN-AEROBIC BACTERIA QUALITIES

- **Can double its population with in 06-08 hrs**
- **De-composes matter into liquid and gases**
- **Can be kept for **two-three** months at ambient temperature in bio-digester tank**
- **Inside processing is not effected by cold atmosphere, as anaerobic process is exothermic in nature, heat will be available inside the chamber of chemical process.**

BRIEF ABOUT BACTERIA – ANAEROBIC

➤ These bacteria consists of four groups

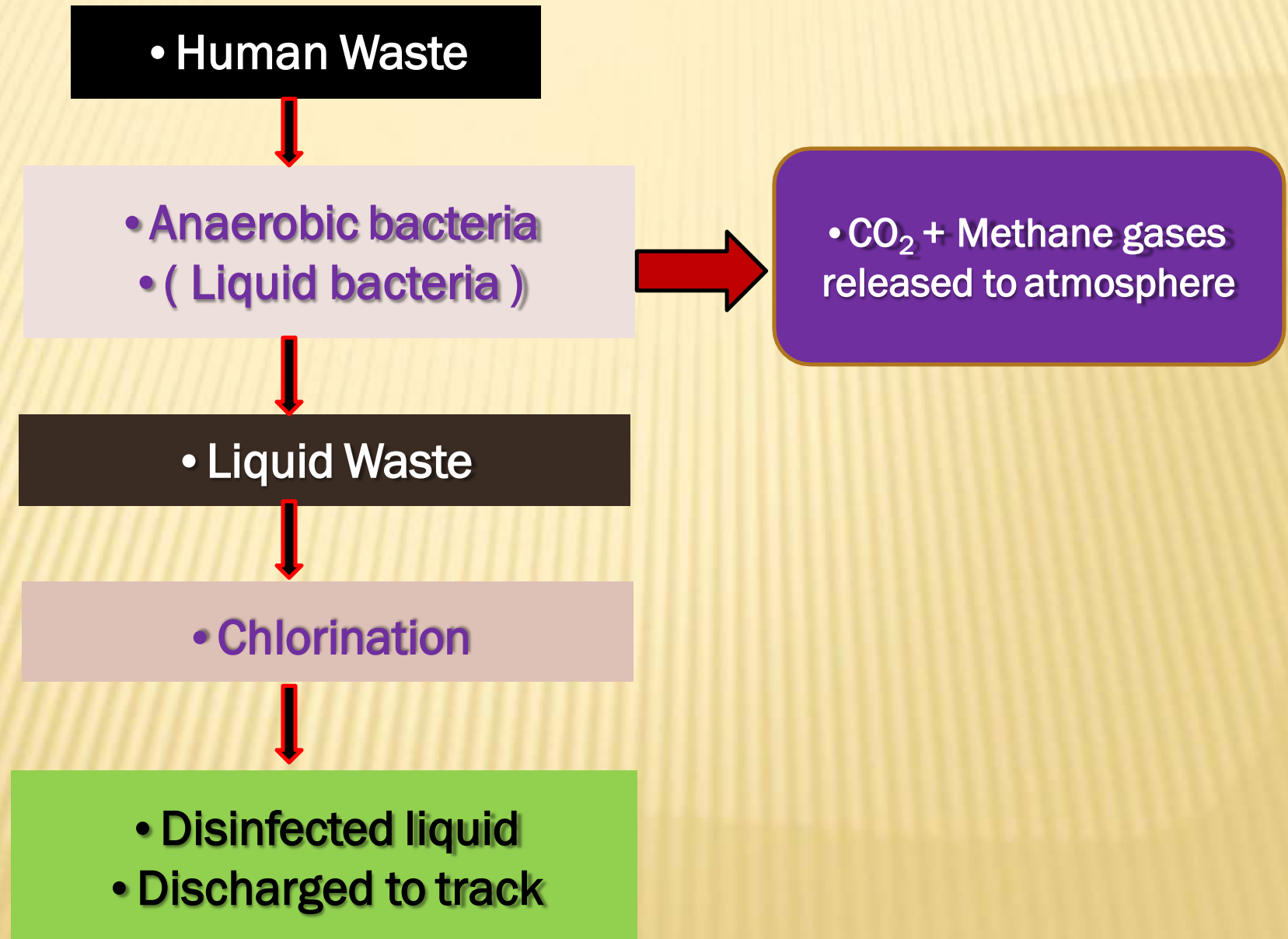
1. Hydrolytic
2. Acidogenic
3. Acetogenic
4. Methanogenic

E.g . *Planococcus matriensis*, *Clostridium schirmacherense*, *Bacillus* sp., *Aeromonas hydrophila*, *Clostridium vincentii*, *Methanosaeta concilii* etc.

WORKING PRINCIPLE OF BIO-DIGESTER SYSTEM

- ➡ **When Anaerobic Bacteria come in contact with human waste, they dispose the same using carbon dioxide, methane and liquid. The CO₂ and Methane gases released to atmosphere and thereafter liquid waste comes in contact Chlorine. Finally disinfected liquid discharged to the ground.**

• Working of Biological toilet system (Anaerobic)



ANAEROBIC BIODEGRADATION

× STEPS IN BIO-DEGRADATION

Large polymers



Hydrolysis (by hydrolytic bacteria)

Simple monomers



Acidogenesis (by acidogenic bacteria)

Volatile fatty acids



Acetogenesis (by acetogenic bacteria)

Acetic acid $H_2 + CO_2$



Methanogenesis (by methanogenic

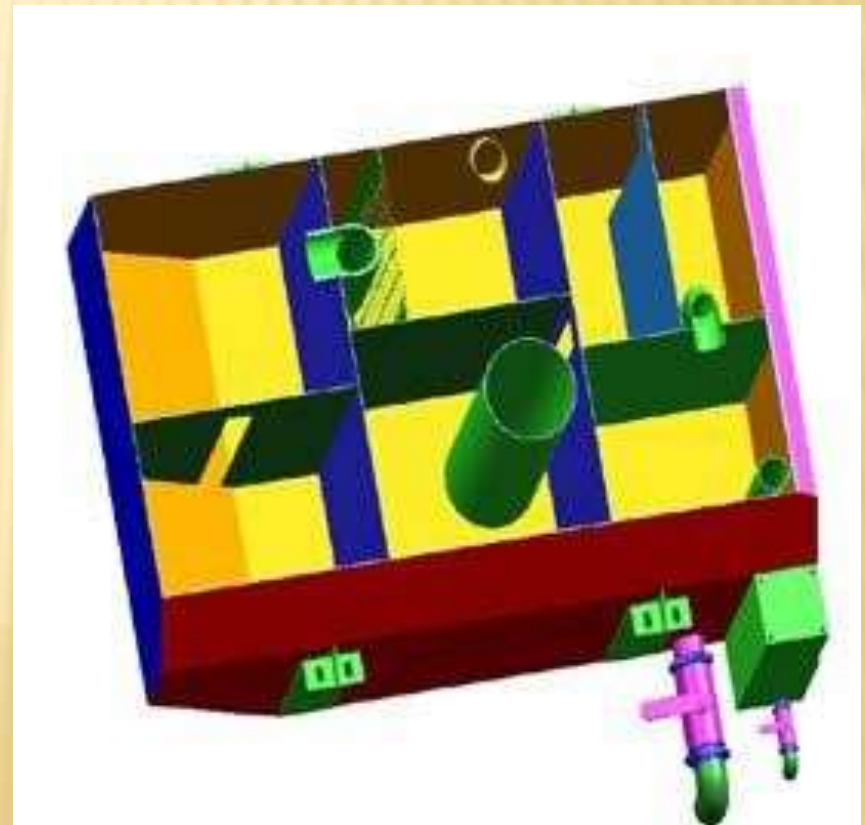
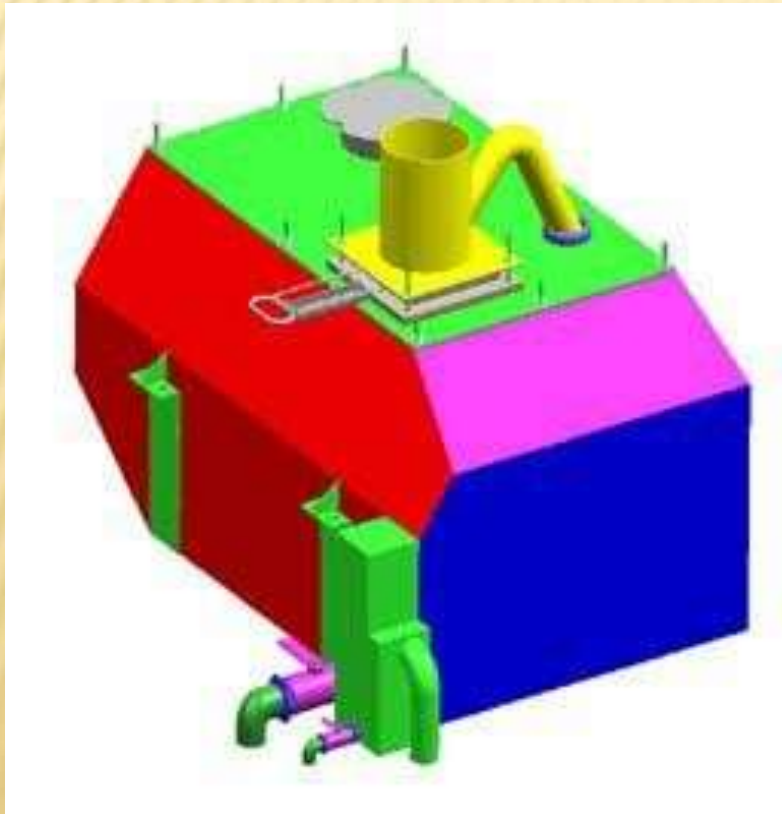
$CH_4 + CO_2$

VARIANT OF TANK SYSTEM:

- **Four design variants with Anaerobic process were jointly developed by IR & DRDO.**
- **Initially all these variant were undergone trial.**
- **Out of these for variant JWG selected 2nd variant on 01.04.2011.**
- **Originally selected variant get changed contd.**

•Variant-2

Brief description	Features			
	Pneumatic s	Electronics	PLC	Flush
System with manual slider valve	No	No	No	gravity



CONSTRUCTIONAL FEATURES OF BIO TOILET TANK

Main parts of Bio digester tank used in ICF/RCF coaches are:

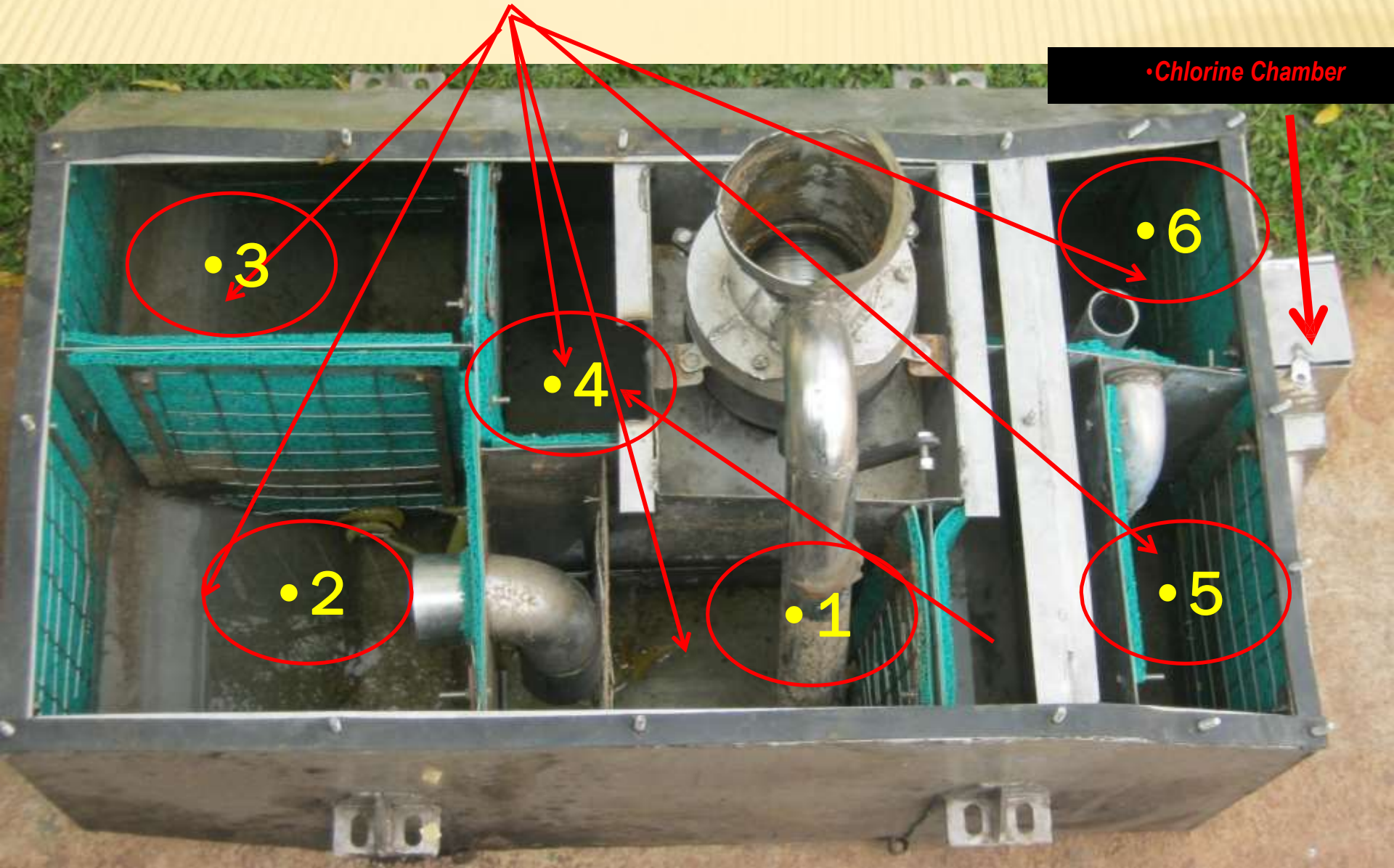
- ✖ Size of the tank is 540 x 720 x 1150 mm.**
- ✖ Empty Tank weight – 110 Kg.**
- ✖ Full Tank Weight – 410 Kg**
- ✖ Height from Rail level - 220 mm.**
- ✖ Mounting brackets-04 Nos.**
- ✖ No of M16 bolt/ mounting bracket – 02 nos.**

CONSTRUCTION OF BIO TOILET TANK

- All partitions are fixed with mats on both sides, with the help of these mats the anaerobic bacteria are set.
- On the outside wall of the tank a Chlorination chamber is fitted, to dispose of chlorinated water, this chamber is filled with chlorine tablets, which chlorinates the bio-degraded liquid.
- This liquid is non-hazardous and environmental friendly.

•Main parts of the Bio digester tank

1. Stainless steel tank with 06 partition walls

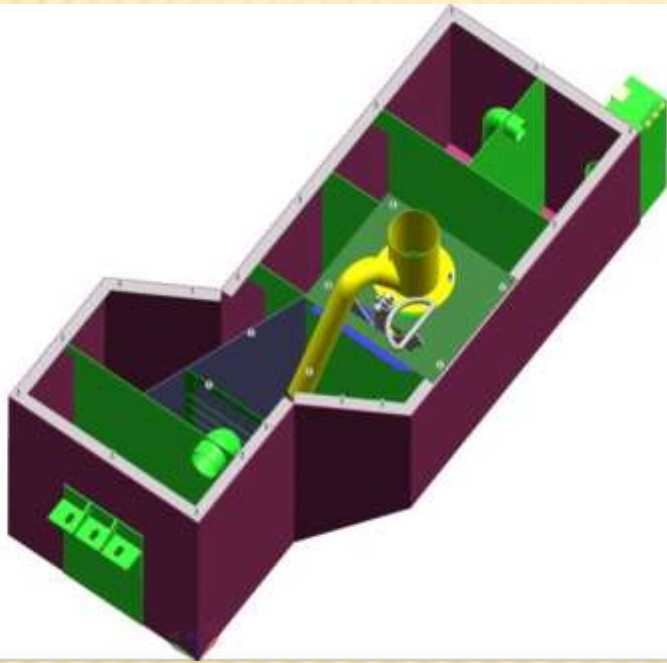


MAIN PARTS OF THE BIO DIGESTER TANK

Colonized rubber mats for nesting of Bacteria



DESIGN OF BIO-TOILET FOR LHB COACHES



CONSTRUCTIONAL FEATURE OF BIO-TOILET FOR LHB COACHES

Main parts of Bio digester tank used in LHB coaches are:

- ✖ **Size of the tank is 547 x 580 x 1680 mm.**
- ✖ **Stainless steel tank with 06 partition walls inside the tank.**
- ✖ **Poly grass mats for protection of bacteria inside the walls.**
- ✖ **SS fasteners in place of MS on tank covers.**
- ✖ **Stronger bonding of Colonized rubber mat with vertical walls**

CHANGES IN BIOTOILET (RETROFITMENT)

- ✖ 1. J type mounting bracket conversion to C type mounting bracket bolting type. At 12 th JWG decision was taken to C type mounting design. –
 - RDSO letter no CG-14053 alt 4. for ICF coaches.
 - RDSO letter no CG-14053 for LHB Coaches.
- ✖ AT 15 th JWG The S Trap design was adopted.
- ✖ IR in regard to RDSO L/no -MC/CB/LF Anaerobic dated 06.10.2017 decided to implement s trap in all coaches.
- ✖ Retrofitment work on conversion of P type to S type to be done as per drg CG 16008.(ICF) and RCF Drawing No. MI005710 Alt – ‘f’ (LHB).

PROVISION OF S-TRAP

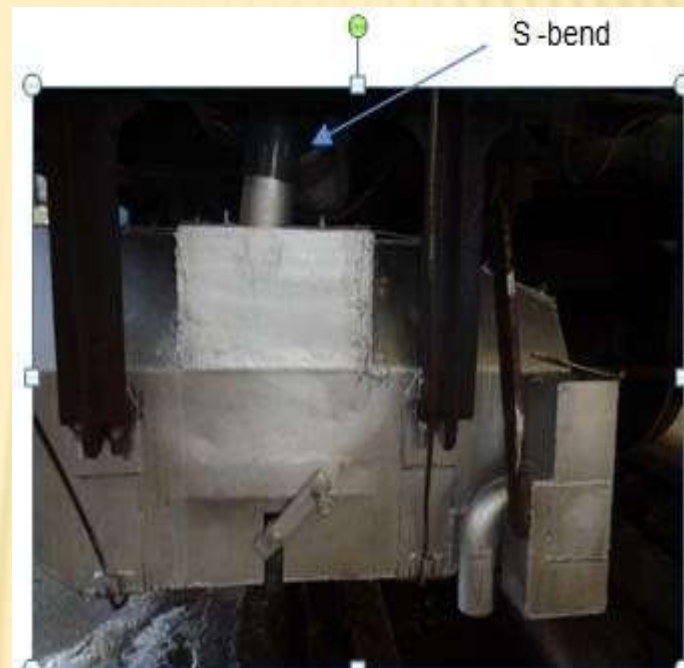
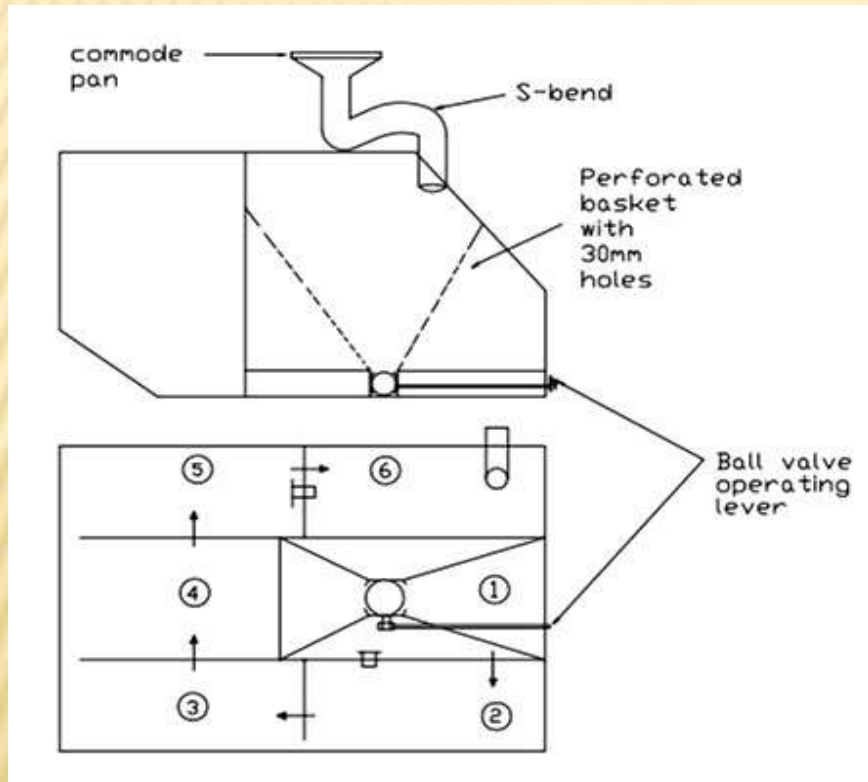
✕ Main feature of New Design are followings-

- a. Complete elimination of by-pass paddle, P-trap and flexible hose connector.
- b. In place of existing 60 mm diameter P-trap, a 'S' band of 100mm diameter is directly coupled to commode pan thus increasing flow area and streamline the waste flow into tank.
- c. First chamber is increased with available space of fourth chamber in existing design to increase volume and accommodate 'S' band.
- d. A perforated bucket of 30 mm diameter hole is provided just below the exit of 'S' band in first chamber to collect foreign objects and to pass the human waste to the tank through holes for decomposition by anaerobic bacteria present in the tank.
- e. The material of S-Trap is Poly ethyl vinyl Ester.

'S' TYPE DESIGN OF BIO DIGESTER TANK



'S' TYPE DESIGN OF BIO DIGESTER TANK



SAMPLING FOR TESTING OF EFFLUENT DISCHARGE

- 1. Sample shall be collected on quarterly basis & sent for testing**
- 2. Samples will be collected randomly—from lot of 5% coaches of the total coach holding but minimum one coach of each type – at an interval of every three months during the trial period.**
- 3. Sampling will start after coach has been in passenger service for 10 days or more. The samples should be collected and sealed in presence of Railway representative.**
- 4. At least one test every quarter shall be carried out in Govt. lab.**
- 5. In case the samples do not meet the requirements, test shall be repeated after taking necessary corrective action.**

PARAMETERS MONITORED

Parameter	Recommended Values
pH	6 to 9
COD	Max 1800 mgO₂/Litre
Fecal Coli Forms count	Less than 10⁷/100 ml

PREVENTIVE MAINTENANCE SCHEDULES

Trip Schedule:

- 1. Attending the routine complaints received from the users.**
- 2. Cleaning the toilet and choking to be removed ,if any.**
- 3. Checking the complete toilet system for any deficiency.**

Preventive Maintenance Schedules

× Schedule- A /Monthly examination:

- 1. All works carried out as mentioned in daily schedule.**
- 2. Visual examination of complete toilet system including under slung equipments.**
- 3. Charging of chlorine tablets and examination of chlorinator**

PREVENTIVE MAINTENANCE SCHEDULES

✧ Schedule-B/Quarterly examination:

- 1. All works carried out as mentioned in A- schedule.**
- 2. Collection and transportation of samples from retention tanks to DRDE, Gwalior or Nominated government accredited lab.**
- 3. Checking of following equipment for repair / replacement for proper functioning**
 - a. A flapper/Slider/Ball if available.**
 - b. B Leaking in piping system, flush system charging.**
 - c. Charging of Bio-culture, if required.**

LIST OF CLEANING AGENTS BEING USED IN MECHANIZED COACH CLEANING IN BIO-TOILET SYSTEM

SN	Locations	Name of chemicals used
1	PVC Floor Cleaning	Spiral (Johnson Diversey) or Sigla Neutral of Eco Lab
2	Ceramic Toilet fittings cleaning	Cleaning Taski R1/Taski R 6 (Johnson Diversey) or Sigla Neutral of Eco Lab .
3	Cleaning agent for commode pan & wall protector	Harpic/Retol/Domex
4	Glass Cleaning	Taski R3 (Johnson Diversey) or OC Glass cleaner of Eco Lab or Collin
5	Laminated Plastic Sheet & Berth Rexene cleaner:	Taski R7 (Johnson Diversey) or OC Neutral cleaner of Eco Lab or Collin
6	Painted Surface	Spiral (Johnson Diversey) or Absorbit of Eco Lab or Collin
7	Stainless Steel Polisher	Suma Inox (Johnson Diversey) or Chromol of Eco Lab or Collin
8	Disinfectant	Brands Stride (Johnson Diversey) or Antiback of EcoLab or Collin or Lizol .

Note: Revised specification/alternative brands can also be issued by Zonal Railways for achieving better performance.

IOH / NINE MONTHLY EXAMINATION

- 1. All works carried out as mentioned in B- schedule.**
- 2. Testing of all toilet system**
- 3. Tightening of all nuts and bolts for proper securing of tanks**
- 4. Drawing and delivering of samples for six monthly tests to Govt. labs**
- 5. Charging of Bio-culture if required based on Test reports**

WORKS TO BE CARRIED OUT IN POH:

- a. All the works to be carried out in half yearly schedule above (clause no. 5.6.4 of the RDSO /2010/CG/CMI-03); and
- b. Dismantling of retention tank for inspection and thorough cleaning. This will be required to be done in one tank of each variant to check general condition. In case condition requires, then all tanks will be removed and thoroughly cleaned.
- c. Charging of Bio-culture. Culture is supplied by DRDE/ IR.

Thank ‘ U’