IR-DRDO-Bio-toilets.

IR-DRDO Bio-Toilet System

- **An environment Friendly Toilet System**
- **Green toilet aims at – Zero – defection on the ground**

1. Discharge on track creates environmental problems as well as problem in working to work man.
2. A multi-directional strategy has been implemented for adoption in IR-Passenger Coaches.
3. MOU has been signed with DRDO for joint technology development
4. The first rake with bio-toilets developed with DRDO is running in Bundelkhand Express since 18th January -2011.
5. Five more rakes fitted with DRDO technology toilets have been allotted to NR, NCR, NER, NFR, CR, WR, WCR and SECR.
6. 2500 more coaches will be fitted with DRDO toilets during 2012-2013.

Advantage of IR-DRDO Bio-Digester

1. No bed smell in toilets from the tanks
2. No infestation of Cockroaches & flies
3. Fecal matter in the tank not visible
4. No clogging of digester
5. Effluent is free from off odour and solid waste
6. No maintenance required
7. Reduction in organic matter by 90%
8. No requirement of adding bacteria/ enzyme
9. No need of removal of solid waste

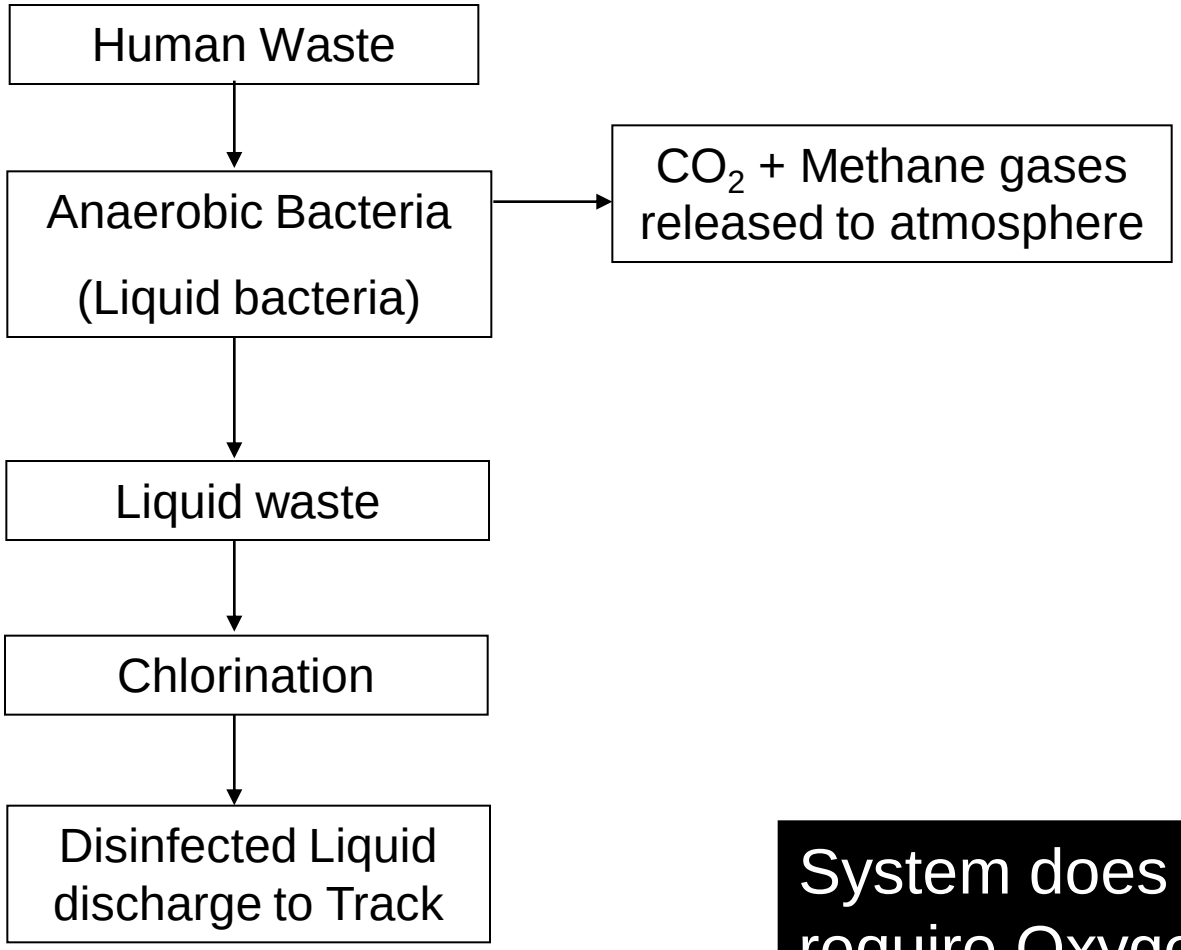
Benefits of Green Toilet

- **Environment friendly**
- **Preventing damages to tracks due to Corrosion**
- **Improved Aesthetics at Railway Stations**

Types of Environment Friendly toilets

1. **Bio-Toilets** – Bio-digester is provided, effluent is discharged on track after bio de-gradation.
2. **Vacuum Toilets** – Direct transport from the toilet bowl to the tank aided by vacuum creation in the tank and pipe line.
3. **Zero discharge toilet systems** – Waste is collected at terminus and processed, solid and liquid separation is done in the tank itself.

Working of Anaerobic System



System does not require Oxygen and also does not require regular cleaning

Brief about bacteria –aerobic/anaerobic

Anaerobic bacteria

- Can double its population within 6 to 8 hrs
- Dominates and decompose matter in to liquid and gases
  - Can be kept for two weeks at ambient temperature
  - Can withstand sub zero temperature as well as upto 60 degree centigrade
  - Cold temperature would not affect the inside processing because:

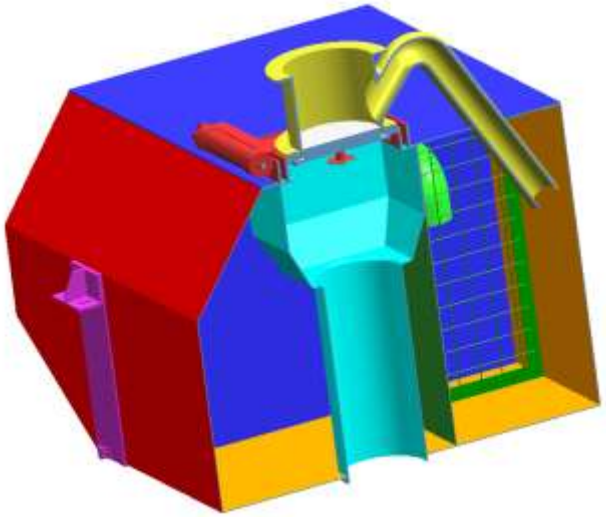
Anaerobic process is exothermic in nature thus, in cold regions heat will be available inside the chamber because of chemical process.

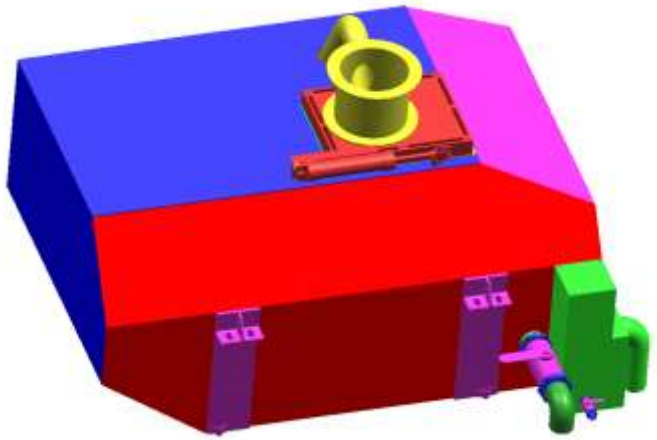
Status of DRDE Bio-Digester

- 46 nos Bio-Digester toilet system with DRDE technology were procured
  - 16 nos of PLC with flapper valve
  - 16 nos with manual slide valve
  - 11 nos with smaller opening
  - 17 nos with solid liquid separator (w.e.f. 16.08.2011)
- These have been fitted in train no 11107 /11108 Gwalior-Varanasi Bundelkhand Express w.e.f. 18.01.2011
- NC Rly has finalized the AMOC with M/s Darshan Enterprises, NDLS and M/s Mohan Rail Components KXH for their bio--digester for one year

Brief about different variants-01

Brief description	Features			
	Pneumatics	Electrics	PLC	Flush
System with flapper valve	Yes	Yes	Yes	Pressurized

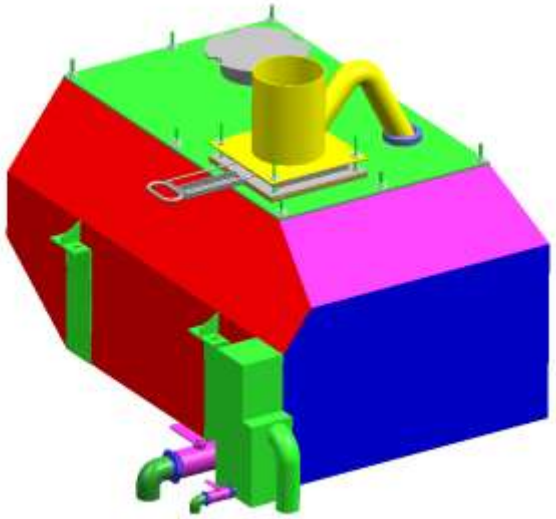


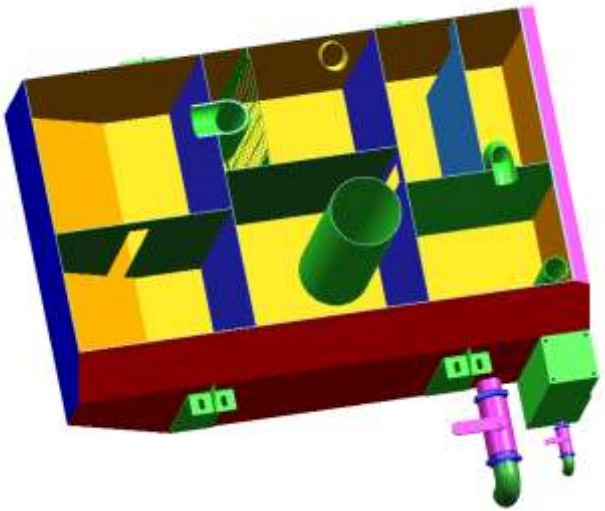


Fail safe mode exist- chute system can be operated without dismantling of tank

Brief about different variants -02

Brief description	Features			
	Pneumatics	Electrics	PLC	Flush
System with manual slider valve	no	no	no	gravity

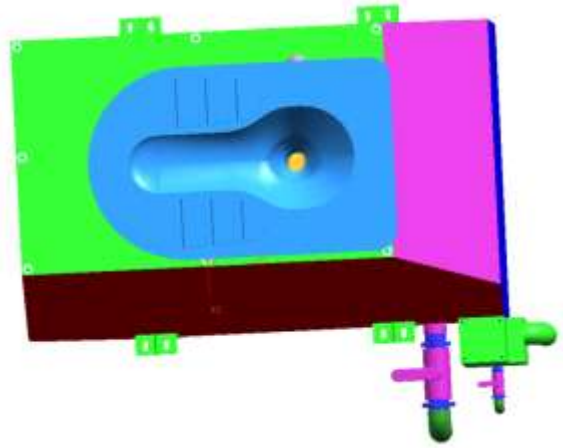


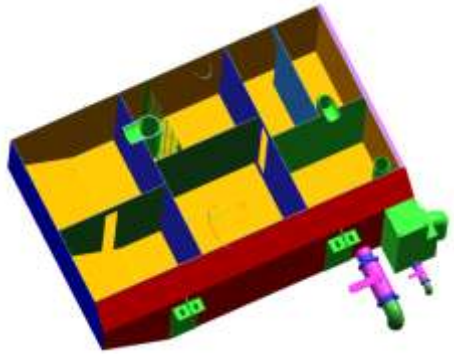


Fail safe mode exist- chute system can be operated without dismantling of tank

Brief about different variants-03

Brief description	Features			
	Pneumatics	Electrics	PLC	Flush
System with reduced opening at inlet For western style Hindware commode is proposed	no	no	no	gravity

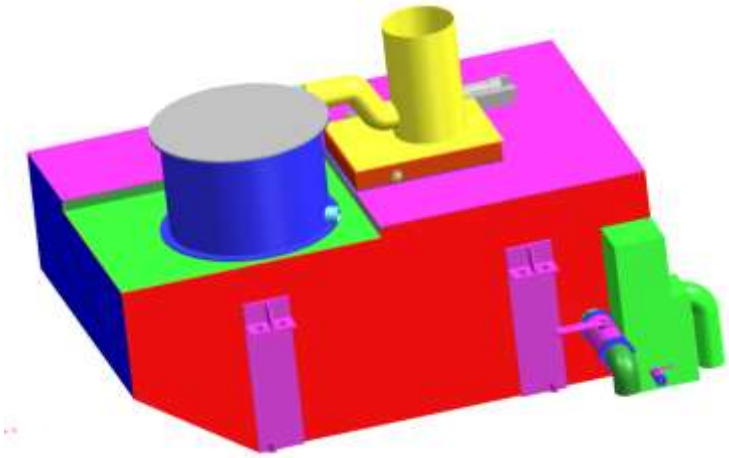


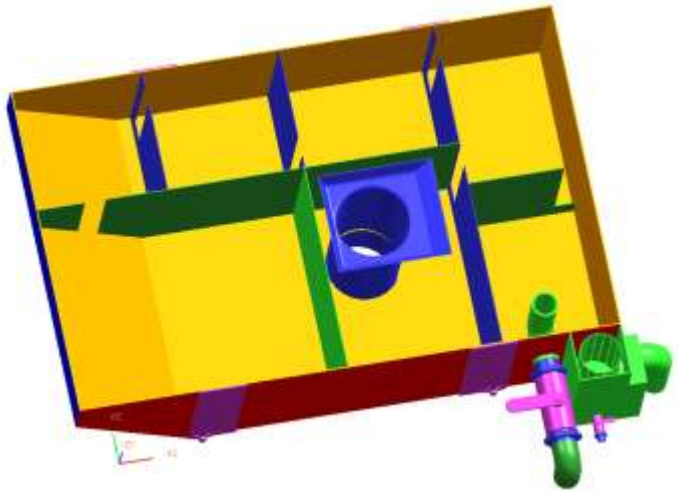


Fail safe mode does not exist

Brief about different variants-04

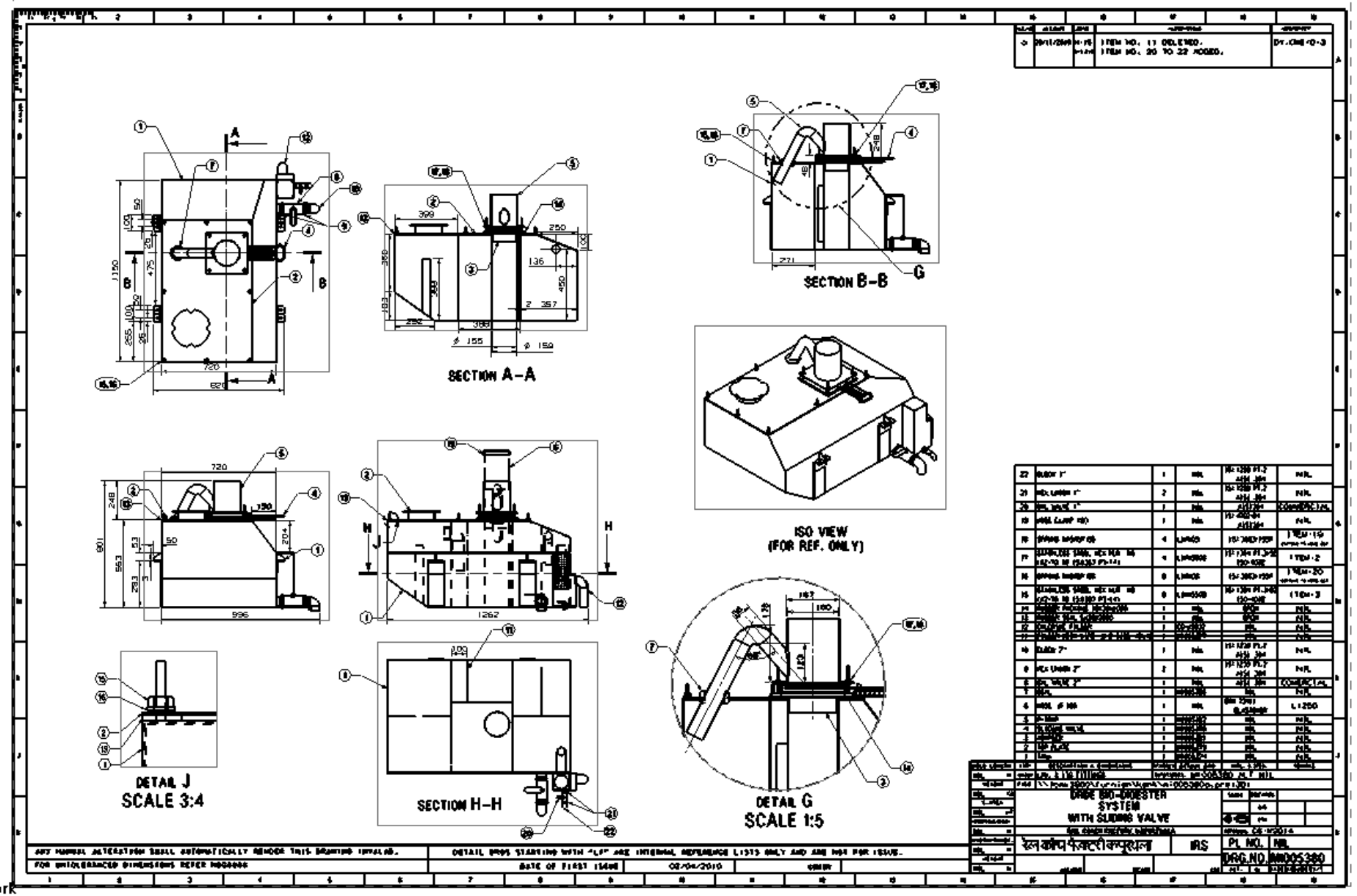
Brief description	Features			
	Pneumatics	Electrics	PLC	Flush
System with solid liquid separator	no	no	no	gravity





Fail safe mode exist- chute system can be operated without dismantling of tank

General Arrangement Drawings



DRDE Tank Mounting









Photographs of Bundelkhand express Bio toilets opened on 11.08.2011(Variant-I)





Photographs of Bundelkhand express Bio toilets opened on 11.08.2011(Variant –I)





Photographs of Bundelkhand express Bio toilets opened on 11.08.2011(Variant –2)







Photographs of Bundelkhand express Bio toilets opened on 11.08.2011(Variant –3)



Photographs of Bundelkhand express Bio toilets opened on 11.08.2011(Variant –3)





PILOT TRIALS ON TRAINS

S. No	Train Name	Coaches
1	Magadh Exp	7
2	Saraighat Exp	2
3	Azimabad Exp	2
4	Bundelkhand Exp	28
5	Chennai – Guwahati Exp	-
6	Gwalior-indore inter city Exp	-

Status of recent trials

Sn	Firm	Coach No./Train	No. of Toilets	Trial From	To
1	DRDE Gwalior (Anaerobic)	05207/Gwalior Barauni Mail & Magadh Exp.	4	June'06	Magadh removed
2	AIKON Ind. Faridabad (Aerobic)	New Delhi-Rewa Exp.	80	Jan'08	Working
3	ZDTS (IIT,Kanpur & Urbane Ind., Chennai)	SR 08224/Tr. No. 6094/6093	2	Feb'09	Working
4	Stone India Ltd (anaerobic)	ER94251 & ER98210 Tr. No. 2345 (HWH-Saraighat Exp.)	2+2	11.06.09 & 25.07.09	Working
5	Kemrock Vadodara (Aneaerobic)	WR 952630 WGSCN, Tr. No. 2947/2948	2	19.08.09	Working
6	IRZ prototype Vacuum Toilets	In the workshop	1	Dec'09	Under the workshop trials

INSTRUCTIONS FOR PRESSURISED CLEANING OF BIOTOILETS:

Cleaning of dirt and muck from the following identified locations, disinfection and drying. With a suitable HP Jet action & Detergents & manually, following shall be cleaned:

INSTRUCTIONS FOR PRESSURISED CLEANING OF BIOTOILETS (contd….)

- Dirt and cobweb formed on the ceiling
- Dirt formed on both sides of the lavatory main door.
- Dirt formed on the side panel on which the lavatory door overlaps.



INSTRUCTIONS FOR PRESSURISED CLEANING OF BIOTOILETS (contd….)

- Muck accumulated behind the wall protectors.



- Muck accumulated on the sides of footrest of the squatting pan.

- Muck accumulated in the wash basin inside the toilet

INSTRUCTIONS FOR PRESSURISED CLEANING OF BIOTOILETS (contd….)

- Muck accumulated on the space below the wash basin.
- Dirt and muck accumulated on the frosted glasses and frame.
- Muck formed on the mirror stand, soap tray and plumbing’s.

INSTRUCTIONS FOR PRESSURISED CLEANING OF BIOTOILETS (contd….)

- Door and side walls above waist level should not be hosed with water, but should be thoroughly cleaned with cloth dipped in detergent solution taking care that no water goes into the mirrors.
- The sidewalls below waist level and the banjo shutters should be thoroughly cleaned with soft soap / cleaning solution and cleaned with water by hand or portable sprayer.
- All dirty spots should be removed with the use of detergent.
- The ceiling and sidewalls should thereafter be wiped dry.
- There should be minimum usage of water.

INSTRUCTIONS FOR PRESSURISED CLEANING OF BIOTOILETS (contd….)

- Cleaning of wash basin



- The mirror should be wiped with a dry duster and if necessary, cleaned with detergent solution and again wiped dry. There should be no scratch mark on the mirror. Porcelain wash basins should be cleaned with detergent powder and wiped dry with duster and stainless steel wash basins should be cleaned with detergent. The porcelain and stainless steel wash basins and lavatory pans should be sparkling clean.

INSTRUCTIONS FOR PRESSURISED CLEANING OF BIOTOILETS (contd….)

- The lavatory floor should be first scrubbed with hand brush & detergent and then jet washed with HP Jet machine and vacuum dried.

- The European style commode should also be washed with suitable detergent & brushed. The plastic commode lid & seat and covers should be washed with detergent & hand brush and wiped dry.

- The commode chutes should be cleaned with a HP Jet or with circular brush throughout its length.



SPECIFIC INSTRUCTIONS FOR PRESSURISED CLEANING OF BIO-TOILETS-

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 have already been issued by RDSO under guidelines for AMOC for Bio-toilets (DRDE type).

Maintenance of the Bio-toilet systems and Guidelines for handling of Bacteria Culture

- Visual inspection of complete toilets system including under slung equipments.
- Toilet chute to be cleared in bio-toilets if there is chocking.
- 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.

Maintenance of the Bio-toilet systems and Guidelines for handling of Bacteria Culture (Contd...

- Charging of chlorine tablets 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, PLC, pneumatic valves, ball valves etc.
- Charging of Bio-culture if required (based on test reports).Culture will be supplied by DRDE/GWL.

(Issued by the RDSO document no. RDSO/2010/CG/CMI-03(Rev.1)

Guidelines for coaching depots for handling of Bacteria

- Wear gloves while handling bacterial culture.
- Store bacterial culture in containers with lid which can be closed.
- During transportation, lids should be tightly closed.
- During storage, lids should be kept loose so that the gas generated inside the container can escape easily otherwise container will get damaged physically.

Guidelines for coaching depot for handling of bacteria (Contd….

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

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

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

Mechanised Cleaning Instructions

The Railways are advised to utilize following types of cleaning machines comprising state of the art technology using least Water & Electricity for mechanized cleaning in CTS and house keeping of coaches. The types of machines to be used are:

1. Portable Type High Pressure Jet Machine.
2. Portable Type Single Disc Mini Scrubber & scrubber drier
3. Portable Type Wet & Dry Vacuum Cleaner.
4. Buffing machine

Portable Type High Pressure Jet Machine.

Some of the important specifications/ features/guidelines for machines are as follows:

The High pressure machine shall have the following in-built features:

a. High Pressure Nozzle with Frequency of Rotation of turbine 100 cycles per sec. The machine shall have motor mounted vertically on reciprocating type pump having Ceramic pistons. The pump shall be made of brass cylinder head. The machine shall be user friendly, lightweight having separate Detergent Injector, Power Saving 4 min. Automatic Start - Stop , Rubber tyre, Wheel Mounted Trolley, Manometer, Double Lance,4 Stage filters etc.

b. The high-pressure machine shall be supplied with necessary attachment, which can clean drains & internal spaces etc.

c. The machine shall be made of anti-corrosive body preferably ABS plastic, Galvanized Stainless Steel, Rust & Corrosion Free Body Frame. The machine shall have all the protection devices such as Overloading Protection, Overheating Protection etc.

d. The mechanized system shall have a facility of detergent or chemical injector built in for effective cleaning.

e. The mechanized system shall also have 0 to 180 bar Continuously Variable Pressure Regulator.

f. The machine shall have a maximum Water discharge rate of 10 to 15 liters/minute.

g. The mechanized systems for washing tracks shall not draw a load of more than 3 KW i.e.13 to 15 amps.

h. The machine shall have a facility of self-priming of 1.5 to 3 meters head.

i. The machine shall work on a maximum inlet water temperature of 60 deg C.

j. The weight of the machine shall not be more than 50 to 60 kgs.

Portable Type Single Disc Mini Scrubber and Scrubber Drier

Single Disc scrubber cum sprayer shall be miniature in size so as to reach underneath the berths in coaches. The machine shall be equipped with all the safety devices & fittings so as to be able to clean the floor area intensively.

The technical specifications of this machine shall be as follows:-

Pad speed …….. ……. -minimum of 180 rpm

Working width …….. …… -not more than 330 mm, 13”

Weight …….. ……. -not more than 20 to 25 kg

Motor …….. ……... -approximately 500 watts

Productivity: ……. …. -600-800 sq meter/Hr

The scrubber drier shall be of similar Productivity with drier to immediately dry the floor.

Portable Type Wet & Dry Vacuum Cleaner

It should be a rugged and reliable wet & dry carpet extractor single phase vacuum cleaner having accessories for effective cleaning in wet, dry & Carpet extractor conditions. This machine should be supplied with accessories such as T – nozzle, Flexible intake tube, Carpet/Floor brush, Crevice tool, Large transparent ‘wash-dry’ attachment, Small transparent ‘wash-dry’ attachment, Insert for hard floors, Round dusting brush, Rigid extension tubes, Detergent bottle.

The machine shall have following in-built features & specifications:

- The suction cleaner shall be multi purpose industrial type, durable, having steel tank for anti-corrosion, portable, rugged in design with durable steel reinforced rubber hose.
- It should have the facility to lift the motor separately for maintenance purposes.
- The suction cleaner shall have an Air flow of 30 –40 ltrs. /sec. with hose
- The suction cleaner shall have a Vacuum of 2000-2500 mm/Kg.
- The suction cleaner shall have a Container Volume 10-12 ltrs for dry and 5-7 for wet.
- The suction cleaner shall not be more than 30-40 kg in weight.
- The suction cleaner shall have a minimum of 8-10 mtrs cable length.
- The suction cleaner shall be equipped with lightweight plastic extension tubes for overhead cleaning.

List of cleaning agents used in Mechanized Coach cleaning

Sr.N	Locations	Name of chemicals used
1	PVC Floor Cleaning	Spiral (Johnson Diversey) or Sigla Neutral of Eco Lab
2	Ceramic Toilet fittings cleaning	Taski R1/Taski R 6 (Johnson Diversey) or Sigla Neutral of Eco Lab
3	Cleaning agent for commode pan & wall protector	Harpic/Retoil/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 Eco Lab or Collin or Lizol

Evaluation by DRDE of Cleaning Agents provided by Railway

S No	Treatments	Cumulative Biogas (ml)	pH	% COD Reduction	Total VFA (mM)
			42 days	42 days	42 days
1	**control**	**16790**	**7.61**	**94.72**	**1.26**
2	Harpic 100ppm	15820 (94%)	7.54	84.08	1.08
3	Harpic 250ppm	14750	6.50	76.28	4.70
4	Domex 100ppm	14660	7.23	93.55	0.923
5	Domex 250ppm	13620	6.33	74.78	2.19
6	Lizol 100ppm	14340	7.28	85.58	1.83
7	Lizol 250ppm	14250	6.27	58.38	5.00
8	R7 cleaner 100ppm	16030	7.20	77.77	1.22
9	R7 cleaner 250ppm	14210	6.26	45.29	9.16
10	PVC floor cleaner 100ppm	14320	7.31	82.32	1.31
11	PVC floor cleaner 250ppm	14070 (83%)	6.46	62.32	4.94
12	Toilet cleaner 100ppm	15450	7.50	77.92	1.28
13	Toilet cleaner 250ppm	14550	6.51	69.71	3.57

Conclusion: All the six chemicals do not show any deleterious effect on biodegradation up to 100 ppm during 42 day study period

Testing Kit required for effluent of Bio-toilet

pH Value	
Purpose	To measure pH value of the effluent **of bio toilets to ensure environmental safety.**
Target value	**6 - 9**
Equipments	Table top pH meter / Portable pH meter / pH indicator strips & magnetic stirrer
Consumables	pH calibration buffers (4.0, 7.0, 10.0), and magnetic stirrer bars
Quantity of sample	**50-100 ml**
Electricity Requirement	Yes
Frequency of sampling	**30 days**
Testing spot	In laboratory at site
Staff required	1

Effluent parameter Analysis, instruments specifications and approximate cost

Instrument	Specifications	Approximate Cost (Rs)
Table top pH meter	**Ph accuracy** – 0.01 units, **Calibration** – up to 3 points with auto buffer recognition, **Display** – large dual line, **Temperature compensation** – Automatic/manual 0 - 100°C, **Memory** – 50 data sets, **Power requirements** – 220 V **Warranty** – 1 Year for instrument and 6 months for electrode.	25,000
Portable pH meter	**Ph accuracy** – 0.01 units, **Calibration** – up to 2 points with auto buffer recognition, **Temperature compensation** – Automatic/manual 0 - 100°C, **Power requirements** –Battery operated, Auto power off for 10 minutes. **Warranty** – 1 Year for instrument and 6 months for electrode.	5000

pH

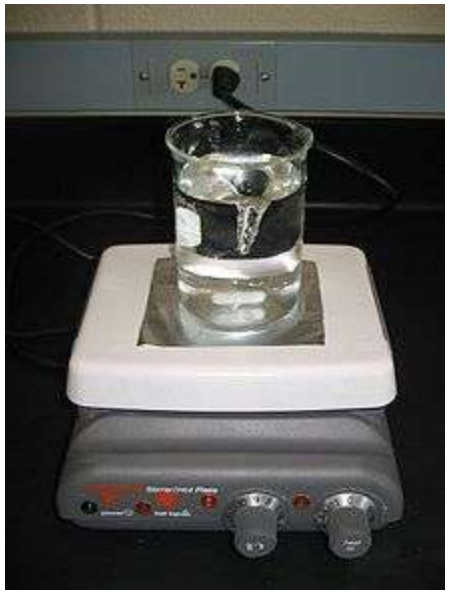
Bench top pH meter



Portable pH meter



pH



Magnetic stirrer



Magnetic bars



pH indicator strips

Testing Kit required for effluent of Bio-toilet

Total Solid (TS)	
Purpose	To estimate amount of total solids in the effluent.
Set Target	**<750 mg /100 ml**
Equipments	Electronic weighing balance, pipettes, Silica crucible, Hot air oven, desiccators.
Consumables	Self indicating silica gel.
Quantity of sample	**25 ml**
Electricity requirement	Yes
Frequency of sampling	**30 days**
Testing spot	In laboratory
Staff required	1

Effluent parameter Analysis instruments specifications and approximate cost

Instrument	Specifications	Approximate Cost (Rs)
Hot air oven	**Temperature –** Up to 250°C, **Temp control** – Thermostatic ± 2°C, **Oven** – Double walled Aluminum/SS, outside MS with epoxy coating. **Shelves** –Wire mesh shelves. **Door** – With synthetic rubber gasket. **Air circulation Fan** – present. **Size** – 455 mm x 455 mm x 455 mm (W x D x H)	40,000

SOLIDS (TS)



HOT AIR OVEN



Dessicator

SOLIDS (TS)



Silica crucible



Micropipettes



Weighing balance

Testing Kit required for effluent of Bio-toilet

Total Dissolved Solids (TDS)	
Purpose	To estimate amount of total dissolved solids in the effluent.
Target value	**< 350 mg /100 ml**
Equipments	Electronic weighing balance, pipettes, Silica crucibles, Hot air oven, desiccators, filter assembly, vacuum pump
Consumable	Self indicating silica gel. Whatman Glass wool filters
Quantity of sample	**25 ml**
Electricity requirement	Yes
Frequency of sampling	**30 days**
Testing spot	Laboratory
Staff required	1

Effluent parameter Analysis instruments specifications and approximate cost

Instrument	Specifications	Approximate Cost (Rs)
Filtering flask assembly	**Assembly** – SS/ Glass. **Filter Dia**- 47 mm. **Filtration area :** 5 -10 cm^2. **Size** – 15-20 cm X 5-10 cm **Out let** – No. 8 perforated silicone **Volume -** 500 ml **Stopper** – mounted on 1 L Glass vessel	10,000

SOLIDS (TDS)



Silica crucible



Micropipettes



Filter assembly



Weighing balance



Hot air oven



Dessicator

Testing Kit required for effluent of Bio-toilet

Total Volatile Solids (TVS)	
Purpose	To estimate amount of total volatile solids available in the effluent.
Target value	**< 500 mg /100 ml**
Equipments	Electronic weighing balance, pipettes, Silica crucibles, Hot air oven, muffle furnace, desiccators, filter assembly.
Consumable	Self indicating silica gel. Whatman Glass wool filters
Quantity of sample	**25 ml**
Electricity requirement	Yes
Frequency of sampling	**30 days**
Testing spot	Laboratory
Staff required	1

Effluent parameter Analysis instruments specifications and approximate cost

Instrument	Specifications	Approximate Cost (Rs)
Filtering flask assembly	**Assembly** – SS/ Glass. **Filter Dia**- 47 mm. **Filtration area :** 5 -10 cm^2. **Size** – 15-20 cm X 5-10 cm **Out let** – No. 8 perforated silicone **Volume -** 500 ml **Stopper** – mounted on 1 L Glass vessel	10,000
Muffle Furnace	**Size –** 125 mm x 125 mm x 300 mm (W x D x H) **Power –** 3.0 KW **Temperature –** Up to 900°C, **Outer Casting** – MS with epoxy coating. **Temp Control** – Digital Temperature controller cum indicator. **Heating element**- Kanthal wire/ special high temperature alloy	25,000

SOLIDS (VS)



Silica crucible



Micropipettes



Weighing balance



MUFFLE FURNACE



Desiccator

Testing Kit required for effluent of Bio-toilet

Chemical Oxygen Demand (COD)	
Purpose	To estimate COD of the effluent **to ensure environmental parameters.**
Target value	**< 2000 mg O_2 / 100 litres**
Equipments	COD digester along with digestion tubes and condensers, Burettes, magnetic stirrer, magnetic bars.
Consumable	Sulphuric Acid, Silver sulphate, mercuric chloride, potassium dichromate, ferroin indicator, ferrous ammonium sulphate.
Quantity of sample	**5-10 ml of sample**
Electricity requirement	Yes
Frequency of sampling	**30 days**
Testing spot	Laboratory/ DRDE/ Govt. approved Labs.
Staff required	2

Effluent parameter Analysis instruments specifications and approximate cost

Instrument	Specifications	Approximate Cost (Rs)
COD Digester	**Controller –** Microprocessor Based Digital Temperature Indicator cum Controller **Display –** LED with set value (SV) and process value (PV) **Block Dimensions (WxDxH) in mm-** 270 mm(L) x 150 mm(W) x 70 mm(D) **Heater Load –** 1.0 KW **Tube cavity –** 40 mm(Φ)x 65 mm (D) **No. of cavities –** 15 holes to accommodate 15 samples **Glass Tube Size –** Supplied with 15 Nos of glass tubes of size 38 mm (Φ)x 200 mm (Length) **Glass Air Condenser Size** – 15 nos. of air condensers of 600 mm length each. **Temperature Range**–Ambient+5°C to150 °C **Temperature Accuracy –** ±1 °C **Sensor –** RTD (Pt- 100) **Material –** External Power Coated CRC Steel **Block –** Polished Aluminum **Tube Rack -**1 No. **Power Supply –** 230 V AC, 50/60 Hz. **Optional –** spare digestion tubes (15 No.) Tube rack (1 No.)	42,000
	Lab coact and Hand Gloves	

Chemical Oxygen Demand





COD DIGESTION APPARATUS

Testing Kit required for effluent of Bio-toilet

Fecal Coli Forms count	
Purpose	To estimate the fecal coli form bacteria count on effluent.
Target value	**> 99% reduction (Less than 10^8/100 ML**
Equipments	Laminar Air Flow Chamber, Incubator
Consumable	Test tubes, FC media plates, spreaders, pipettes, conical flasks, Glass marker, magnetic stirrer.
Quantity of sample	**10 ml**
Electricity requirement	Yes
Frequency of sampling	**30 days**
Testing spot	Laboratory/ Govt. Labs. only
Staff required	2

Effluent parameter Analysis instruments specifications and approximate cost

Instrument	Specifications	Approximate Cost (Rs)
Laminar air flow chamber	**Size –** 1200 mm x 600 mm x 600 mm (L x W x D) **Door –** Acrylic **Light –** Both UV and Flourescent **Outer casting –** Duro board / SS 304. **Filter –** HEPA with 0.3 µm pore size. **Accessories:** Cock for Gas/vacuum line, Bunsen burner	1,50,000
Incubator	**Temperature –** Ambient to 60 °C. **Temp Control** – Thermostatic ± 1°C **Size –** 450 mm x 450 mm x 600 mm (LxWxD) **Heating elements:** Bottom. **Casing –** inside – Double walled Aluminium/SS, outside – MS with epoxy coating **Door –** Glass window and with synthetic rubber gasket. **Shelves –** Wire mesh shelves, **Power –** 240 V AC **Air circulation Fan –** Present.	40,000

Fecal Coli Form Count



Laminar air flow chamber



BOD incubator

Testing Kit required at Inoculum Generation Plant

pH Value	
Purpose	To measure pH value of the effluent **of bio toilets to ensure environmental safety.**
Target value	**6.5 – 7.5 pH**
Equipments	Table top pH meter / Portable pH meter / pH indicator strips & magnetic stirrer
Consumables	pH calibration buffers (4.0, 7.0, 10.0), and magnetic paper for pH testing
Quantity of sample	**50-100 ml**
Electricity Requirement	Yes
Frequency of sampling	**30 days**
Testing spot	In laboratory at site
Staff required	1

Testing Kit required at Inoculum Generation Plant

Bio-gas production	
Purpose	To see the activity of various groups of Microbes in the inoculum
Set Target	-
Equipments	Gas Flowmeter
Other equipment	Gas flowmeter flexible pipe & adopter
Frequency of sampling	**Daily**
Testing spot	Inoculum Generation plant.
Staff required	1

Testing Kit required at Inoculum Generation Plant

Methane % Test	
Purpose	To see the methane content of the biogas in side the plant
Set Target	**40 – 70 %**
Equipments	Gas Chromatograph
Quantity of sample	**10 – 15 ml of gas**
Frequency of sampling	**Weekly Testing**
Testing spot	In laboratory
Staff required	1

Testing Kit required at Inoculum Generation Plant

4. MPN for methanogens	
Purpose	To see the methanogenic bacteria count in the inoculum
Set Target	**1000/ML**
Equipments	Gas Chromatograph, Laminar Air Flow Chamber, Incubator, Sealer, Desealer
Quantity of sample	**10 – 15 ml of gas**
Frequency of sampling	**Once in a month**
Testing spot	In laboratory inside Laminar air flow chamber
Staff required	2

Performance Parameters Effluent:

SN	Parameter (as per APHA Test Method).	Recommended Values for next six months	Targeted value (Max.)
1	**pH**	6 to 9	6 to 9
2	**Total Solids**	Max 750mg/100 ml	750mg/100ml
3.	**Total Volatile solids**	Max 500 mg/100 ml	500 mg/100 ml
4	**Total Dissolved solids**	Max 350mg/100ml	350mg/100ml
5	**COD levels**	Max 2000 MgO_2/Lts	Max 2000 MgO_2/Lts
6	Fecal Coli Forms count	99% Red(Less than 10^8/100ml)	

Performance Parameters Inoculum:

SN.	Parameter (as per APHA Test Method).	Recommended Values
1	**pH**	6.5 -7.5
2.	**Bio-Gas Test**	--
3.	**Percentage methane**	40-70%
4.	**MPN count for methanogens**	Max. 1000/ml

TRAIL TEST SCHEME FOR FIELD TRIAL OF BIO-TOILETS (Issued by RDSO (DOC No. RDSO/ 2010/ CG/Ts-Rev-02) May-2011)

Visual Inspection during field Trial

Date of Inspection ---------- Type of coach ----------

1. Thorough inspection of mounting/ securing arrangement for Bio-digester tank
2. Any leakage in joints/ connections in the complete system including retention tank and water pipe line
3. Adequacy of the provisions made for segregation of non Bio-degradable items
4. Functionality of flush buttons & water tabs
5. Adequacy of flushing of the pan –

   A. By using pressurized flushing

   B. By normal manual flushing
6. Any mal odour / stench : (yes/no), if yes , please specify light, medium or heavy
7. Overall cleanliness level of the toilet room
8. Notices for users and maintenance personnel in Hindi, English & regional language of the originating and destination station

Contd…

9. Performance of non-bio-degradable waste ejection system: Its effectiveness and reliability

   A- Working satisfactorily (Yes/ No), if no, give reason & remarks for malfunctioning

   B- Choking of toilet pan (Yes/ No) if yes, give reason

10. Tank evacuation date (if any) with coach no. and date

11. Details of attention/ maintenance required with coach no., date & time taken

12. Adequacy of strength & capacity of waste treatment tank

13. Chocking of P-trap (yes/no) if yes, give reason & attended or not

14. Availability and operation of flapper / Ball valve

Testing of Effluent Discharge

1. Sample shall be collected on monthly basis & sent for testing
2. One sample from each coach will be collected every month
3. Sampling will start after coach has been in passenger service for 10 days or more
4. The samples should be collected and sealed in presence of Railway representative.
5. Atleast one test every quarter shall be carried out in Govt. lab.
6. In case the samples do not meet the requirements, test shall be repeated after taking necessary corrective actions within a fortnight .

Procedure of Sampling

1. The sample shall be collected in 1 litre plastic bottle by simply opening the knob provided in the sampling port
2. The date and time of sampling and coach no. must be mentioned on the bottle
3. The sample collected in the bottle shall be transported to lab at the earliest but not later than 24 hours after collection of sample
4. The test results shall be furnished in prescribed format – Annexure-I
5. Consolidated trial report shall be sent by monitoring railway to RDSO at the end of prescribed trial period

Procedure of Sampling

Proforma forAnnexure-I

Date of Sampling **Date of lab testing**

Coach No	Variant of Bio–digester	Observations/ Results					
		pH value	Total solids	TDS	Total volatile solids	COD level	Fecal coli forms Count
Target Value		6 to 9 pH	＜750 mg/100ml	＜350 mg/100 ml	＜500 mg/100ml	＜2000 mg o2/litre	＞99% reduction (less than 10^8/100 ml

Thank You