





First Passenger complaint

Okhil Babu's letter to the Railway Department in 1909

"I am arrive by passenger train Ahmedpur station and my belly is too much swelling with jackfruit. I am therefore went to privy. Just I doing the nuisance that guard making whistle blow for train to go off and I am running with 'lotah' in one hand and 'dhoti' in the next when I am fall over and expose all my shocking to man and female women on plateform. I am got leaved at Ahmedpur station.

This too much bad, if passenger go to make dung that dam guard not wait train five minutes for him. I am therefore pray your honour to make big fine on that guard for public sake. Otherwise I am making big report to papers."

Okhil Chandra Sen wrote this letter to the Sahibganj divisional railway office in 1909.

It is on display at the Railway Museum in NewDelhi.



Concerns....????

- Can old age Open defecation accepted in 21st century?
- Can hygiene be relegated?
- Can manual scavenging be allowed?
- Is there any technical viable solution?
- How long it will take to implement viable solution?



Need for Environment Friendly Toilets

- Unacceptable hygiene conditions, particularly at railway stations
- Preventing damages to tracks by way of corrosion
- Likeable sights at stations
- Environmental friendliness
- Eliminating manual scavenging

Ministry of Rural Development, Government of India, through its policy documents, has also decided to have total sanitation in the country and completely eliminate the practices leading to open defecation.



Challenges in implementation

- Not-so-disciplined Indian toilet habits
- To cater requirements of long distances
- Separating non-degradable waste
- IR maintenance practices - Minimum peripheral such as air and electricity
- Easy for retro fitment for Wide scale proliferation of technology



Efforts taken by IR so far

Description of Toilet system	Environment friendliness
Direct discharge type toilet system since long	No
Biological Sewage treatment toilet system Microphor, USA by ICF in 1993 Fitted by ICF on 2 ACCW and 6 GS coaches in 1993	Yes
Vacuum Toilet system EVAC, Sweden by RCF in 1995 Fitted by RCF in one IRZ coach, has Extensive High end technology and frequent post treatment	Yes
Macerated & chemically treated toilet system Rail Tech, Canada by RCF in 1998 Fitted by RCF on 8 conventional coaches in 1998	No



Efforts taken by IR so far

Description of Toilet system	Environment friendliness
Controlled Discharge Toilet System Since 2000-01	No
Aerobic type biological Toilet M/s Aikon in Rewa Express 68 toilets Since 2009-10	Yes
Zero Discharge Toilet System IIT, Kanpur water recycling project Frequent post treatment	Yes
Anaerobic bio-toilet Since 2011 MoU between DRDE and IR	Yes

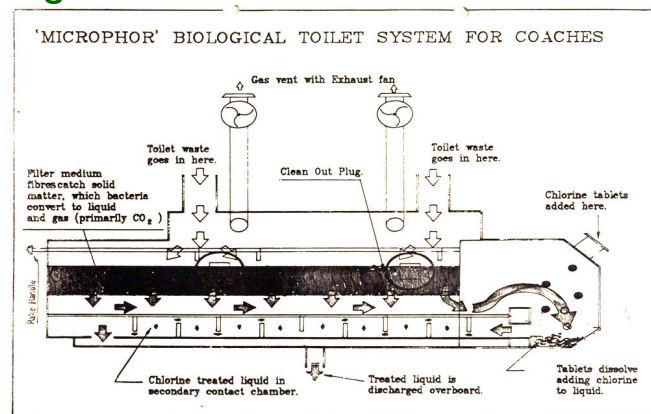


Biological sewage treatment toilet system

Single tank was mounted below end lavatories covering full width of coach.

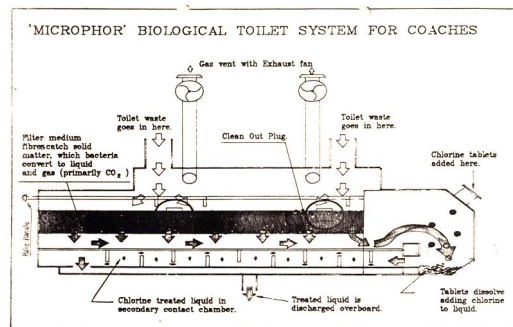
Upper section of the tank receives waste.

Filter medium with fibers kept to hold semi-solid waste and liquid passes through it to chlorinator and then to sterilizing tank.





Biological sewage treatment toilet system



Limitations:

- Blocking of system due to plastic cups, bottles, coconut, metal parts etc.
- Draft gear could not be inspected from bottom
- Bacteriological system sensitive to toilet cleaning agents like phenyl.
- Cockroaches & flies infestation.
- Regular dosing with Bacteria and enzymes
- Manual removal of residual solid waste.

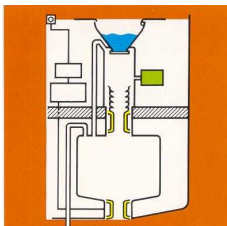


Macerated & chemically treated toilet system

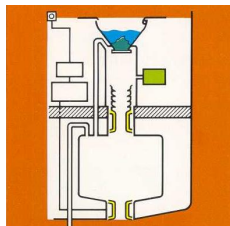
- Similar to CDTs.
- Effluent goes into a maceration chamber directly under the bowl.
- Macerated by violent blending of air, water and chemicals for 70 seconds.
- Then dumps into retention tank, which holds effluent below speed of 35 KMPH.



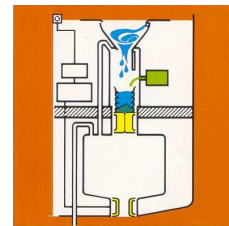
Macerated & chemically treated toilet system



System Ready
Flapper assembly closed, small quantity of water in bowl



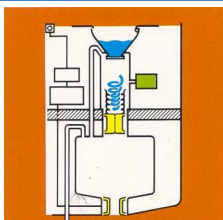
Just Used
Effluent contained in upper bowl, similar to domestic toilet



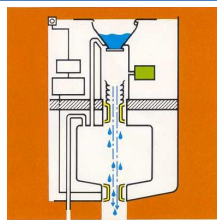
Flush Button Pressed
Yellow valve closes,
Flap valve opens,
Chemical dispensed,
Water valve opens
allowing water to clean
& flush waste



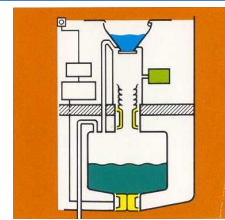
Macerated & chemically treated toilet system



Maceration & treatment
 Flush valve closed, Air under pressure injected, violent blending of air, water and chemicals for 70 seconds



Direct Discharge
 Pinch valve opens, expels macerated & treated effluent onto roadbed



Retention upto 35 KMPH
 Effluent retained in tank, will be discharged when restriction is removed

Limitations:

- Å No working in the event of loco changeover/failure and stabilizing in platform.
- Å Theft of aluminium flushes knobs, copper connectors for slide valves etc.
- Å No maintenance support by firm.

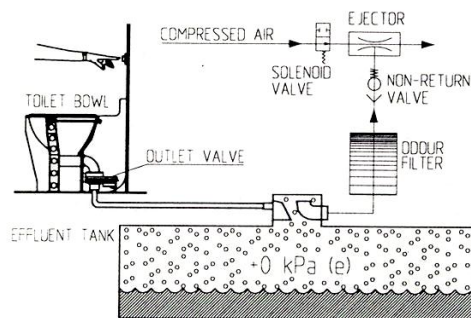


Vacuum toilet system

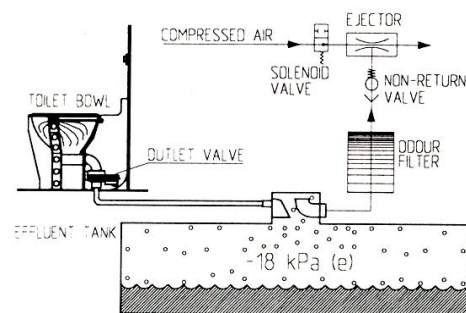
- Direct transport from the toilet bowl to the tank aided by vacuum
- Water used per flush is 250 ml only
- Centralised tank retains the effluent until emptied
- Effluent emptying facilities can be fixed or mobile
- In fixed type, evacuation pumps to be deployed at the terminating stations which transfer the effluents to ground tanks
- Mobile type units can be installed on trucks which can be used for collection at large stations



Vacuum toilet system



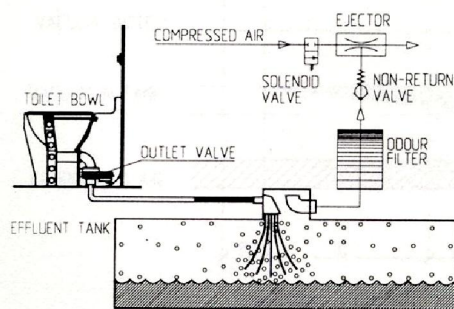
Flush Knob Pressed
 Flush valve lamp comes on,
 Ejector starts and begins
 building up vacuum in the
 system. Odour filter blocks
 odour



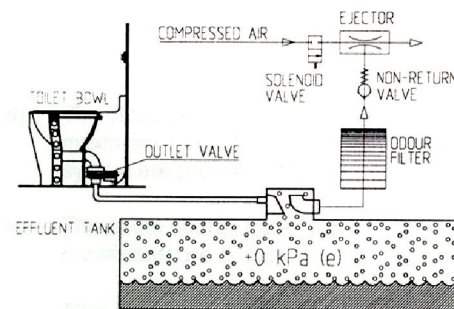
Flushing Initiated
 When vacuum level of -18kPa is
 reached, water pressuriser unit
 is activated, water valve opens
 and toilet bowl is flushed



Vacuum toilet system



Flushing Completed
 The Ejector, Water valve and
 Water Pressuriser close at the
 same time as the outlet valve
 opens – contents of the bowl
 transported to tank



Cycle completed
System ready
 The output valve closes and
 the system is in its stand-by
 position – ready for use



Vacuum toilet system

Limitations:

- No working in the event of loco changeover/failure, non-availability of compressed air, stabilizing in platform.
- The system needs better monitoring as several indicators and alarm signals are outputted by the system.
- If required conditions are not met, the system stops the toilet.
- Elaborate infrastructure





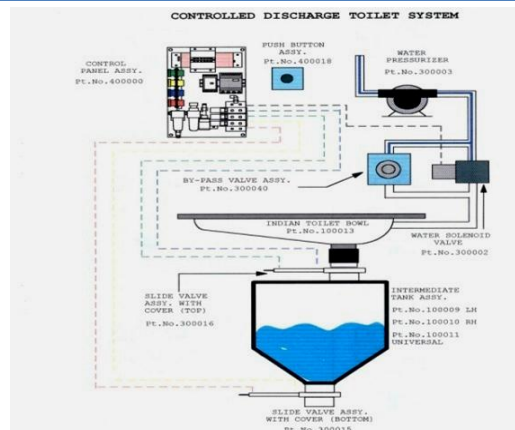
Controlled discharge toilet system

- This system ensures that the waste from the toilet is retained in under-slung tanks while the train is waiting at a station or it is passing through city limits.
- The waste is finally discharge on the track when *Train picks up 30 kmph speed + 15 cycles of flush Or When the train is de-accelerating and approaching to 30 kmph.*





Controlled discharge toilet system



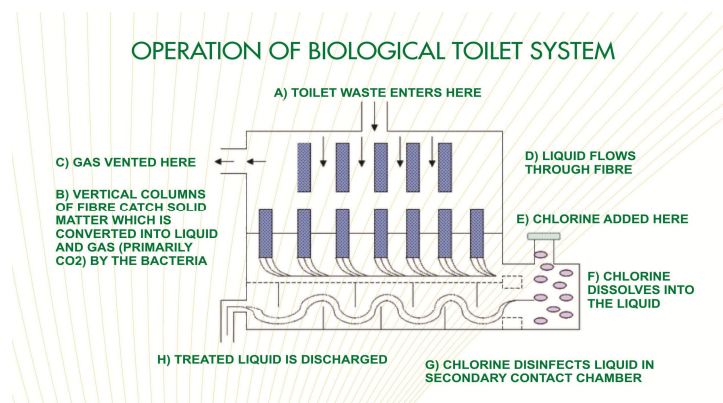
Limitations:

- ⌘ Does not fulfill the requirement of green toilet
- ⌘ Requires both pneumatics and electrics for operation
- ⌘ Requires other electronics gadgets PLC etc.
- ⌘ Requires frequent maintenance



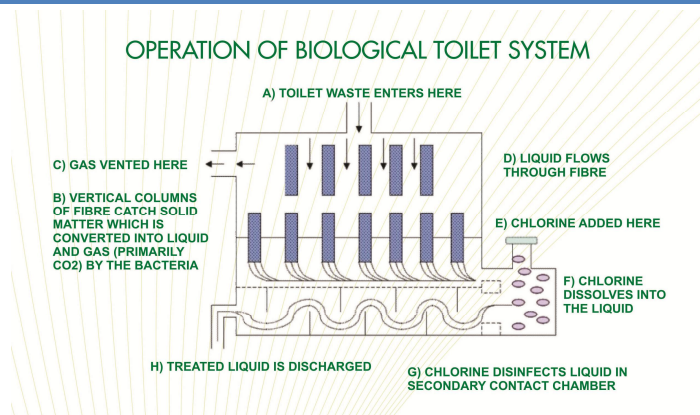
Aerobic Bio-toilet system

- Bio digesters imported from M/s Microphor, USA
- Aerobic bacteria used for decomposing the waste into gases and water.
- Liquid is discharged on the ground after chlorination.
- This system has been successful but periodic replenishment and high initial as well as maintenance cost are the stumbling blocks.





Aerobic Bio-toilet system



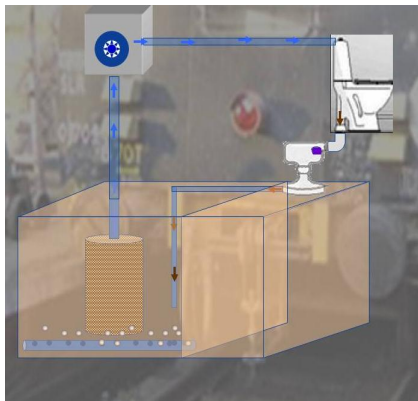
Limitations:

- Foul smell
- Lack of non-bio-degradable separation system
- Choking due to accommodation of non-bio-degradable materials



Zero discharge toilet system

- This toilet works on the principal of solid liquid separation with solid portion stored, evacuated, transferred and dump into pits for composting.
- Liquid portion filtered, treated, recycled for flushing purpose.
- These toilets have been developed by a consortium consisting of RDSO, IIT/Kanpur & URBANE Industries, Chennai

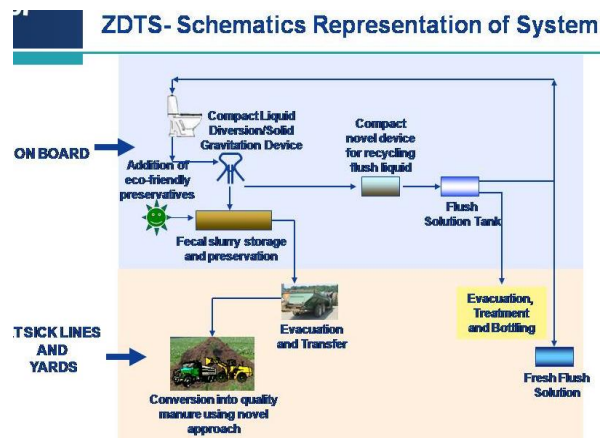




Zero discharge toilet system

Limitations:

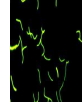
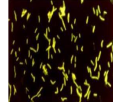
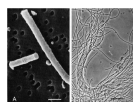
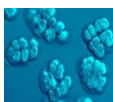
- Needs evacuation frequently.
- Needs extensive ground facilities like pits, transfer pumps etc for composting.
- Higher operational cost.
- Quality of recycled water for flushing needs improvement as it has mild stink.
- Detention of rakes at pit lines.





Anaerobic bio-digester system

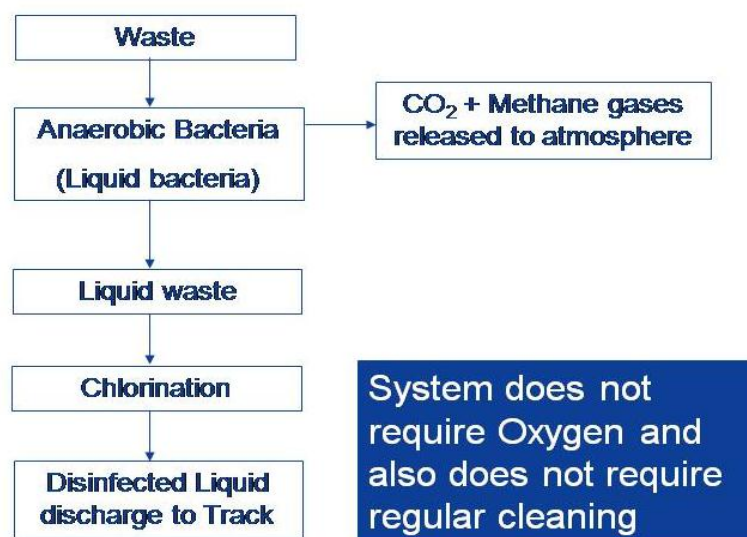
- In this technology anaerobic bacteria is used for de-composition.
- DRDO developed these bacteria for use in high altitudes areas like Siachen, Glacier .
- This bacteria once charged does not require replenishment for long time and system is maintenance free.





Anaerobic bio-digester system

Working of Anaerobic System





Anaerobic bio-digester system

STEPS IN ANAEROBIC DIGESTION

Large polymers are converted into simpler monomers

↓

Simple monomers are converted into volatile fatty acids

↓

Volatile fatty acids are converted into acetic acid, CO_2 & H_2

↓

Acetate & H_2 are converted into CH_4 & CO_2

Hydrolysis

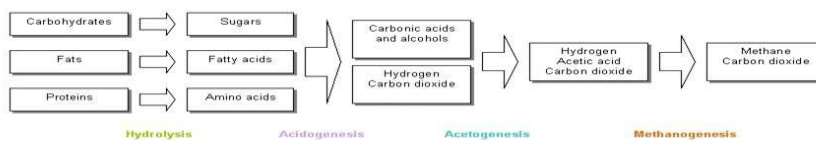
Acidogenesis

Robust

Acetogenesis

Methanogenesis

Sensitive





Anaerobic bio-digester system

-Bio gases, parameters, choking

Composition of Bio-gases

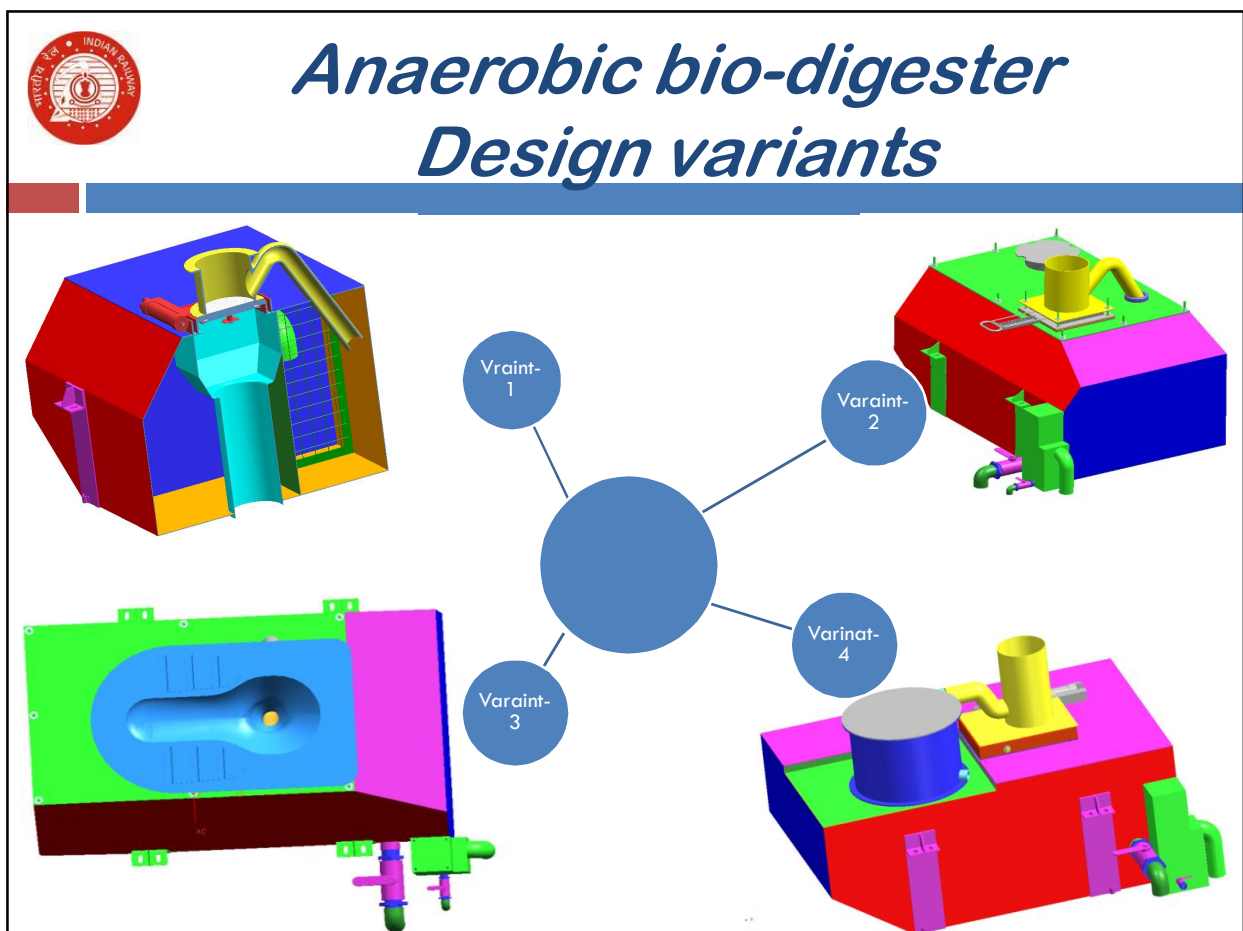


Compound	Chemical Name	%
Methane	CH ₄	50–75
Carbon dioxide	CO ₂	25–50
Nitrogen	N ₂	0–10
Hydrogen	H ₂	0–1
Hydrogen sulfide	H ₂ S	0–3

Parameters being monitored



Parameter	Recommended Values
pH	6 to 9
Total Solids	Max 750mg/100ml
Total Dissolved solids	Max 350mg/100ml
COD levels	Max 2000 ppm





Anaerobic bio-digester

Design variants	Limitations
Varaint-1 with PLC with electrics and pneumatics	Failure and theft of PLC. NoN availability of electricity and air. High cost of AMOC. Frequent attention similar to CDTs. Leakage through flapper valve.
Varint-2 with manual slider without electrics and pneumatics	No problem in maintenance, except opening in case of foreign object. It is required to be opened between adjacent coaches.
Varaint-3 with smaller dia , no fail safe arrangement, without electrics and pneumatics	Being no fail safe mode, all foreign objects going to tank, thus tank is with full of garbage. Frequent choking problems.
Vraint-4 with manual flapper with solid liquid separator.	Manual flapper leakage, solid liquid separator groove blockage thus not functions as desired.



Anaerobic bio-digester

The tank is made of stainless steel to size 1150 x 720 x 540 mm, and under slung on mounting brackets in the coaches.

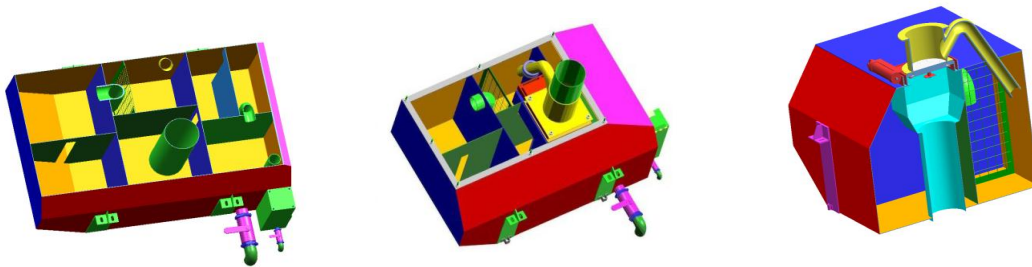
Total volume of tank – 400 Its
Effective volume of tank – 300 Its
Empty tank weight – 110 Kgs
Full tank weight – 410 Kgs
Height from Rail level – 225 mm





Anaerobic bio-digester

- Å The tank has 6 partition walls inside the tank (seven chambers).
- Å Poly grass mat is provided on the partition walls for colonisation of bacteria.
- Å Ball valve with handle for operation is provided for making toilet direct discharge in case of chocking.
- Å First chamber has grill partition so that non-bio-degradable objects do not pass to further chambers.





Anaerobic bio-digester

- Å Fecal matter in slurry form goes from 1st chamber to 2nd chamber through a pipe (from bottom of first chamber).
- Å Slurry flows from 2nd chamber to 6th chamber through slits in the partitions.
- Å From 6th chamber to 7th chamber it flows through a pipe (from bottom of the 6th chamber).
- Å From 7th chamber to the chlorinator it flows through a pipe (from top of the 7th chamber).
- Å Finally chlorinated water is discharged to the ground.
- Å Nylon matting are provided on all walls for colonization of bacteria.

In case of choking, valve has to be opened



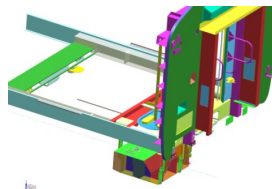
Cost comparison of different toilet systems

Description of toilet system	Approx. cost per unit	Approx. AMOC Cost per unit
Open discharge chute system	Rs/- 2500	Nil
Controlled discharge toilet system	1.25 lacs	36,000 per annum
Aerobic toilet system	1.83 lacs	40,000 per annum
Anaerobic toilet system	0.63 lacs	Nil
Vacuum toilet	3.0 lac	Not known-will be significantly higher



Draw backs in the present design

Indian passengers has the tendency to drop the waste including the non Bio-degradable items into the toilets, which can lead to choking of the system. Ball valve provided for releasing the choke in the present design cannot be operated from inside the coach. This leads to run the train with choked toilet for the entire journey.





Improvements in anaerobic system

- Ball valve provided for removing the choke in the system, is made operational by means of a foot pedal provided inside the toilet itself, hence in the case of choking the valve can be opened from inside.
- Dust bin is provided in the toilets to facilitate dropping of non Bio-degradable waste in it and avoid throwing these items in the toilet bowl.
- Pictorial information is provided in the form of stickers pasted inside the toilet about the system.



Standard sticker to be provided in the toilet

HEIGHT OF HINDI TEXT 8 MM BOLD IN RED COLOUR HEIGHT OF ENGLISH TEXT 8 MM BOLD IN RED COLOUR 'INDIAN RAILWAY' MONOGRAM HEIGHT OF HINDI TEXT 8MM BOLD LEAF GREEN COLOUR HEIGHT OF ENGLISH TEXT 8MM BOLD LEAF GREEN COLOUR HEIGHT OF HINDI TEXT 5 MM IN BLUE COLOUR HEIGHT OF ENGLISH TEXT 5 MM IN RED COLOUR HEIGHT OF HINDI TEXT 8MM BOLD LEAF GREEN COLOUR HEIGHT OF ENGLISH TEXT 8MM BOLD LEAF GREEN COLOUR	भारतीय रेल की हरित क्रांति (बायोटॉयलेट) में सहयोग प्रदान करें। HELP INDIAN RAILWAY FOR BIO-TOILET GREEN EVOLUTION रेल यात्रियों से अनुरोध - REQUEST FROM RAIL PASSENGERS- यह टॉयलेट, बायो टॉयलेट है अतः THIS TOILET IS BIO-TOILET ☐ कृपया शौचालय में बोतल, अखबार, नैपकिन, पॉलीबैग, कपड़ा इत्यादि न डालें। PLEASE DO NOT THROW BOTTLE, NEWS PAPER, NAPKIN, POLY BAG CLOTH etc. INSIDE THE BIO-TOILET. ☐ शौच के बाद कृपया प्लश अवश्य चलाएं, अन्यथा शौचालय चोक हो जाएगा। PLEASE FLUSH THE TOILET AFTER USE, OTHERWISE IT MAY BE CHOKED. ☐ शौचालय में रखे कूड़ेदान (डस्ट-बिन) का प्रयोग करें। USE DUST BIN KEPT INSIDE THE LAVATORY. ☐ शौचालय को गंदा न करें। KEEP TOILET CLEAN कृपया इस हरित-अभियान में हमें सहयोग प्रदान करें। PLEASE ASSIST US IN GREEN - MOVEMENT	10 190 10 277
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NOTE :-

- MATERIAL AND SPEC. :- LAMINATED STICKER AS PER FOLLOWING SPECN.
 - BASE MATERIAL - SILVER COATED PET FILM
 - BASE COLOUR - WHITE COLOUR
 - THICKNESS - 0.38 MM
 - ADHESION TO STEEL - 750gms/2.5cm(MIN)
 - AND L.P. SHEET
- HEAT RESISTANCE - 1) STICKER SHOULD NOT HAVE DETERIORATION OF ADHESIVE ON CONTINUOUS EXPOSURE TO ATMOSPHERE.
2) PRINTING MUST HAVE GOOD RESISTANCE TO THE ATMOSPHERIC CONDITION.
- WATER RESISTANCE - STICKER SHOULD NOT COME OUT IN WASHING WITH WATER SOLUTION.
- SELF LIFE - MIN. LIFE 1 YEAR IN UNUSED CONDITION.
- LETTER HEIGHT AND COLOUR AS SHOWN IN BRACKETS.
- L.P. STICKER SHOULD BE PASTED ON INSIDE LAVATORY WALL AND ON LAVATORY DOOR OR NEARBY AREA AT SUITABLE LOCATION.

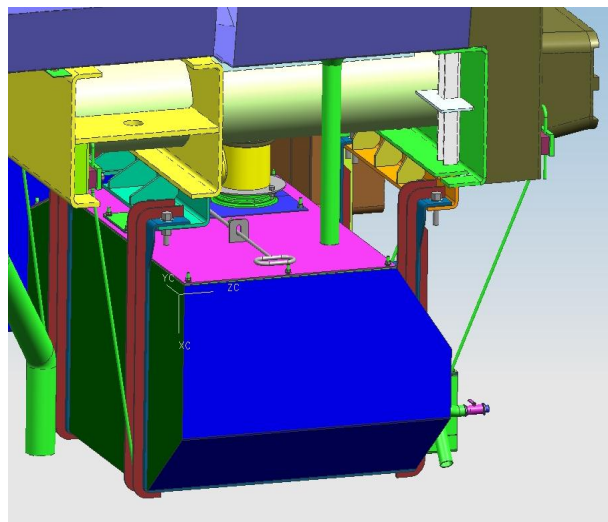
ALT.	ITEM	AUTH.	DESCRIPTION	QTY.	DATE

ITEM DESCRIPTION & DIMENSIONS	NO. OF SHEETS	REF. ORG.	DATE	BY	WTL. & SPEC.	REMARKS
SUPERSEDED BY:-		INDIAN RAILWAYS				
SUPERSEDES:-		ICF/RCF TYPE COACHES				
SCALE	P	NOTICE FOR BIO-TOILET FITTED COACH				
1:5	C					
	D					
	J.S. SS/ 14					
CDG NO. :-	B.G.	R.O.S.D. (CG)	CG-14044			



Bolted Design for retrofitment with additional 'C' Channel

- ⌚ This design is mainly suitable for new coaches only.
- ⌚ This design can also be used for retro-fitment in those old coaches which are marked for replacement of complete head stock.
- ⌚ Presently RCF is using 152 mm dia pan outlet with 125mm ball valve & ICF is using 100 mm Pan outlet dia with 125mm ball valve.
- ⌚ Ball valve and P-trap is part of tank assembly and mounted on adaptor of tank.





Bolted Design Bio Digester by Southern Railway



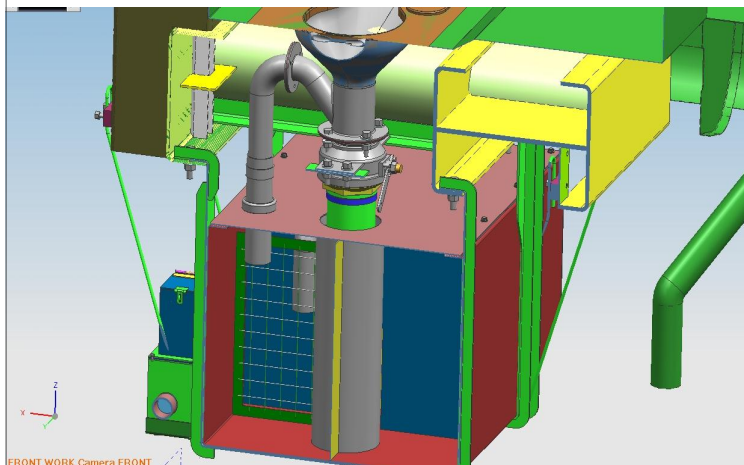


Improved Bio Digester (Bolted Design)

• Bio digester tank shall be directly mounted on outer and inner head stock.

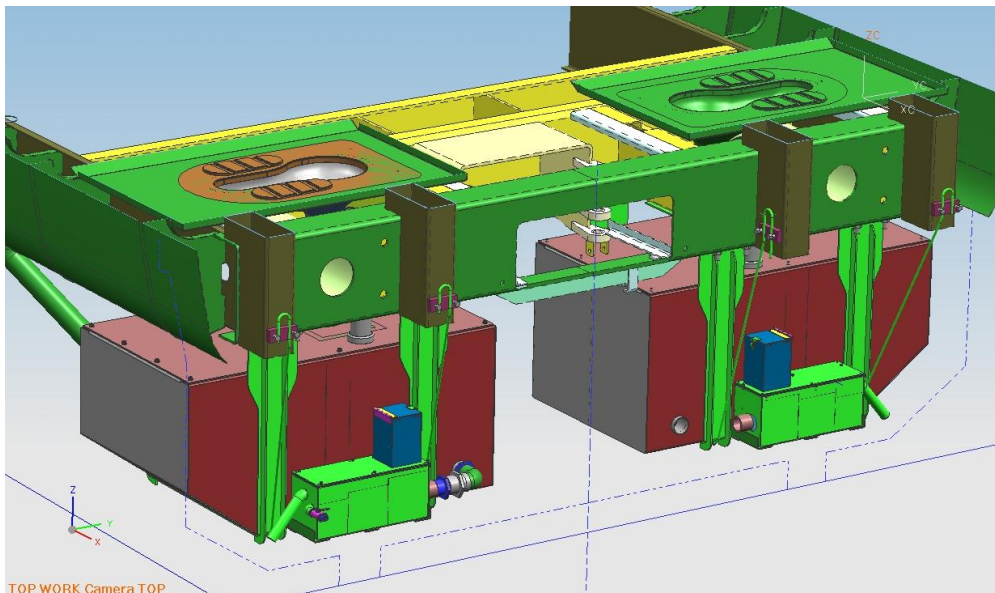
• For mounting of bio digester tank outer C-Chanel of inner and outer head stocks shall be required jig drilling.

• For mounting of ball valve welding of two additional brackets shall be required.





Improved Bio Digester (Bolted Design)





Improved Bio Digester (Bolted Design)



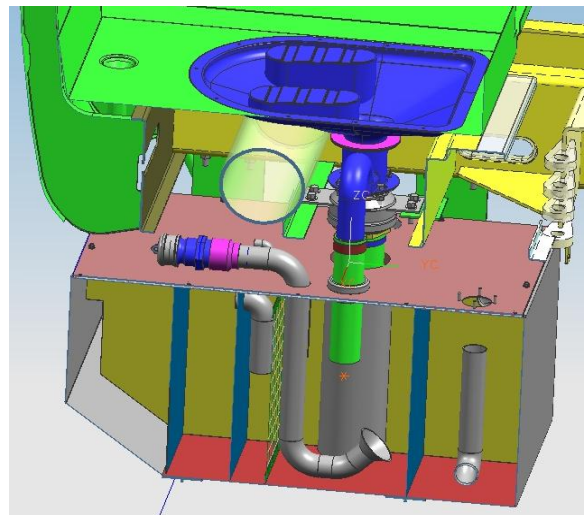
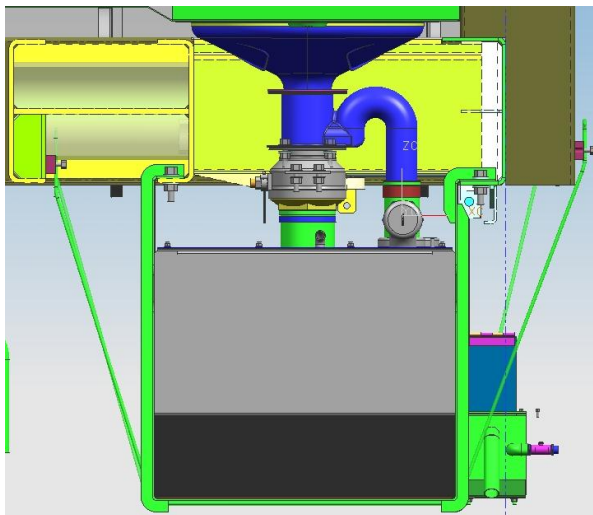


Improved Bio Digester (Bolted Design in LHB coach)





Improved Bio Digester



With quick coupling for evacuation in first chamber



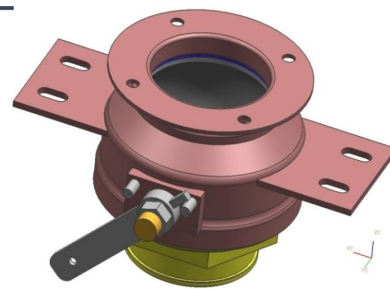
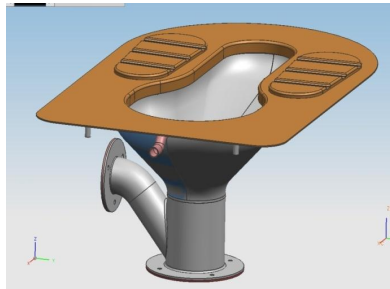
Improved Bio Digester



With quick coupling for evacuation



Improved Bio Digester (Bolted Design)



- Lavatory pan and P-trap has been integrated to avoid any leakage from this joint and design has been finalized similar to RDSO drawing no. CG-K6026 for bio toilets.
- Flushing jet ring of dia19 mm having holes of 4mm has been provided for effective gravity flushing arrangement.
- The diameter of the Pan outlet has been standardized & specified as 100mm with having matching dia of ball valve i.e. ball valve dia has also been standardized as 100mm.



Ball Valve Opening Mechanism

Types of Opening Mechanism

- ⌘ Push Pull Rod With Pulling Handle.
- ⌘ Rake and Pinion Mechanism Developed by MRC.
- ⌘ Gear Mechanism Developed by JSL
- ⌘ Fulcrum and Lever Designed by M/s Rail Fab & M/s Oasis.
- ⌘ Wire rope based opening mechanism developed by NR in coach no. NR99234
- ⌘ Hydraulic Controlled Opening Design Developed By RDSO.



Ball Valve Opening Mechanism

Push Pull Rod With Pulling Handle

⚙ This design was simple and easy to operate however this mechanism can be operated from outside of the coaches only

⚙ In case of jamming of ball valve, problems were faced in operating this mechanism during run.





Ball Valve Opening Mechanism



Rack and Pinion Mechanism Developed by MRC

Initially design was appreciated for their operability from inside of the lavatory

Later on operational difficulties faced due to jamming of rake and pinion itself as well as jamming of ball valves.



Ball Valve Opening Mechanism



Gear Mechanism Developed by JSL

This mechanism is also facing jamming problem.
BEML coaches fitted with JSL design opening mechanism can
not be operated even coaches has not been put in service.



Ball Valve Opening Mechanism



Fulcrum and Lever Design

• This design is simpler compared to MRC and JSL. Design is based on simple lever with restoration spring.

• Design optimization is required in this design also as joints are not designed properly.



Ball Valve Opening Mechanism

Wire rope based opening mechanism developed by Northern Railway – variant I



Clutch wire casing with wire rope supported on the top plate of bio toilet tank.



Two springs connected to opening lever of ball valve for pulling back to its closed position.



Ball Valve Opening Mechanism

*Wire rope based opening mechanism developed
by Northern Railway - variant II*



Coated wire rope of almost
5mm routed through SS tube
to inside of the coach



Routing of wire ropes through
SS tubes and supported on top
cover of the tank



Ball Valve Opening Mechanism



Hydraulic Controlled Opening Design Developed By RDSO.

• Hydraulic opening mechanism fitted in coach No. NE13051 for in service trial. System is working satisfactorily

• Simple two position Opening and Closing by a opening handle provided on end wall of the lavatory inside a boxed enclosure.

• Being a flexible linkage, no issue of infringement with any other part. Elegant look.

• No moving parts for opening mechanism, hence the System reliability is very high



Ball Valve Opening Mechanism

Hydraulic Controlled Opening Design Developed By RDSO.

- Minimal/ Nil Maintenance Requirement as the system is self-lubricated and generally does not require maintenance. Self lubrication ensures high reliability and long life
- Very high opening torques are possible.
- No use of electrics/pneumatic power.
- Presently it is manual but can be automated with minimal power requirements.
- Lower cost if utilized as a package to operate multiple toilets.
- Opening mechanism can be retrofitted in existing ball valves with minor modification.
- High degree of low cost automation possible to
 1. Detect jam conditions of ball valve
 2. Automate opening closing of the ball valve



Ball Valve Opening Mechanism





Ball Valve Opening Mechanism





Testing of Effluents of Bio-toilet

Details	Set Target	Sampling quantity	Frequency of sampling	Remarks
pH value	6- 9	50 – 100 ml	90 days	To be tested in Laboratory /at site
Total Solids (TS)	< 750 mg /100 ml	25 ml	90 days	To be tested in laboratory
Total Dissolved Solids (TDS)	< 350 mg /100 ml	25 ml	90 days	-do-
Total Volatile Solids (TVS)	< 500 mg /100 ml	25 ml	90 days	-do-



Testing of Effluents of Bio-toilet

Details	Set Target	Sampling quantity	Frequency of sampling	Remarks
Chemical Oxygen Demand (COD)	< 2000 mg O ₂ /100 litres	5 – 10 ml	90 days	Laboratory /DRDO /Govt approved labs
Fecal Coli Forms count	> 99% reduction (less than 10 ⁸ /100 ml)	10 ml	90 days	Govt approved labs only



Storing of sample

Details	Container	Minimum sample (ml)	Sample type	Preservation	Maximum storage	
					Recommended	Regulatory
pH	Plastic or Glass	100	Composite	Analyse immediately	15 min	15 min
Total solids	Plastic or Glass	25 – 50	Composite	Refrigeration (4-7° C)	7 days	2 – 7 days
Total dissolved solids	Plastic or Glass	25 – 50	Composite	Refrigeration (4-7° C)	7 days	2 – 7 days



Storing of sample

Details	Container	Min sample (ml)	Sample type	Preservation	Maximum storage	
					Recommended	Regulatory
Volatile solids	Plastic or Glass	25 – 50	Composite	Refrigeration (4-7° C)	7 days	2 – 7 days
Chemical oxygen demand	Plastic or Glass	5- 50	Composite	Analyse immediately or add H ₂ SO ₄ to pH <2.0 and refrigerate	7days	28 days
Total fecal coli forms count	Plastic or Glass	1 – 10	Composite	Add sodium thiosulphate and refrigerate (4-7° C)	1 day	1 day



Evaluation by DRDO of cleaning agents provided by Railway

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



Collection of Samples

Sample shall be collected on quarterly basis and sent for testing

Samples will be collected randomly from a 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

Sampling will start after coach has been in passenger service for 10 days or more

Collect samples from the bio digester 30 minutes after the train becomes stationery/still

Open the sample port and let water drain for 2 minutes to remove settled solids particles and to ensure that sample is representative of the system



Collection of Samples

The samples should be collected and sealed in presence of Railway representative.

Atleast one test every quarter shall be carried out in Govt lab

In case the samples do not meet requirement, test shall be repeated after taking necessary corrective actions within a fortnight

Sample shall be collected in 2 litre plastic bottle by simply opening the knob provided in the sampling port

Date and time of sampling and coach No. must be mentioned on the bottle

Sample collected in the bottle shall be transported to lab at the earliest but not later than 24 hours after collecting of the sample



POH of coaches fitted with Bio-Toilet

During POH of the coach fitted with Bio toilet, the tank shall be removed from the coach and kept at safe place and refitted on the same coach after other attention on the coach.

In case there is any damage or leakage the, inoculum shall be drained and the tank repaired.

After repairing and re-fitting on the coach it has to be refilled with required level of fresh culture (approx 120 litres) before dispatch of coach.



Anaerobic bio-digester system Bacteria filling





Anaerobic bio-digester system Opened tank after six months





Non-bio-degradable separation mechanism



