



Toilets and Trains

G. Raghuram

W.P. No.2008-12-07
December 2008

The main objective of the working paper series of the IIMA is to help faculty members, research staff and doctoral students to speedily share their research findings with professional colleagues and test their research findings at the pre-publication stage. IIMA is committed to maintain academic freedom. The opinion(s), view(s) and conclusion(s) expressed in the working paper are those of the authors and not that of IIMA.



INDIAN INSTITUTE OF MANAGEMENT
AHMEDABAD-380 015
INDIA

Toilets and Trains¹

G. Raghuram
Indian Institute of Management, Ahmedabad

Abstract

Indian Railways (IR) is a large transport organization running 8700 trains, reaching 7000 stations and handling about 1.6 crore passengers per day. IR runs several long distant trains, some of which involve journeys upto three nights. The number of non suburban passengers traveling on IR is about 0.6 crore per day.

There are three sources of fecal matter generation in IR (i) Toilets in trains, (ii) Railway stations; and (iii) Use of railway tracks for open defecation.

The existing toilet system in the coaches discharges excreta directly to the ground and the railway tracks. The consequences include unacceptable hygienic conditions, particularly in the railway stations, and damage to rails. IR is making efforts to introduce environment friendly toilet discharge system, for which three options are being considered; modular, vacuum and chemical.

Toilets at stations are a part of amenities being provided, linked to the category of the station. There is an attempt to modernize toilets at important stations.

A related socio economic problem is that of people residing near the railway stations, without access to toilet facilities, using tracks for open defecation.

The issue of dealing with fecal matter should be viewed in the larger context of waste management. With effective waste management, fecal matter can be recycled and used as liquid fertilizers and quality organic manures.

This paper attempts to understand the issues related to fecal matter management on the IR, and provide a framework for solutions.

¹ Prepared by Prof. G. Raghuram, Indian Institute of Management, Ahmedabad, August 2007.
Email: graghu@iimahd.ernet.in

We acknowledge the research support provided by Sushma Chowdary.

1. Introduction

Indian Railways (IR) runs 8700 passenger trains, reaching about 7000 stations and handling approximately 1.6 crore passengers per day. One of the commitments of the IR in its 'Citizen's Charter on Passenger Services' on Indian railway's is to provide safe and dependable train services to passengers and ensure adequate passenger amenities in trains and at railway stations, which includes provision of clean and hygienic surroundings both at trains and in stations.

A recent Comptroller and Auditor General of India (CAG) report observed, "Passenger amenities like toilets and urinals at stations are not commensurate with the quantum of passengers using them and are poorly maintained at many stations, thereby straining existing facilities and hampering cleanliness efforts with passengers overcrowding the station premises. This is further complicated by the failure to prevent unauthorized persons from entering station premises." [CAG, 2007]

A related problem is that of people residing near the railway stations, without access to toilet facilities, using tracks for open defecation. Stagnation of waste on tracks is common near stations and railway tracks. Apart from the poor hygiene, this causes discomfort to the passengers onboard trains, when they stop near the stations. It also makes it difficult for the railway staff to work on or near the tracks.

The problem of efficient management of feces has existed since the times when people started to live in permanent settlements, primarily for the reasons of cleanliness, odor and hygiene. Feces and the pathogens in them contribute to spreading of diseases and intestinal parasites. It is a matter still requiring attention and education in developing countries. [Wikipedia, 2007a]

The issue of dealing with fecal matter is a significant problem area for IR and needs multi dimensional efforts. This paper attempts to understand the issues related to fecal matter on the IR system, and provide a framework for solutions.

2. Estimate of Fecal Matter

There are three sources of fecal matter generation in IR

- Toilets in trains
- Railway stations
- Use of railway tracks for open defecation

There is an added complexity due to discharge of fecal matter from the toilets in trains, due to mobility of the trains. Fecal matter from passengers at the stations and tracks, being in a stationary context, should be more manageable.

While the IR runs 8700 trains daily, only about 1600 trains are long distance mail/express trains. Nearly 4000 trains are suburban trains, running an average distance of 42 kms. The remaining 4700 trains run an average of 273 kms, of which 3100 are passenger trains, running anywhere from 50 to 250 kms (with a few exceptions), and the balance 1600 mail/express trains running anywhere from 300 to 2400 kms (with a few exceptions). In terms of the problem of fecal matter, the mail/express trains and the longer distance passenger trains need attention. While we have not attempted to do so, it would be useful to analyze the profile of the long distance trains in terms of duration of run (more than 36 hours, 24-36 hours, 12-24 hours, 8-12 hours, 4-8 hours and less than 4 hours) and timing (two or more nights, one night and crossing early morning hours, one night and arriving early morning and only day), keeping in view the biological functioning and cultural habits for usage of toilets.

From another perspective, there are about 38,000 non suburban carrying coaches, which amounts to an average of 152,000 train toilets on the IR system, of which about 60 per cent (about 90,000) would be on the move as part of a train. Of course, the level of utilization would vary, depending on the train profile.

We next look at the number of passengers who are likely to use the toilets on trains. Table 1 gives the split of passengers across the different types of trains and classes, along with the average distance and time traveled.

Table 1: Passengers across Types of Trains (2005-06)

	Suburban	Non Suburban				Grand Total	
	All Classes	Upper Class	Second Class Mail/Exp#	Second Class Ordinary	Total		Total Non Suburban
Originating Passengers (m)	3,329	50	668	1,678	2,346	2,396	5,725
Passenger Kms (m)	106,419	27,601	292,501	189,113	481,614	509,215	615,634
Average Lead (kms)	32.0	559.3	437.9	112.7	205.3	212.6	107.5
Overall Average Speed (kms/hr)	40.6	47.9	47.9	37.8			
Average Time (hrs)	0.8	11.7	9.1	3.0			
Effective Usage		28*	367*	335^			

Also includes Sleeper Class

*Assuming 50 per cent use and 10 per cent of which use toilets twice

^Assuming 20 per cent use

The potential users would be the ‘upper class’ (who are mostly in the long distance mail/express trains), ‘second class mail/express’ and a certain proportion of the ‘second class ordinary’ passengers. Assuming 20 per cent of the ‘second class ordinary’ and 50 per cent of mail/express passengers are potential users, and 10 per cent of the mail/express users use toilets twice, the total usage per year (as estimated for 2005-06) would be about 730 million (m) ie 2 m per day. It would be useful to estimate the actual proportions, especially of the longer distance ‘second class mail/express’ and ‘second class ordinary’ passengers, since the numbers are very large.

In terms of usage per toilet in a coach, the 2 m per day would reflect as a little over 22 uses per day. To achieve this average, while the upper class toilets would see a significantly lower use, the second class toilets, accounting for a larger share would see a marginally higher use than 22. It should be noted that this analysis does not take into account the additional uses for urination alone.

One person produces about 500 litres of urine and 50 litres of fecal matter per year. So the estimate of fecal matter per use would be 0.14 litres, resulting in 274,000 litres generated in trains per day. A similar estimate can be generated for urine generated.

With a similar methodology, including IR employees and other workers, and visits of non passengers to stations the demand and fecal/urinary matter generated can be estimated at stations.

With regard to open defecation near stations, it would be necessary to study the extent of this practice and the consequences.

3. History of Toilets in IR Trains

In the first 55 years of operation of the IR, there were no toilets in the lower class carriages in trains. On July 2, 1909, an aggrieved Babu Okhil Chandra Sen lodged a complaint (see Box 1) to the then Transportation Superintendent, Sahibganj. It is believed that after this, the railway authorities introduced toilets in all lower class carriages in trains running more than 50 miles.

Today, the rule is that the trains running more than 150 kms have to provide toilets in all compartments. It is a matter of concern that the IR very often violates this rule by artificially terminating trains short of 150 kms, and running another train with the same coaches after a short while, in a manner that a significant share of passengers who need to travel a longer distance continue across the two trains. For example, there is an Ahmedabad-Vadodara (100 kms) train, which immediately continues its journey as a Vadodara-Surat (140 kms) train. Should this instead have been an Ahmedabad-Surat train, with the obvious requirement of providing toilets?

Box 1: The Man behind the Introduction of Toilets in Indian Trains

Okhil wrote this letter in his anguish. Though the letter lacked the basic English grammar, it became an important document in the history of IR.

Dear Sir,

I am arrive by passenger train at Ahmedpore station and my belly is too much swelling with jack fruit. 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 Dhotie in the next when I am fall over and expose all my shookings to man, female, women on platform. I am get leaved at Ahmedpore station.

This too much bad, if passenger go to make dung, that dam guard no wait 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.

Yours faithful servant,
Okhil Chandra Sen

[Wikipedia, 2007b]

4. Toilets in Trains

The traditional method of disposing human waste from trains is merely 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' 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. Generally the problem is unavoidable, although there are solutions where toilets are automatically locked when the train pulls into a station. [Wikipedia, 2007c]

Traditional Toilet in Trains



The Parliamentary Standing Committee Report on IR [MOR, 2004] noted:

In order to further enhance the standard of cleaning of toilets, a new scheme 'Clean Train Stations' has been developed in which mechanized cleaning facilities will be provided at selected stations enroute on the entire system to ensure effective cleaning of coaches toilets during day time. This scheme will cover most of the long distance trains and all reserved coach including sleeper class coaches.

Pilot project of mechanized cleaning has been implemented at Ratlam, Western Railway since August, 2003. This scheme shall be extended to other stations also. Modular toilets with improved aesthetics and cleanability have been provided on some coaches of Jan Shatabdi Express trains. All new Air Conditioned (AC) coaches (except First AC), all coaches with Centre Buffer Couplers (CBCs), and 280 non CBC Sleeper coaches being manufactured at Integral Coach Factory and Rail Coach Factory in the year 2004-05 will also be provided modular toilets.

During oral evidence, the Chairman, Railway Board informed, "In 31 stations, mechanized cleaning is going on. The 'Ratlam' type of experiment has been very successful. Under this model, when the train stops at a station for 15 to 18 minutes, each toilet in the train is cleaned thoroughly. We will be expanding it this year. Our aim is to take 'Ratlam, type of mechanized cleaning of all coaches to another 15 stations. During 2003-04, we had envisaged modular type of toilets. Most of the Jan

Shatabdi and Linke-Hofmann-Busch (LHB) type coaches have been fitted with modular toilets as well as discharge control toilets ie wherever the speed is less than 30 kmph, that is, while approaching or standing at a station, it should not discharge excreta. This concept is being extended to other trains also”.

Further, he added, “These control discharge type and modular type toilets have been very successful. Most of the new type of coaches we picked up last year are easily cleanable and maintenance effort is less. It maintains good hygiene. Besides this, we have gone for mechanized cleaning and ‘Pay and Use’ toilets at the stations. That is well held and we are expanding very fast. Mechanized cleaning has been now in use at Hazrat Nizamuddin for nearly one year and at New Delhi and Delhi stations it started recently. In most stations we have given implements to our ‘safaiwalas’. They have been well trained in that activity. They have been given the attire because of which they have developed a sense of pride while working there. There are problems because of the limited strength of the ‘safaiwalas’, but we have tried to take care of that. We provide the implements from the outside so that their productivity goes up. We provide all proper mechanical implements. We have seen that the productivity of the ‘safaiwalas’ with mechanized cleaning goes ten times higher than when they use ordinary brooms, implements and manual methods.”

The chapter 2, CAG Report No 6 of 2007, focusing on the cleanliness and sanitation on IR, identified a lot of problem areas and inadequacies in this context. Their overall recommendations are given in Box 2.

5. Future Outlook by the IR

The IR is experimenting with three types of toilets in trains

- Modular Toilets
- Vacuum Toilets
- Chemical Toilets

Box 2: Gist of Recommendations from CAG Report, 2007

- Railways should evolve performance criteria or standards for each and every cleanliness related activity and its supervision over all zonal railways. A comprehensive overall action plan at the apex level should be prepared addressing all cleanliness related issues followed by zonal action plans dovetailed with the overall action plan.
- Railways should consider rationalizing the reporting structure and putting in place a system whereby the responsibility of maintaining cleanliness and hygienic surroundings at railway stations and in trains, exclusively vests with one authority.
- Railways need to assess the financial requirements for cleanliness related activities and provide for them in the budget specifically. This would also enable monitoring of the cleanliness initiatives. Similarly, the Railways also need to have an overall financial plan for provision of infrastructure, amenities, user awareness campaigns etc., as per an action plan and actual field requirements.
- Railways need to frame a policy on waste management in compliance with extant regulations. A mechanism may be put in place to realistically assess the quantum of garbage generated so that adequate facilities and infrastructure such as dustbins and vats can be provided. Proper collection and disposal of garbage also needs to be ensured.
- Railways need to draw up a plan of action with identified milestones for provision of adequate infrastructural facilities such as water supply, washable aprons, drains and sewerage system and machines along with conducive platform surfaces and ensure that they are maintained properly. Railways also need to provide for adequate infrastructure and resources in coaching yards and trains to enable cleaning of coaches in a more effective manner.
- For effective and efficient implementation of schemes such as ‘Pay and Use’ Toilets and ‘Clean Train Station’, Railways should provide for facilities as planned and ensure proper coordination between the departments besides effective monitoring and supervision.
- Railways need to adequately provide and maintain passenger amenities like toilets and urinals, water booths, seating arrangements and waiting halls commensurate with the quantum of passenger traffic handled at the stations
- The manpower requirements at the stations need to be reviewed and provided for, apart from instituting a mechanism for training and controlling absenteeism. Further, quality benchmarks should be prescribed for outsourced cleanliness related activities. Quality of supervision should also be improved
- Railways should institute a sustainable mechanism to restrict entry access to prevent unauthorized entry into station premises.
- Railways should strive to enhance the level of user awareness on a large scale and to initiate effective means of harnessing user perception to bring about improvements in the system

Modular Toilets

The IR have redesigned coach toilets completely to make them more comfortable and modern. The redesigned toilets have been developed as fibre reinforced plastic built modules which can be fitted directly inside coaches in place of conventional toilets.

Modular toilets have been introduced in Jan Shatabdi train coaches. Modular toilet is a controlled discharge toilet system, which stores toilet discharge in a sealed tank in stationary condition and avoids dirtying stations. The tank is emptied slowly when speed of train exceeds predetermined limit of 40 kms per hour. The discharge begins in open area outside cities and degenerates fast without creating any environmental concern. The modular toilets will cost Rs.7.5 lakh per coach. It will form part of operation cleanliness that IR have launched.

Research is being carried out under a technology mission as a collaborative effort between Indian Institute of Technology, Kanpur and Research, Design and Standards Organization (RDSO), supported by the Ministry of Human Resource Development (HRD) and Ministry of Railways. Box 3 gives a brief on this.

Vacuum Toilets

The RDSO of the IR has come up with their specifications for the various types of toilet systems in trains. [RDSO, 2005]

Vacuum toilet system is required for standard mainline rolling stock to flush out the toilet waste with minimum water consumption to a collection/retention tank mounted below the under frame. The toilet system should provide a sealed commode with an efficient flushing system and provide odour free interior of the toilets applicable to Western and Indian style toilets of mainline broad gauge (BG) coaches of IR.

Box 3: Environmental Friendly Coach Toilet Discharge System

The stretch of the IR network is long and in some cases a passenger may be required to spend up to three nights on a train. The existing coach toilet system in the IR passenger trains consists of a lavatory in which the excreta are discharged directly to the ground through the lavatory chute. The design of the toilet is very simple. The coach toilets are by and large convenient to a variety of users, robust, and almost maintenance free. However, the present system has some major concerns due to discharge of fecal matter on the track. These concerns include: damage to the rails, unacceptable aesthetic and hygienic/sanitary conditions, particularly on the railway stations, and non compliance to the environmental regulations/standards/practices. Prototype Physico-chemical and Biological toilet systems are being currently investigated. Prototype residue management systems for installation in railway yards/stations are also being explored.

[Tare, 2006]

Generally, IR mainline passenger coach has four toilets, of either Western commode or Indian squat pan types. Some coaches may have only two or three toilets. The number of toilets and their type (Indian or western) depends upon the coach type. Irrespective of coach designs the toilet system is required to meet the following objectives:

- Clean, odourless, hygienic and aesthetically pleasing toilet.
- No discharge of waste.
- No spillage of wastes on the bogie parts, undergear or track.
- Minimum life cycle cost to IR

Vacuum Toilet



The water consumption shall be minimum, with 100 per cent cleaning of the commode (maximum 0.8 ltr per flush for Indian type and 0.8 ltr for Western type). As the air supplied from the coach may contain dirt and moisture, the toilet should include suitable filter and moisture arrester

Water Supply

(a) In AC coaches, one tank of 40 ltr capacity is available over the toilet roofs at each end, at a height of about 2030 mm from toilet floor. Water is pumped to these from underframe mounted main water tanks. Water flow to the flushing valve is by gravity.

(b) In non AC coaches, one tank of 450 ltr services each toilet at a height of 2030 mm from toilet floor. These tanks are not pressurised and the water flow from these tanks is by gravity.

Duty Cycle

The toilet should be ready for use by the next passenger within one to two minutes. The toilet shall be used upto approximately 150 times in 24 hrs. Journeys varying upto 77 hrs are performed by IR coaches.

Waste Processing

The effluents are collected in a tank which is under slung below the WC. A pump mounted alongside the tank delivers the effluents to the treatment system at a steady rate through a membrane sieve to trap solids. A mixture of coagulating and disinfecting chemicals is injected into the delivery line to promote coagulation while preventing decomposition of organic compounds. Adsorption or organic scavenging will also be needed to meet the quality norms specified. Here, water entrained in the sludge trickles through an SS304 mesh and is recycled. Dewatered sludge is to be removed during the

train clean up operation. The residual pressure of 0.5 to 1 kg/sqcm is maintained by continuous recycle of excess treated water for use in flushing.

The tenderer shall clearly indicate the system for rendering the toilet discharge environmentally inert. Chemicals used in the toilet if any, shall be dispensed so that there is no chance of their contact with the user. The details of chemicals and agents, along with their consumption rates and approximate costs, shall be indicated.

Waste Collection and Processing Tank

The tank shall be of stainless steel to AISI316L with sufficient capacity for duty cycle mentioned earlier. If underslung tanks are provided, they shall be of superior quality stainless steel, designed to withstand ballast stone hits and cattle run over by the trains. The tenderer shall ensure high quality of fabrication and mating, for completely leak proof construction. Level sensors should be provided. Two centrifugal pumps with facility for auto operation should be provided.

Discharge

The treated effluent should be disinfected before it is recycled/discharged so that there are no pathogens in it. The discharge should carry no bacteria and be odourless. The effluent should comply with the following pollution control requirements: BOD 100 PPM, COD 250 PPM and PH 5.5 to 8.0. There should be a facility for removal of non degradable collected in the tank without requiring a complete disassembly or coming into contact with germ processed waste. The discharge should not directly impinge on the bogies, undergear and the rails.

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 BG coaches of IR.

Chemical Toilets

The IR had experimented with chemical toilets in certain long distance trains, but did not find it successful, both in terms of odour and frequency of disposal. However, this is commonly used in aircraft and trains in other countries.

Chemical toilet is a toilet using chemicals to disinfect the waste instead of simply storing it in a hole, or piping it away to a sewage treatment plant. These toilets are most commonly found on airplanes and trains, identified with a blue colored dye in the bowl water. (In the United States, this blue liquid formula is generally called "Anotec".) An even simpler chemical toilet consists of a seat on a container or bucket of water, with a solution of chemicals used to disinfect and deodorize. These are sometimes found on intercity buses or in homes where indoor plumbing is not available.

Lavatories on aircraft consist of a sink, a waste bin, and a toilet. The toilet does not flush with water; rather, suction removes the waste into a collection bin below.

[Wikipedia, 2007c]

Chemical retention tanks are usually present aboard newer carriages and railcars in wealthier and more densely populated parts of the world. One issue is that the tanks need to be regularly emptied, usually when being attended at a terminal station or prolonged stopover. If a train is required in service again within too short a period, the tanks may not get emptied. In this case, toilets may back up and cause displeasure to passengers (the traditional waste disposal methods do not have this problem). Another point of note is that carriages may have less "in service" time if fitted with chemical retention tanks. [Wikipedia, 2007d]

Chemical Toilet



6. Toilets at Stations

The IR have 8018 stations under various zones. Under the new guidelines issued in 1999, these stations have been organized into six categories based on the passenger earnings of the station, for providing passenger amenities.

The yardsticks and extent to which the amenities were to be provided was linked to the category of station. The categorization of stations was to be reviewed after every five years. The number of stations in various categories is given in Table 2.

Table 2: Categorization of Stations

S No	Category	No of Stations	Criteria
1.	A	228	Non suburban stations with annual passenger earnings of Rs 6 crore and above
2.	B	195	1. Non suburban stations with an annual passenger earnings between Rs 3 crore to Rs 6 crore. 2. Stations of tourist importance or an important junction station (to be decided by General Manager)
3.	C	501	All suburban stations
4.	D	328	Non suburban stations with passenger earnings between Rs 1 and Rs 3 crore
5.	E	5264	Non suburban stations with passenger earnings less than Rs 1 crore
6.	F	1502	Halts
Total		8018	

[CAG, 2007]

The CAG report noted the following regarding pay and use toilets at stations:

Regarding the provision of ‘Pay and Use’ toilets at stations, and the number of stations where this facility is available, the Ministry of Railways stated that since the task of bringing about perceptible cleanliness is stupendous, it has been decided to give focused attention to certain areas and one of them is introduction of ‘Pay and Use’ scheme of toilet. The facility is available at over 400 stations. Though no formal survey has been undertaken to get the response of the public yet the feedback indicates this facility is considered highly desirable and representations are received from various quarters to extend the same to more stations. However, about the plans to extend this facility at more stations the Ministry stated that it is proposed to provide ‘Pay and Use’ toilets at A to E category of stations. [CAG, 2007]

The CAG team visited many stations under the A, B and C category and reported on where the provisioning of toilets and urinals as per the minimum essential requirements (Table 3).

Table 3: Stations, where Toilets and Urinals were not as per the Minimum Essential Requirement

Category of stations (Number of stations visited)	Number of stations where toilets and urinals were not as per minimum essential requirements	Names of some of the important stations
1	2	3
A (173)	78	Rourkela, Dehradun, Ahmedabad, Hyderabad, Lucknow, Gorakhpur, Allahabad City, Tinsukia, Hubli, Mysore, Agra Cantt, Visakhpatnam, Dhanbad, Ranchi
B (91)	38	Sonarpur, Chakradharpur, Lakhimpur, Lalkuan, Bangalore Cantt, Guna, Sonepur
C (34)	10	Dankuni, Bagnan, Malad, Chembur, Titwala

[CAG, 2007]

Pay and Use Sulabh Sauchalayas



7. Open Defecation on Railway Tracks

This issue involves the non passenger sector and non railway users like people living in the surrounding areas near tracks without facilities to toilets, especially in urban and semi urban areas. Open defecation is a larger socio cultural issue in the Indian context. Even Mahatma Gandhi has commented on this in the early 20th century. Efforts apparently are being taken by the Ministry of Rural Development to completely eradicate the open defecation in India by 2012. However, the problem is more significant in non rural areas.

Stagnation of waste on tracks is common near stations and railway tracks. Apart from the poor hygiene, this causes discomfort to passengers on board trains, when they stop near the stations. It also makes it difficult for the railway staff to work on or near the tracks.

8. Conclusions

- It is important for IR to focus on the issue of dealing with fecal matter on their system. Open discharge of fecal matter must stop. Current practices are outdated. Other country railway systems have advanced in this matter. There are lessons to be learnt from other modes such as aircraft and ships.

- A lot more research and analysis needs to go into this topic, to understand the magnitude of the problem and the consequences.
- Implications on different stakeholders such as (a) users: passengers (b) users: Non passengers (c) users: railway staff (d) cleaners (e) coach maintenance workers (f) track maintenance workers and (g) non users, including passengers have to be clearly understood and dealt with appropriately. A related stakeholder in a different context is the locomotive staff whose concern has not yet been addressed since there are no toilets in locomotives.

- There are many related issues, which have not been addressed, that IR needs to worry about. One of the important issues is removing caste based employment in the cleaning task. In fact, if the activity of fecal matter disposal system is distasteful and does not attract people, then market economics (and not caste economics) should operate. Salary levels in such tasks should go up to levels where supply is generated. Only then, there will be pressure to reduce overall costs and improve fecal matter disposal systems.

References

1. CAG, 2007. 'Cleanliness and Sanitation on Indian Railways.' Chapter 2, CAG Report No 6 of 2007
2. MOR, 2004. Standing Committee on Indian Railways
3. RDSO, 2005. 'Schedule of Technical Requirements and Toilets for Indian Railway Coaches.' Research Design and Standards Organization
4. Tare, Vinod, 2006. 'Environment Friendly Coach Discharge System, 'IIT Kanpur
5. Wikipedia, 2007a. Human Feces
6. Wikipedia, 2007b. Okhil Chandra Sen's Letter
7. Wikipedia, 2007c. Chemical Toilets
8. Wikipedia, 2007d. Passenger Toilet Trains