

Fig. 1: Project location

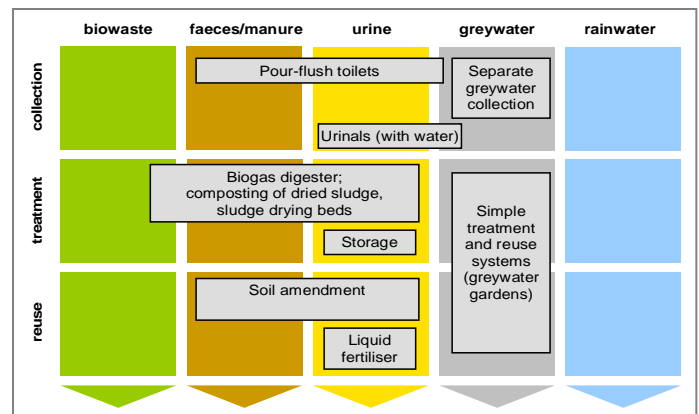


Fig. 2: Applied sanitation components in this project

1 General data

Type of project:

Upgrading of sanitation system at a rural training institute

Project period:

Start of planning: July 2004

Start of construction: February 2005

Start of operation: August 2006

Project scale:

Vocational training institute with 300 students and a variable number of guests attending workshops; 22 pour-flush toilets and biogas digester

Capital cost?

Address of project location:

Nani Devti village (close to Ahmedabad), Gujarat State, India

Planning institution:

seecon GmbH (Swiss consulting firm) and Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ) GmbH, ecosan program

Executing institution:

Navsarjan Trust (an India NGO)

Supporting agency:

Swiss Agency for Development and Co-operation (SDC)

This is a draft version. Text in yellow is currently still being investigated with the responsible project staff.

2 Objectives and motivation of the project

The objectives of this project were:

- to find technical solutions that can help in the elimination of manual scavenging practices, which is a caste-based occupation in India and a source of discrimination
- to improve the sanitation situation at this rural training institute
- to provide Navsarjan Trust first-hand experiences on ecologically sound sanitation concepts and with the knowledge for further dissemination of ecosan in the state of Gujarat.

Navsarjan Trust aims to implement, evaluate and disseminate socially and culturally acceptable, sustainable and hygienically safe sanitation, treatment and reuse concepts for human excreta (urine and faeces) and greywater.

3 Location and conditions

The DSK institute was built on an area of 3.2 ha in Nani Devti village near Sanand, about 30 km southwest of Ahmedabad City (a city of 3.7 million inhabitants (in 2004) in Gujarat State in the west of India at the border to Pakistan). The institute has buildings for administration, kitchen and a workshop, one hostel for males, one hostel for females and a building for computer classes. The institute is used by 220 students and approx. 20 staff members (the staff members do not live on site). Thus the number of people permanently staying on the campus is approx. 240. At times, this number can increase to 400 when participants of meetings and workshops are also at the campus (do these participants also stay overnight?). Numbers of students and staff are a bit confusing.



Fig. 3: Navsarjan Vocational Training Institute (DSK) in Nani Devti village (source: seecon GmbH, which year?)

Before this project was implemented, the wastewater from the campus (with flush toilets? How many?) was collected and infiltrated into the ground by two soak-pits located close to the hostel building. The following reasons have led to a malfunction of this system:

- Due to the lack of maintenance (sludge removal of the soak-pits), sludge accumulated at the bottom and walls of the soak-pits leading to an insufficient infiltration of the wastewater into the ground.
- In addition, wastewater was not discharged into the soak-pits at ground level but at a depth of 3 m below ground. This caused a permanently flooded sewer and soak-pits, resulting in significant odour as well as unhygienic conditions (flies breeding contributing to the transmission of diseases).
- The groundwater level varies between 5 m (during dry season) and only 1.5 m below ground (during rainy season). It can therefore be assumed that wastewater also mixed with the groundwater, which was a severe health risk as groundwater is used for drinking water.

For these reasons, and to meet the needs of an expansion of the institute (expansion from what size to what size?), a new sanitation concept was developed.

In India, the under-five mortality rate¹ is currently 72 children per 1000 (<http://www.childinfo.org/mortality.html>).

4 Project history

Navsarjan Trust, an NGO based in the city of Ahmedabad, was established in 1989 to help eliminate discrimination based on the caste system (including gender), to assure equality of status and opportunities and to ensure the rule of law. The NGO works with Dalits², but also with tribes and other resource-poor groups all over Gujarat. Navsarjan Trust has come to realise that education coupled with skilled training could help in the economic empowerment of the Dalit community.

Thus a suitable training centre had to be established. With financial support from the Swiss Agency for Development and Co-operation (SDC), a vocational training institute called "Dalit Shakti Kendra" (DSK) was established in 1999 to provide technical training in various fields to Dalit youth and to link them up with institutions for financial assistance for self-employment.

The planning process started in July 2004 and the construction started in February 2005. The new sanitation system was inaugurated in August 2006.

How did Navsarjan Trust get together with seecon GmbH and GTZ?

5 Technologies applied

The new sanitation concept includes the following components:

¹ The under-five mortality rate is the probability (expressed as a rate per 1,000 live births) of a child born in a specified year dying before reaching the age of five if subject to current age-specific mortality rates.

² "Dalits" is a term for people historically stigmatised as so-called "untouchables", representing approx. 16% of the Indian population. They work in leather industries, as a shoemaker, unskilled worker in agriculture or scavenger. The last-mentioned group is responsible e.g. for the excavation of graves, the removal of animal carcasses and of human excreta (modified from Wikipedia.org).

Water supply

The entire water used at the campus is groundwater which is pumped into a storage tank. From there the fraction for cooking and drinking is pumped into a reverse osmosis plant (due to its salt content) while the predominant (how much?) fraction is used directly. The byproduct of the generation of 1,000 litres of drinking water is 3,000 litres of low quality water which is used as flushing water for the pour-flush toilets (is the 3000 litres = the brine? Or what is meant by byproduct?).

How much water is used at the campus?

Who built the RO plant? Running costs?

What happens to the brine? Is this what is used for toilet flushing?

Biogas plant

A new common sanitation complex was built consisting of 22 toilet cabins (11 for females and 11 for males) arranged in a circular shape around a biogas plant located in the center. In these toilet cabins, pour-flush squatting pans (so-called "rural" or "pour-flush" pans) made of ceramics were installed which are equipped with a water seal (Fig. 4) and are supplied by the Indian company Shital Ceramics. Compared to conventional flush toilets, these toilets reduce water consumption and keep the blackwater relatively concentrated. Low quality water (brine?) from the reverse osmosis plant is used to flush the toilets.

All students have to use the sanitary block connected to the biogas plant – all the other toilets (except two which are not accessible to the students) have been removed from the campus.

What is the distance from hostel to toilets? What is the design number of people using this sanitation complex?



Fig. 4: Pour-flush squatting pan ("rural pan") and water seal ("P-trap") (supplier: Shital Ceramics, India).

The decision for a biogas plant was made in order to treat the blackwater (blackwater is a mixture of urine, faeces and flushing water) and to recover energy in form of biogas. The biogas plant has a "floating drum" cover which simultaneously stores and provides the produced gas at a constant pressure. The slurry (biogas plant effluent) is led to a sludge drying bed.



Fig. 5: New sanitation complex with 22 pour-flush toilets and biogas plant (source: seecon GmbH, which year?)

Urinal centre

The former common toilet centre has been converted into a urinal centre. Two independent enclosures provide urinals (How many?) for ladies and gents. The urine is collected in a tank and pumped to storage/hygiene tanks when full. The urinals were originally designed as waterless urinals but are now used with flushing water, see Section 11 for explanation. Supplier for waterless urinals?



Fig. 6: View of ladies squatting urinals, which are now water flushed (source: seecon GmbH, which year?)

UDDTs for night-time use

Near the gents hostel two "Urine-Diversion Dehydration Toilets" (UDDTs) have been constructed by the MIT (how did MIT get involved?) to serve students and staff members as "emergency toilets" during the night (Fig. 10). The design, with the anal cleansing part behind the faecal hole at the back, resulted however in spilling of the anal washwater into the faeces hole. Therefore both of these UDDTs are not in use anymore. There is a plan to place the anal cleansing part on the side.

For the ladies hostel (the former Community Training Centre) an additional single-vault UDDT has been built for "emergency use" during the night. Why can't they use the other toilets at night? What is the distance from bedrooms to toilets? What does the squatting pan look like here?

Greywater treatment

A new stand for dishwashing was built (Fig. 7) where the water is supplied by a solar panel operated pump (Fig. 8). It was planned to lead the dishwashing stand effluent via an organic

filter (container filled with straw) to a storage tank. However, this filter had been designed with a hydraulic gradient that could not be built due to the high groundwater level in this area. This resulted in the straw being permanently flooded and consequently losing its filtration effect. Therefore a new filter has been installed (when?) whose effluent is fed into a storage tank before it is reused for gardening purposes.



Fig. 7: View of new stand for washing dishes (source: seecon GmbH, which year?)



Fig. 8: Solar panel and water pump (source seecon GmbH, which year?)

New bathrooms (comprising shower facilities (how many?), washbasins and laundry facilities) have been constructed (where exactly?) to serve students. The greywater is discharged to elevated greywater gardens for pretreatment. Any surplus of water that does not infiltrate into the soil is collected in a tank (size?) and is reused for irrigation purposes during dry periods. Are there drain pipes in the base?



Fig. 9: Elevated (why "elevated"?) gardens for the treatment/reuse of greywater (source: seecon GmbH, which year?)

Kitchen water will be treated (when?) in a similar treatment/reuse unit as the greywater collected from the new shower facilities.

Greywater from the ladies hostel (showers?) (the former Community Training Centre) is led to a settling tank and is further reused for subsurface irrigation of the surrounding lawn. A greywater garden for a further treatment is planned. When?

The sludge (digestate) from the biogas plant is led to a drying bed, composted and then stored for a further reuse as soil amendment.

Organic solid waste management

Kitchen waste is disposed of in a landfill and grass clippings are used to cover the sludge drying beds. These materials could however be fed to the biogas plant provided they are chopped before. But due to lack of time and staff this is presently not done.

6 Design information

A summary is given here for the design information. Further details is available in Wafler and Heeb (2006), see Section 13.

Water supply

Assuming an average of 240 people permanently on the campus, an amount of approx. 11 m³/d of water is consumed equalling a water demand of approx. 46 L/(cap x d).

Biogas plant

For flushing of the squatting pans, a volume of 4-5 litres of water is needed. Assuming a water flushing volume of 4 L/(cap x d), on average 1.5 uses/(cap x d) and between 240 and 400 people onsite, this results in a daily amount of blackwater of 1.4 to 2.4 m³/d. With the given volume of the biogas digester of 27.3 m³, this results in a hydraulic retention time (HRT) of 11 to 20 days. With a HRT of 11 days at mesophilic temperatures, anaerobic decomposition and hygienisation (if at all) will however be very low (see also Section 11).

UDDT for night-time use

Prefabricated urine diversion squatting pans made of fiber-reinforced plastic have been installed serving as "emergency toilets" at night (as UDDTs).

Supplier?



Fig. 10: Urine-diversion squatting pan that allows separate collection of urine, faeces and anal washwater (source: seecon GmbH, which year? Supplier?). The anal washwater section on the left of the pan was found to be too small.

Photo of UDDT installed? Is it being used?

7 Type of reuse

The following products are being reused:

- The **biogas** is used as a substitute to Liquefied Petroleum Gas (LPG) and firewood for cooking. The amount of biogas produced is not measured but the amount of saved LPG is known: From an original consumption of 25 cylinders of LPG per month, the use of biogas saves on average 2-3 cylinders (of 16 kg LPG each) per month (what does this equate to in cost savings?).
- The **digested slurry** from the biogas plant is used as a soil conditioner, e.g. for growing seedlings.
- **Urine**, which is collected (with water) from the urinal centre and the urine-diversion dehydration toilets, is applied after storage as a nitrogen-rich liquid organic fertilizer in the kitchen garden (to grow what?) and the campus lawn in general. Urine onto lawn? Dilution? Fertilising results?
- **Greywater** from dishwashing is treated by organic (straw) filter, stored and used to irrigate nearby plantations. Which crop?
- Pre-treated greywater (after greywater garden) from the new bathrooms is reused for irrigation purposes in dry season.



Fig. 11: Kitchen garden near the hostel for male students. (source: seecon GmbH, which year?) What is grown? Get better photo?



Fig. 12: Organic straw filter at the dishwashing stand (source: seecon GmbH, which year?)

8 Further project components

For the ladies hostel it is planned (when?) to install an additional emergency night toilet (What type? Why at top of the building?) at the top of the building and to build a second greywater treatment garden.

9 Costs and economics

Information on investment costs and operation & maintenance costs is yet to be provided. Who paid for what?

Due to the excavation required, the cost for the biogas plant was much higher than expected: on the height of 2.5 m, the groundwater flooded the pit and the further excavation (up to 6 m) had become much more demanding than expected.

10 Operation and maintenance

To disseminate knowledge on the different implemented technologies, operation and maintenance is done by trained institute staff and students.

Two gardeners and one "ecosan person" are responsible for the maintenance of the grounds. The students have to help them with the work and are responsible for the maintenance of the grounds in general and especially for the toilets. A group of approx. 10 students shares one toilet and the responsibility for its maintenance.

What are the actual tasks which are carried out, how often and by whom exactly?

11 Practical experience and lessons learnt

Three years after its implementation, the sanitation system on the DSK campus is working satisfactorily even though the operation team aims at further improvements.

Urinal centre:

The waterless urinals do not have any siphons, therefore odour control devices become necessary. Odour control devices from Shital had been installed but most probably due to incorrect

installation, odours came out of the drains anyhow and hence flushing became necessary. A Swiss odour trap (which brand? With sealant liquid?) has also been tried but since the urinals were flushed twice a day for cleaning purposes, the flushing water stream exceeded the flow capacity of those odour traps which led to flooding of the urinals.

The odour traps have therefore been removed and today the urinal is flushed 8 times a day (at peak times) with ground water (water consumption of 250-300 L/d). With this high amount of flushing water, compliance with the requirements of the WHO guidelines for safe reuse may be compromised³.

New waterless urinals are now on the market, also in India, and may be trialed in the future⁴.

How long is urine stored for?

Biogas plant and sludge drying beds:

With the actual number of 240 to 400 people permanently present on the campus, the volume of 27.3 m³ of the biogas plant has become insufficient. This leads to a hydraulic retention time of 11 to 20 days being much lower than the 45 days initially designed for.



Fig. 13: The biogas plant inside the sanitation complex (source: Annik Staub, Sept. 2008).

If the slurry was homogeneous, this would result in a very low hygienisation effect (pathogen die-off). But it was found that the slurry is inhomogeneous (liquids pass the digester faster than faecal matter). This would mean that the sludge remains longer in the digester than estimated in the design, possibly allowing for a better hygienisation. In order to check the hygienisation effect, pathogen tests are planned for a further decision on how to proceed (When? Results?). If not complying with the requirements, one option could consist in adding an anaerobic baffled reactor (ABR) to the system.

In order to increase the gas production organic material is sometimes added: from the neighbouring farmer's cow manure is added to the plant (rarely) or else chopped kitchen waste (sometimes). But if the kitchen waste is not chopped properly, the outlet of the biogas tank will be clogged: the staff has to free the jammed part with a stick. Since the chopping of the raw

³ Relevant WHO Reuse Guidelines from 2006: http://www.who.int/water_sanitationhealth/wastewater/gsuwww/en/index.html

⁴ See also this list of suppliers for waterless urinals: <http://www.gtz.de/en/dokumente/en-urine-diversion-appendix-suppliers-lists-2009-14-May.pdf>.

kitchen waste (e.g. banana peel) is time consuming and needs to be done properly (the material should be mushy), it is often neglected by the kitchen staff.

However, it should be taken into account that also the secondary treatment on the sludge drying beds contributes to a further pathogen die-off. The problem is that during monsoon, the sludge drying bed is exposed to heavy rain and as a consequence is flooded in this period. In order to reduce the moistening of the compost, an elevation of the sludge drying beds has been discussed.

Are there other lessons learnt (how was involvement of the students and school staff?). User acceptance?

12 Sustainability assessment and long-term impacts

A basic assessment (Table 1) was carried out to indicate in which of the five sustainability criteria for sanitation this project has its strengths and weaknesses.

Table 1: Qualitative indication of sustainability of system. A cross in the respective column shows where the system component is considered to have a strong (+), average (o) or weak (-) sustainability.

Sustainability criteria:	collection and transport			treatment			transport and reuse		
	+	o	-	+	o	-	+	o	-
• health and hygiene	x			x				x	
• environmental and natural resources		x		x			x		
• technology and operation	x			x				x	
• finance and economics			x			x		x	
• sociocultural and institutional		x		x				x	

Sustainability criteria for sanitation:

Health and hygiene include the risk of exposure to pathogens and hazardous substances and improvement of livelihood achieved by the application of a certain sanitation system.

Environment and natural resources involve the resources needed in the project as well as the degree of recycling and reuse practiced and the effects of these.

Technology and operation relate to the functionality and ease of constructing, operating and monitoring the entire system as well as its robustness and adaptability to existing systems.

Financial and economic issues include the capacity of households and communities to cover the costs for sanitation as well as the benefit, e.g. from fertilizer and the external impact on the economy.

Socio-cultural and institutional aspects refer to the socio-cultural acceptance and appropriateness of the system, perceptions, gender issues and compliance with legal and institutional frameworks.

For details on these criteria, please see the SuSanA Vision document "Towards more sustainable solutions" (www.susana.org).

With regard to long-term impacts of the project, the main impacts of the project are

1. Improved environmental conditions (e.g. reduced odour and groundwater contamination) - observed?
2. Reduced disease incidences from poor sanitation (observed?)
3. The learning effect for students to see wastewater as a resource
4. Experience for Navasarian Trust with ecosan systems

It must be noted that the main driver for this project was the desire to improve the existing wastewater management system. The reuse of products is an "add-on", but optimisation of this aspect (also with regards to biogas production) is not a focus point for the staff.

13 Available documents and references

- This project is shown briefly in a 1-minute promotional video clip on ecosan (from 2007), posted on Youtube: <http://www.youtube.com/watch?v=2ZQdGvpok3Y>
- Wafler, M. and Heeb, J. (2006) Report on Case Studies of ecosan Pilot Projects in India, report for GTZ-ecosan. <http://www2.gtz.de/Dokumente/oe44/ecosan/en-ecosan-case-studies-draft-report-iesni-2006.pdf>
- Find out from seecon if there is a more recent report?

14 Institutions, organisations and contact persons

Project owner and operator:

Navsarjan Trust
 Contact: Sanjiv XXX (sanjiv272005@gmail.com)
 2, Ruchit Apartments, Behind Dharnid-har Derasar, Vasna, Ahmedabad - 380007, Gujarat, India
 E: navsarjan@icenet.net
 I: <http://www.navsarjan.org/>

Technical consultancy:

seecon GmbH (Martin Wafler, Johannes Heeb)
 Bahnhofstraße 2, 6110 Wolhusen, Switzerland
 E: johannes.heeb@seecon.ch
 E: martin.wafler@seecon.ch
 I: <http://www.seecon.ch/>

Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ) GmbH
 Ecosan program
 P.O. Box 5180
 65726 Eschborn, Germany
 E: ecosan@gtz.de
 I: <http://www.gtz.de/ecosan>

Ecosan Services Foundation
 Pune, India

Technical planning/implementation

SAVE (Saline Area Vitalization Enter-prize) Ltd.
 Shree Apartment, University Hostel Road, Ahmedabad - 380009, Gujarat, India
 E: saveldad1@sancharnet.in

Suppliers of pour-flush squatting pans:

Shital Ceramics Works

103, Suyojan, Milan Park Society, near Swastik Cross Road,
Navrang-pura, Ahmedabad - 380009, Gujarat, India

E: shitalcera@rediffmail.com, shitalcera@yahoo.com

I: <http://ruralsanitation.net/>

ARIES (to supply what? Waterless urinals?)

169, New H Sector, Govindpura Industrial Estate, Bhopla,
Madhya Pradesh, India

E: ariesngo@rediffmail.com

Case study of SuSanA projects

Pour flush toilets with biogas plant at DSK Training Institute

SuSanA 2009

Authors: Martin Wafler, Johannes Heeb (both: seecon GmbH), Annick Staub (annick.staub@gmail.com) and Christian Olt (GTZ)

Editor: Carola Israel, Elisabeth von Münch (GTZ), ecosan@gtz.de

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