sustainable sanitation alliance

Case study of sustainable sanitation projects

Urine and brownwater separation at GIZ main office building Eschborn, Germany

Fig. 1: Project location

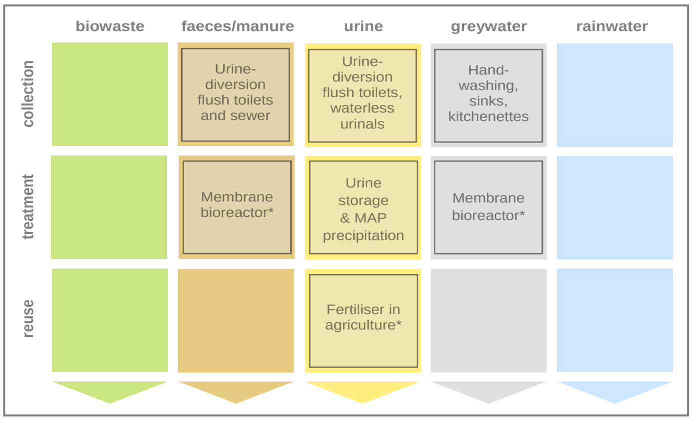

Fig. 2: Applied sanitation components in this project.
* marks components realised in phase 2.

1 General data

Type of project:

Demonstration project in an urban office building

Project period:

Start of construction: 2005
Start of operation: end of 2006 (phase 1)
Start of research project (treatment and reuse): July 2009 (phase 2, www.saniresch.de)

Project scale:

Approx. 400 employees and visitors served by the urine separation system: 50 urine-diversion flush toilets, 23 waterless urinals, 10 m³ urine storage tank. Investment costs: EUR 125,800.

Address of project location:

Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH,
Dag-Hammerskjöld-Weg 1-5
65760 Eschborn, Germany

Planning institution:

Pettersson & Ahrens Ingenieur-Planung GmbH, Germany and GIZ ecosan program.

Executing institution:

Maßalsky GmbH, Germany.

Supporting agencies:

Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH.
Hessen State Ministry for Environment (HMULV). Subsidy for Phase 1 by Investitionsbank Hessen (IBH) of EUR 43,070.
German Federal Ministry of Education and Research (BMBF) for Phase 2.

2 Objectives and motivation of the project

Objectives of the project:

1. To demonstrate the implementation of an ecological sanitation (ecosan) concept (here with urine-diversion flush toilets, urine storage and reuse) in an urban context. Ultimatively, if this technology was used widely in Germany, it could also prevent pharmaceutical residues contained in urine from entering into surface water and groundwater (as these substances are only partially removed in conventional wastewater treatment plants).
2. To reduce the amount of water used in the GIZ House 1 building.
3. To research important aspects of ecosan systems in Germany (social acceptance, reuse of urine in agriculture); this is done in Phase 2.

The GIZ headquarters in Eschborn is frequently visited by international GIZ staff and decision makers, making this a good location for the demonstration of innovative ecological sanitation concepts.

Fig. 3: The main building ("House 1") at the GIZ headquarters in Eschborn near Frankfurt, where this project is implemented (source: GTZ).

3 Location and conditions

The GIZ headquarters consists of four multi-storey buildings and is located in Eschborn, a city of 21,000 inhabitants, 10 km northwest of Frankfurt am Main, the financial capital of Germany.

Approximately 1,450 people work in the GIZ headquarters (in 2009), of which the main building ("House 1") provides space on 10 floors for about 650 employees, the canteen and one large auditorium (capacity for about 250 people). House 1 has a double-Y shaped floor plan with a central section and two wings at either end. The urine diversion system is installed only in the central section of the building. The total number of persons using the urine separating toilets is difficult to estimate but may be around 400 people per working day.

4 Project history

The GIZ main building ("House 1") was constructed in 1976. When it was 30 years old it was completely renovated during 2004 to 2006 because the environmental performance and the technological standards of the building were not satisfying anymore, creating high operation and maintenance costs.

On behalf of the German Ministry for Economic Cooperation and Development (BMZ), GIZ is running an ecosan program since 2001 to mainstream ecosan concepts around the world.

When House 1 had to be renovated, the GIZ ecosan team promoted the implementation of an ecosan demonstration and research project. This project in House 1 was planned to be implemented in two phases:

Phase 1: The construction of the urine separation, collection and storage system along with the renovation works, was financed by GIZ and subsidized by the HMULV (Hessen State Ministry for Environment). The construction of phase 1 was completed in late 2006 and the installations are being used since then.

Phase 2: In mid 2006 an application for funding for a research project on urine and brownwater[1] treatment was submitted to BMBF (German Federal Ministry for Education and Research). The research project was proposed by GIZ, universities (University of Bonn, RWTH Aachen University and Giessen University of Applied Sciences) and industrial partners (Huber SE and Roediger Vacuum GmbH). The BMBF approved the project and it has started in July 2009. It is called Sanitary Recycling Eschborn (SANIRESCH).

The research project focuses on the development of treatment technologies and reuse practices, user acceptance, environmental and health issues (particularly with regards to micropollutants), legal and economic aspects, and the applicability of the system in industrialised, emerging and developing countries.

For more informations and the latest updates visit the projects webpage: www.saniresch.de.

[1] mixture of flushing water and faeces

5 Technologies applied

SANITARY EQUIPMENT (Phase 1)

Urin and brownbater collection

The urine and brownwater separation and storage system which was installed in Phase 1 consists of:

- 23 waterless urinals
- 38 urine-diversion flush toilets for the collection of urine and feaces (originally 50 were installed)
- The urine collection is working waterless
- Brownwater consist of feaces, toilet paper and flush water
- Two separate piping systems for undiluted urine and brownwater collection
- Urine storage tanks (each 2.5 m^3) in the basement of the building

Fig. 4: Left: waterless urinal (Keramag). Right: urine-diversion flush toilet (Roediger) at GIZ main building; note the two buttons for flushing: the small one is for the urine flush, the larger one for the faeces flush (source: L. Ulrich, January 2009).

Fig. 5: Left: Plastic urine storage tanks in the basement of House 1 with connected urine pipework. Right: urine tanks with level indicating plastic pipes (source: L. Ulrich, April 2009).

Greywater collection

- The greywater derives from 6 kitchenettes (with sinks and dishwashers) and 18 hand washing basins.
- The daily greywater inflow amounts to 350 l.

PROCESS TECHNOLOGY (PHASE 2)

Urine precipitation:

Two urine treatment options are investigated:

1) Treatment by prolonged storage for direct application of urine to fields.
2) Precipitation of phosphorus and nitrogen from urine by the addition of magnesium oxide. This process produces the crystal magnesium-ammonium-phosphate (MAP) or struvite. The system is air-tight.

The hydrolysed urine (30-50 l per cycle) has a phosphate concentration of 180 mg/l. The ammonium concentration is 2,700 mg/l. During a typical week about 2,000 l of urine can be treated thus generating about 1.6 kg dried struvite. The phosphate recovery efficiency with technical magnesium oxide amounts to 50-65%. The recovery with analytical magnesium oxide increases to 90-95%.

To optimise the MAP-reactor two different filter bags were compared. The filter bags of nylon show a clearer advantage compared to filter bags of needle felt (polypropylene). However more MAP is retained in the needle felt bags which are not reusable. There is a loss of 12-37% in the needle felt bags. In opposition to needle felt bags, the nylon bags can be reused up to 3 months. On the other side, the needle felt bags are clearly cheaper than the nylon bags (2.50 € per unit compared to nylon bags with 38 € per unit).

Because of the high manual work, the MAP costs are very high. The world market price for MAP is approximately 480 € per ton.

The MAP precipitation reactor got installed in May 2010. The start up of the reactor took place. The optimisation is still going on (see Fig. 6).

Fig. 6: Left: MAP precipitation reactor manufactured by Huber SE, installed in the basement of house 1. Right: the struvite (MAP) produced.

Brownwater treatment system

The daily water consumption in the brownwater collection amounts 450 l. The brownwater treatment system in the basement of building 1 includes 2 steps:

- First step: Stainless steel tank (cylinder with a storage of 0,4 m³) as hydraulic buffer for the feed to the MBR tank and pre-treatment for solid removal (brownwater filtrate 200 l/d). The cylinder is equipped with a stirrer to prevent sedimentation in the conical part of the tank.
- Second step: Membrane bioreactor (MBR) with submerged HUBER ultrafiltration in a synthetic tank. With a vaccum (transmembrane pressure -350 mbar) the brownwater is sucked through the membrane with 38 nm nominal size. Due to the small membrane pore size, all particles, bacteria and the majority of viruses are retained.

The brownwater treatment system produces permeate from 2,000 l/d brownwater inflow rate 450 l/d. The chemical oxygen demand is reduced by 95-99%. The substance concentration in the permeate is as follows:

- Total Phosphorus: 5.2-5.5 mg P/l
- Total Nitrogen: 50-80 mg N/l
- Dry matter contents: approx. 4.5 g/l

The permeate produced is suitable for use as irrigation water. The system is air-tight. This plant got installed in July 2011. The optimisation is still going on.

Fig.7: Left: Stainless steel tank (cylinder) includes pre-treatment. Right: This is how the MBR looks like about three quarters filled up with activated sludge. The bubbles are produced by air that is blown into the reactor at the bottom of the container.

Greywater treatment system

The greywater treatment system includes three steps:

- First step: Storage tank as hydraulic buffer for the feed to the MBR tank (volume 480 l). Equipped with a preceding 3 mm sieve for the retention of hairs and other unwished matter.
- Second step: Membrane bioreactor (MBR) with submerged HUBER ultrafiltration (3.5 m^2 membrane surface) in a synthetic tank (volume 478 l). The membrane bioreactor works like the MBR of the brownwater treatment system. The flux rate of the membrane is 6 l/d*m^2 and the transmembrane pressure was adjusted to 60 mbar. The cleaning efficiency of COD elimination amounts 96%.
- The greywater inflow rate also the produces permeate rate amounts 500-600 l/d. The chemical oxygen demand is reduced to 95-97%. The substance concentration in the permeate is as follows:

- Total Phosphorus: 20-30 mg P/l
- Total Nitrogen: 12-35 mg N/l
- Dry matter content: approx. 5 g/l

- Bathing water quality is produced fulfilling EU regulations. Due to microbiological properties, permeate can be used for toilet flushing, irrigation purposes as well as process water without any problems.
- The greywater plant was installed in May 2011 and is running stable. The system is air-tight

Fig. 8: The completely installed greywater system. On the right is the control cabinet (white).

6 Design information

House 1 has a central section and two wings. The urine diversion sanitation system is implemented only in the central section. The waterless urinal are installed on all 10 floors. Originally the urine diversion flush toiletts were also installed at all 10 floors, now they are installed at 9 floors.

Fig. 9: Urinal inlet sieve with flat rubber tube as odour seal (Keramag). Left: old model (mostly replaced, see Section 11). Right: optimised new model (source: L. Ulrich, April 2009).

Waterless urinals

The Keramag waterless urinals (model Centaurus), which are made of sanitary porcelain, are equipped with a sieve made of high-grade steel and a flat rubber tube as odour seal (see Fig. 9). The flat tube opens when urine flows through it. The sieve traps pubic hair which could otherwise stop the flat rubber tube from closing properly.

Urine-diversion flush toilets

The toilets by Roediger (model NoMix) have two separate bowls for urine and brownwater collection and two pipe connections for the separated wastewater fractions. They are made of sanitary porcelain. The urine is collected undiluted (without flush water) by means of a valve located below the urinal bowl: the valve is opened when the user sits down (see Fig. 10).

There are two buttons for toilet flushing (see Fig. 4): the smaller button is for the urine flush, which releases about 1-3 L of water[2], and the larger button the faeces are flushed using 6 L of water. As users reported the 1-3 L flush to be ineffective. Mostly the 6 L flush is used. Some users even flush two - three times.

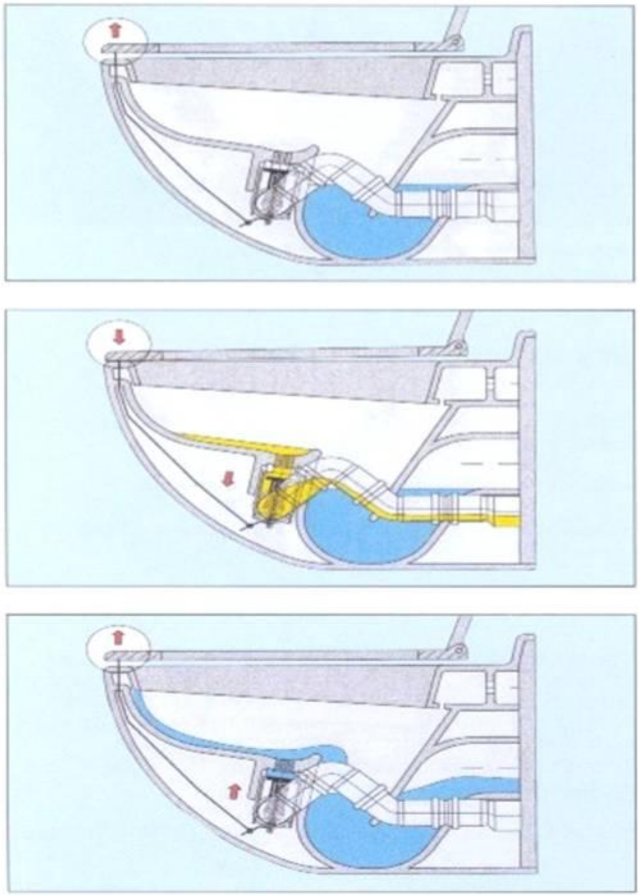

Fig. 10: Functional diagram of a urine-diversion flush toilet (source: Roediger Vacuum). Top picture: closed valve before user sits down (idle state). Middle picture: toilet in use with the valve open; bottom picture: during flushing (user no longer sitting).

Pipework

Two separate piping systems are implemented for separate urine and brownwater collection.

The urine flows from the toilets to the storage tanks in cast iron pipes with enamel (epoxide) coating. The pipe diameters are 100 mm (for the main collectors), 80 mm and 50 mm. A connection to the conventional sewer is installed as well, which enables bypassing of the urine tanks.

[2] Exact volume for the urine flush is yet to be measured on-site.

This pipe material was chosen to minimise the formation of urine stone (encrustations). Enamel has a very smooth surface. This avoids that particles get caught to the surface. Plastic pipes would also be possible and are cheaper.

Urine storage tanks

A total volume of 10 m³ is provided for urine collection and storage. The four polyethylene (PE) tanks of 2.5 m³ each are located in the basement of the building in a room in the car park area, and are equipped with sampling and level measuring devices. The pipework design allows filling each tank separately.

Measurements in 2008 showed that it takes about 3 months to fill the 4 tanks (corresponding to a storage time of 3 months). When the tanks are full, the urine overflows to a sewer. Therefore, about 40 m^3 of urine are collected per year.

7 Type and level of reuse

Urine reuse

Up to the beginning of 2010 urine has only been reused for demonstration purposes in pot plants in the offices of the GIZ ecosan team. Several times urine was transported to universities for research purposes: one entire tank load of 10 m³ was taken to the University of Aachen for MAP precipitation tests, and several batches of the urine were taken to the Universities of Giessen and Bonn for chemical analyses.

Reuse of treated urine is now realised in Phase 2. Under German fertiliser law, urine reuse in agriculture is not yet possible without special permits. In the upcoming BMBF funded research project urine is applied at a research field of the university of Bonn. Wheat, field beans and miscanthus are fertilized with it. Additionally, the GIZ ecosan team will try to establish such a permit for the application of stored urine as fertiliser on local agricultural fields.

Fig. 11: Left: Application of urine (source: U. Arnold, March 2010). Right: Cereals grown on the research field nearby Bonn (source: U, Arnold, June 2010).

MAP reuse

The MAP precipitation reactor got installed in Phase 2. In March the fertiliser test with MAP was started. The reuse of MAP takes place on experimental fields close to Bonn. Summer wheat was seeded after the first application of fertiliser. To compare the efficiency of MAP there are 4 plots without fertiliser and others with urine as a fertiliser, mineral fertiliser and MAP as a fertiliser. The struvite was applied manually to achieve an equal distribution.

Fig.12: Left: On the right parcel the plants received MAP (white powder is visible). Right: The MAP fertiliser is visible as white powder on the soil. To compare the results, there are 4 parcels without fertiliser and others with urine or mineral fertiliser.

Brown- and greywater permeate reuse

Also brown- and greywater treatment got installed in Phase 2. In the section "Process technology" at page 3 is already indicated, that permeate from the brown- and greywater treatment have a high quality. Due to these microbiological properties it is possible to use the permeate for toilet flushing, irrigation purposes as well as process water.

In this specific case the treated greywater is reused for the purging of the pre-treatment of the brownwater treatment system (see Fig.7 left). Almost the whole treated greywater is used. The treated brownwater is not reused. The reason is that the building is already supplied with process water of other origin (groundwater which has to be pumped anyhow; see also chapter 8 "Water saving"). Therefore permeate is not required and is piped into the sewer.

Fig. 13: On the left side, there is a bottle of untreated greywater visible. On the right side, there is a sample of purified greywater. It is clear and has no visible residues. The light brown colour is caused by humins.

8 Further project components

The GIZ ecosan team regularly conducts guided tours through the facilities. A demonstration room with various urine-diversion toilet models from all over the world is adjacent to the urine storage tanks.

Due to the complete renovation of the buildings facade and the use of energy efficient heating systems and boilers the energy consumption of House 1 was substantially reduced.

The new ground design and a green roof (about 50 % of the total surface) enhance a positive microclimate and reduce rainwater runoff.

The building has won several awards including the "CSR Mobility Award" for sustainable travel management in 2008 from DMM, B.A.U.M. and VCD, and the "Bike + Business Award" in 2009 from the "Planungsverband Ballungsraum Frankfurt Rhein/Main (PVFRM)" and the "ADFC Hessen".

Water saving

During 2004-2006 all four GIZ buildings in Eschborn were equipped with water efficient fittings. Two of the four buildings, including the main building, are equipped with a separate service water system for toilet flushing, hand washing and cleaning, using the groundwater that has to be pumped up in order to lower the high groundwater level for the underground carpark in the building.

The groundwater which has to be pumped anyway is used as service water in preference to the more expensive municipal drinking water. Nevertheless, the 2nd phase contains greywater treatment. This aspect was added (despite the specific situation found here) as greywater treatment is a key aspect for a decentral wastewater management system.

9 Costs and economics

Table 1 shows a cost comparison between the present prototype installation and a conventional system.

These costs are based on a prior cost estimate from the year 2004 (for scenario 1) and actual costs from the year 2006 (for scenario 2).

Table 1: Investment costs[3] (in EUR) for the collection system for scenario 1 (conventional system, based on cost estimation) and scenario 2 (ecological system installed at GIZ building, based on actual costs) for Phase 1.

Product		Scenario 1 (conventional)	Scenario 2 (Phase 1)
Urinals (23 units installed)	€/unit	790	315
	total	18170	7245
Toilets (48 units installed)	€/unit	350	1347
	total	16800	64656
Pipe systems	total	59550	84600
Urine collection tank, pumps	total	-	38800
Total investment costs	€	94520	195301
Difference (Ecosan /conventional)	€	+ 100781	

Compared to scenario 1, the additional costs of scenario 2 are 85,700 EUR (see Table 1). The relatively high costs for scenario 2 are due to the following factors:

- Some components are currently only being manufactured in small numbers (e.g. the urine-diversion flush toilets). This has led to unit costs for urine diversion toilets that were in 2005 about 5 times higher than the unit costs of conventional toilets[4].
- The urine tanks had to be manufactured specifically to fit into an existing room.
- Some units were designed with an extra safety factor (e.g. the urine pipe with enamel coating)
- The separated wastewater fractions are not reused onsite thus still requiring a sewer connection. If no sewer connection was necessary, this could lead to cost savings in the case of a new building.

The use of the urine-diversion flush toilets and the waterless urinals would reduce the water consumption for toilet and urinal flushing by approx. 364 m^3 per year compared to flush urinals and conventional toilets depending on the assumptions made.[5] As people flush often twice (due to the improper toilet design , see chapter 11), the actual water savings are lower, only 33 m^3 per year. This amount however cannot exactly be quantified because separate water meters measuring the water consumption before and after the installation of the new sanitary equipment were not installed.

Resulting from the water savings mentioned above, the calculated costs savings of scenario 2 compared to scenario 1 amount to approx. 729 (theoretical case of optional conditions) / 67 (real case) EUR/year (see Table 2).

Table 2: Estimated water-related operating costs (in EUR/year) of the two scenarios[6]. Scenario 2: “Real” includes the fact that most people flush more than ones. It calculates that every person flushs 1.7 times for flushing feaces. “Theoretical” considers the optimal conditions. One flush is sufficent in any case.

Parameters	Scenario 1 (conventional)	Scenario 2 (Ecosan, installed Phase 1)	
		Theoretical	Real*
Urinals	412	0	0
Toilets	1151	834	1496
Total	1563	834	1496
Difference (conventional – ecosan)		729	67

[3] The costs are taken of the “economic feasibility study of the new sanitation system in building 1 in the gtz headquater”; master thesis of Andrés Lazo Páez.(2010).

[4] In 2009 the unit costs for Roediger NoMix toilets were EUR 780 and for Keramag Centaurus waterless urinals EUR 505 (discounts possible for larger orders).

[5] Assumptions for this calculation: Users: 120 men and 120 women (staff and guests), 220 working days per year. Men using the urinals 2 times/day at 3,9 L/flush (scenario 1) and 0 L/flush (scenario 2) and using the toilet 0.8 times/day at 6 L/flush(scenario 1) and 6 L/flush (scenario 2). Women activating the urine flush 2 times/day at 6 L/flush (scenario 1) and 3 L/flush (scenario 2) respectively and the faeces flush 0.8 times/day at 6 L/flush (scenario 1) and 6 L/flush (scenario 2).

[6] Costs for water supply and wastewater disposal are calculated with 2 EUR/m^3 each. Maintenance costs are not included in this calculation.

10 Operation and maintenance

The installations which convey undiluted urine need special care because they are prone to the formation of urine scale (e.g. struvite).

Waterless urinals

Every evening the waterless urinals are cleaned (wiped down manually). On the highly frequented ground floor they are additionally cleaned every hour between 9:00h and 13:30h with a wet cloth and subsequently sprayed with a special odour removing cleaning agent for waterless urinals[7].

At least once a week the sieves and rubber tube seals are replaced by clean ones. The removed sieves are cleaned and stored for the replacement in the next week. The rubber tube seals are replaced about once per year when the sealing mechanism does not work properly any more (not on a regular basis). The cost of one rubber tube (see Fig 9) is EUR 17.

Urine-diversion flush toilets

The daily cleaning routine is the same as for conventional toilets. For precipitation prevention the urine valve (in open position) needs to be soaked for the weekend with urine scale removing chemicals[8] once a month. This is done one Friday in a month by filling 200 ml of this chemical into the open valve (seat pressed down to open the valve).The left detergent is flushed out with water on Monday morning. Annually, the functionality of the valves is controlled and defective valves should be cleaned or replaced. If this maintenance routine is not followed problems will occur, see below.

Compared to conventional toilets this maintenance work is slightly more time consuming. Besides the valves' cleaning, the cleaning routine does not differ from normal toilet maintenance.

11 Practical experience and lessons learnt

The toilets and urinals have been in use since the end of 2006. Since then valuable experience has been gained by operating the source separating collection system.

The users' opinion on the project and on ecosan in general

In September 2008 a GIZ internal survey about the acceptance of the waterless urinals and urine-diversion toilets as well as ecological sanitation in general was carried out. The following facts were revealed by the survey (217 participants):

- 90% of the participants pointed out that they like the idea of separately collecting urine and faeces for the application as fertiliser in agriculture.
- 71% would buy products fertilised with human excreta, whereas only 6% would not.
- 46% say urine should be permitted as fertiliser in organic agriculture, 12% think not.
- 48% would move into an apartment with urine-diversion toilets, 25% would not.
- The majority of users likes the modern design of the toilets and appreciates the installation of the novel watersaving sanitation system in the GIZ main building. However, only 5% of the users say the cleanliness of the toilet is better compared to conventional toilets, and 51% say it is worse.
- Many people complained about the higher demand for toilet cleaning after defecation and insufficient flushing strength for brownwater if a lot of toilet paper is used. 61% of the users flush the toilet more than once after usage.

Low nitrogen content of the collected urine

With 2.8 g/l[9] the measured nitrogen concentration for the stored urine is two thirds less than literature values for stored urine (7-9 g/l). One main reason for this is probably that nitrogen loss occurs in the form of ammonia gases being emitted through the tank's ventilation system. This could be reduced in the future by reducing the ventilation rate so that only pressure equalisation takes place. It is also possible that the urine may be diluted with some water added when the urinals are cleaned improperly.

Experience with the waterless urinals

The cleaning staff changes relatively often at the GIZ facilities. It has been found that thorough instruction of the staff which is responsible for the maintenance of the urinals is sometimes lacking. These problems are slightly reduced by replacing sieves and rubber tube seals with a new, optimised model (see Fig. 9) but if maintenance is neglected, then these will also cause odour problems.

As a result, the urinal sieves, and rubber tube seals were in some instances not cleaned for many weeks or months. This led to the accumulation of urinestone on the sieve (Fig. 13) as well as pubic hair and slime deposits which then cause odour problems.

Fig.14: Urine scale deposition on a waterless urinal's outlet sieve (old model) (source: L. Ulrich, December 2008). With the new model of the sieve and rubber tube seal (see Fig. 9 right), such urine scale formation and internal pubic hair accumulation is reduced.

Experience with the urine diversion flush toilets

The main problem with these toilets is that the urine pipe valve is susceptible to slimy struvite precipitations (see Fig. 15). This causes clogging of the valve, causing the urine to discharge through the brownwater pipe. Therefore, it is crucial to apply an adequate maintenance routine (see Section 10)[10]. As this maintenance has been neglected in this project, all valves

[7] URIMAT MB-AktivReiniger with Kalkex

[8] 200 ml of "MELLERUD Urin- und Kalkstein-Entferner" (urine and calcium stone remover) per toilet

[9] The total nitrogen concentration in the stored urine was measured on about five occasions.

[10] Pictures showing clogged and then cleaned valves can be seen here: http://www.flickr.com/photos/gtzecosan/sets/72157611453079661/

stopped working after about two years of use and now need to be replaced (June 2009)[11].

The trade-off between sufficient flushing strength and water saving should also be adressed in further development of the toilet bowl design. It was found that the urine flush is often not strong enough to flush away urine-soiled toilet paper. When users flush twice, water savings are negated.

About two third of female users do not sit down on the toilet seats or any other toilets in public places[12].Therefore, the urine of these females is not collected. This problem could be reduced by providing disinfection sprays for the seats.

Fig.15: Soft urine precipitations inside a urine valve of a Roediger urine-diversion toilet. This valve was disassembled and cleaned after clogging (source: L. Ulrich, December 2008). One valve costs EUR 118 and requires a bowden cable costing EUR 51 (location of valve in Fig. 9).

Results of phase 2: SANIRESCH

Within the 2nd phase many new results are coming up. It will not be possible to report everything in detail within the case study. Therefore check also the website: www.saniresch.de/en

12 Sustainability assessment and long-term impacts

In Table 3 a basic assessment was carried out to indicate in which of the five sustainability criteria for sanitation (according to the SuSanA Vision Document 1) this project has its strengths and which aspects were not emphasised (weaknesses).

Table 3: Qualitative sustainability assessment of the system. The crosses indicate the relative sustainability for each project component (column) and sustainability criterion (row). (`+´ means: strong point of project; `o´ means: average strength for this aspect; `-´ means: no emphasis on this aspect in the project.

	collection and transport			treatment[a]			transport and reuse[a]		
Sustainability criteria:	+	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	

[a] Only partially implemented for urine, MAP and greywater (see section 7).

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).

The following impacts of this project can be highlighted:

1. This project demonstrates the feasibility of urine and brownwater separation in an urban context to visitors from all over the world and thus helps to disseminate the ecosan concept.
2. By introducing an innovative sanitation system at its own main office building, GIZ shows its commitment to the ecosan approach.
3. The waterless urinals save water compared to conventional urinals.
4. This project has raised the visibility of the ecosan program within GIZ.

[11] The valves could be cleaned but are very difficult to put back into place.

[12] A very small sample size consisting of fifteen females was used.

Urine and brownwater separation at GIZ main office building Eschborn, Germany

13 Available documents and references

Detailed design information and drawings are available on request from the GIZ ecosan programme. A presentation on this project is available here:

http://www.saniresch.de/images/stories/downloads/de-presentation-gtz-eschborn-haus1-2009-09.pdf

Further information on the economic faesibility study of the installed sanitation is available in the master thesis from Andrés Lazo Páez.
http://www.saniresch.de/images/stories/downloads/MasterThesisAndresLazo.pdf

Additional information on treatment and recycling of the urine, brown- and greywater collected at the headquarters can be found at:
http://saniresch.de/en

14 Institutions, organisations and contact persons

Project owner and project champion
Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH
Ecosan program
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E: saniresch@gtz.de
I: http://www.gtz.de/ecosan

General planning

ttsp+HWP+Seidel
Planungsgesellschaft GmbH
Hanauer Landstraße 187-189
D-60314 Frankfurt am Main
E: sek@ttsp-hwp-seidel.de
I: http://www.ttsp-hwp-seidel.de

Technical planning

Pettersson & Ahrens Ingenieur-Planung GmbH
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D-61236 Ober Mörlen
E: ingenieur-planung@p-a.de
I: http://www.p-a.de

Installation

Maßalsky GmbH
Installation Heizung-Sanitär
Güterbahnhofstraße 30
D – 08371 Glauchau
E: info@massalsky.de
I: http://www.massalsky.de

Suppliers

Roediger Vacuum GmbH (urine-diversion flush toilets)
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Case study of SuSanA projects

Urine and brownwater separation at GIZ main office building, Eschborn, Germany

SuSanA 2011

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