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Waterless sanitation in UNESCO-IHE building

Delft, The Netherlands

1 General Data

Type of Project:
Awareness raising and demonstration project for waterless sanitation in the building of an international water education institute.

Project Period:
Implementation phase: April/May 2006
Operation phase: indefinitely
Reuse research phase: Possibly mid 2008 onwards

Project Scale:
11 waterless urinals and 1 urine diversion dehydration (UDD) toilet in an office building (with canteen) – approx. 150 staff members at UNESCO-IHE.

Address:
UNESCO-IHE Institute for Water Education, Westvest 7, 2611 AX Delft, The Netherlands

Planning Institution:
UNESCO-IHE Institute for Water Education, Department of Urban Water and Sanitation

Executing Institution:
Same as Planning Institution

Supporting Agency:
UNESCO-IHE Institute for Water Education and City of Delft through its Environmental Technology Subsidy Scheme

2 Objectives of the project

The main objective of this project was to raise awareness for novel waterless sanitation options and ultimately ecological sanitation by letting everyone see and use such facilities. A secondary objective was to reduce water consumption in the building (Figure 1) by replacing almost all the conventional urinals with waterless urinals (two conventional urinals were not replaced because they were located in remote areas of the building). Further objectives were to use the facilities for teaching purposes and to gain experiences regarding user acceptance.

It should be stressed that this project is by no means a “model project” for ecosan because sanitisation and reuse is not (yet) practised here. However, we believe that this projects is still important and relevant because it “paves the way” for the future (first step of raising awareness for other toilet types has been achieved).

Figure 1: UNESCO-IHE building in Delft (source of this photo and all others: UNESCO-IHE)

3 Location and general conditions

The location of the project is in the building of UNESCO-IHE Institute for Water Education, in Delft, The Netherlands. The mission of the institute is to contribute to the education and training of professionals and to build the capacity of sector organisations, knowledge centres and other institutions active in the fields of water, the environment and infrastructure, in developing countries and countries in transition.

Approximately 1400 different people visit the UNESCO-IHE building per year, including: MSc students, short course participants, staff (UNESCO-IHE, IRC, NWP and canteen staff), guest lecturers, participants at special events, etc. All these visitors to the building are potentially exposed to the eleven waterless urinals (for males) and one UDD toilet (for females). - In the building, there are now still 2 conventional urinals and 33 conventional water-flush toilets.

About 4,330 m^3 of water are used in a typical year in this building (average value for 2005 and 2006). Water is used for sanitation (urinal and toilet flushing, hand washing), for the teaching and research laboratories, in the kitchen (the building includes a canteen), as boiler top-up water and for some limited outdoor use in summer. The waterless urinals are installed in three locations in the building (eight on the ground floor, three on the first floor). They are expected to reduce the total water consumption by about 15% (or 650 m^3/year). The old conventional urinals used about 4 – 6 L per flush.

For the ladies, we installed only one urine diversion dehydration (UDD) toilet because this part of the project was deemed to be riskier than the waterless urinals. This toilet is the first UDD toilet in a public building with many different users in Western Europe (to our knowledge).

commissioned by
gtz ecosan program recycling oriented wastewater management and sanitation systems
Federal Ministry for Economic Cooperation and Development

4 Technologies applied

The supplier for the waterless urinals was the Danish company Uridan. These urinals make use of a special "blocking fluid" to block the odour from the sewer system: urine passes through the floating oil-based fluid while odour from the sewer does not. The blocking fluid is made from vegetable oil. The surface of the urinals is coated with a wax layer to avoid attachment of bacteria.

Unfortunately, the urine has to be discharged to the sewer rather than collected and stored, because funding for a urine storage tank was not available at the time (see also Section 5).

The UDD toilet was supplied by Separett, Sweden (via their Dutch supplier Ecosave), and is installed in a one-cubicle ladies toilet on the ground floor adjacent to the canteen and library. This type of toilet was selected over other UD toilets for the following reasons:

- Whilst urine diversion water-flush toilets are probably easier to accept by the user (e.g. the "NoMix" toilets by Roediger), they still use significant amounts of water and fail to raise awareness for waterless sanitation options (particularly important for developing countries; see institute's mission in Section 3).
- The Separett toilet can easily be retrofitted into an existing cubicle (it was not possible to break through the floor and use space below the toilet room for a larger faeces vault).
- This type of toilet requires less maintenance compared to composting toilets.

For aesthetic purposes, the toilet has a blue cover flap over the faeces bin, which swivels open when the user sits on the toilet seat (Figure 4). The advantage of this is that a new user does not have to see the faeces or toilet paper of a previous user. A disadvantage is that those users who prefer not to sit on a public toilet seat, but instead to hover above it, have to somehow push down on the toilet seat. Also, if the cover flap is jammed or the user does not push down on the seat, it can happen that a user defecates onto the cover flap, which would create a big mess (see also Section 11).

The cleaning staff empties the bag from the faeces bin daily to the general solid waste bin, which is located in a small court yard and emptied weekly (the bag contains mainly just toilet paper and a small amount of faeces). The urine from the UDD toilet flows to the sewer.

As mentioned in Section 2 already, this setup is far from ideal – since no sanitisation and reuse is practised in this way. But it was a practicable solution for us to realise this project within our constraints in this way, and we see this project as a "first step" to an ecosan approach.

5 Type of reuse

At present, there is unfortunately no reuse of the urine and faeces as part of this project. The reason is that the project leader has not yet obtained funding to implement this next step of the project. Reuse could possibly take place in the small court yard of the building or at Delft City Botanical Gardens.

Regular urine reuse in agriculture is not yet possible under Dutch laws except for research purposes.

Even without reuse, we believe that this project is already creating significant awareness for the potential of waterless sanitation and ultimately ecosan.

6 Further project components

Further project components include:

- Awareness raising with staff at the City of Delft, which funded the waterless urinals;
- Visits by school classes (e.g. in April 2007);
- Incorporating the facilities into teaching on ecosan (e.g. showing students our facilities, assignments in which they have to carry out surveys amongst users); and
- Possibilities for MSc-level research, e.g. studying aspects of user acceptance.

Future extensions of the project may include installation of a UDD toilet for males, and of course the implementation of sanitisation and reuse aspects (see Section 5).

7 Project History

Up until mid 2004, there was little awareness of ecosan amongst students, lecturers, professors and general support staff at UNESCO-IHE. Since then, ecosan content has been incorporated into the curriculum of several modules which form the basis of the MSc programmes, and an on-line ecosan course has been rolled out (first run in March to June 2007). We realised that we should "practise what we preach". In June 2005, UNESCO-IHE provided an "internal research grant" to allow the project leader, Dr. von Münch, to investigate waterless sanitation options for the building.

Subsequently Dr. von Münch applied for funding to the City of Delft who have an Environmental Technology Subsidy Scheme. In December 2006, the subsidy of € 6,000 was granted and this, together with contributions by UNESCO-IHE and Uridan, was sufficient to realise the project so that the facilities were installed in April and May 2006.

8 Costs

Capital costs were[1]:

- Uridan urinals (including delivery): € 7,645 (11 at € 695 each)
- Separett UDD toilet (including delivery): € 650
- Installation of all urinals (by contract plumber): € 990
- Installation of UDD toilet (by Ecosave; took about half a day): € 586
- Total capital cost: € 9,870

The cost of the UDD toilet is relatively high because it is not yet mass-produced and it includes non-essential items such as the flap covering the faeces bin and a fan which may not be necessary in all cases.

Annual operating costs or savings are:

- Lower drinking water consumption (paid to drinking water company Eneco): minus € 702 per year (estimated 15% reduction of typical water consumption of 4,330 m^3/year, at € 1.08 per m^3 for 650 m^3)
- Lower wastewater treatment charge: minus € 897 per year (at € 1.38 per m^3 again for 650 m^3), paid to Delflanden Waterboard
- Cost of blocking fluid "Urilock": € 528 per year (€ 4 for 200 ml[2]; replacing blocking fluid in all 11 urinals once per month; 200 ml needed per urinal)
- The time for cleaning of the urinals and UDD toilet, as well as time for replacement of the blocking fluid, is not significantly different compared to the situation before.
- The water savings due to the one

[1] Excluding the Dutch BTW (VAT) because UNESCO-IHE gets the BTW back at the end of the financial year.

[2] The cost of the blocking fluid used to be higher (€ 18 per 200 ml) in the first year of operation but has recently come down to the price quoted above (February 2007).

UDD toilet are negligible and are not included in the annual cost calculation.

- Total annual cost savings are therefore: € 1,071

The annual cost savings are quite low because water is cheap in the Netherlands; therefore the project payback time is long.

9 Operation and Maintenance

Just like the old conventional urinals, the waterless urinals are cleaned three times in 24 hours (early evening, morning and lunch time) by the contract cleaning staff who wipe the surface of the urinals with a moist cloth (the supplier recommends use of the Uriclean solution, which leaves a wax-like residue to prevent sticking of urine).

We are currently replacing the blocking fluid in all urinals once per month, rather than waiting for "break through" of the blocking fluid (as shown in Figure 6). We found that if we leave it longer, then eventually urine drains more slowly, and pipe blockages due to urine precipitates occur (Figure 7). The supplier states that the blocking fluid needs to be replaced after 7,000 uses of the urinal but according to our estimates, we have to replace it after only approximately 1,000 uses. Perhaps this is due to the fact that the urinals are not used at night and on the weekends, and thus the urine in the outlet tube, on which the blocking fluid floats, can become old and stagnant.

The cleaning staff cleans the UDD toilet daily and empties the plastic bag from the faeces bin to the normal solid waste bin once per day. The faeces bin is not full after a normal day of use but it is easier to keep the same daily routine for the cleaning staff. They also have to take out the small plastic insert in the toilet bowl (Figure 4) and clean underneath it (in June 2007, we permanently removed this insert to make cleaning easier; the insert is meant to slightly enlarge the urinal section).

The cleaning staff also tops up the plastic squeeze bottle (Figure 3) with water – the users can use this bottle to rinse the urine compartment (e.g. to remove traces of menstrual blood in the urine compartment).

About once every two months, the cleaning staff should remove the wire mesh filter at the air intake to the fan inside the toilet and clean this filter under running water (the filter is just visible in Figure 8).

The inside of the toilet and the underside of the toilet top should also be cleaned about every three months to ensure hygienic conditions and to keep odour to a minimum. There have been some rare occasions when the inside of the toilet was messed up (with greywater or even with faeces). This is difficult to clean but should happen only very rarely (see Section 11).

The urine discharge pipe will need to be cleaned from time to time to prevent blockages caused by build-up of urine precipitates (we have not yet experienced any problems with the urine pipe during the first 13 months of operation).

10 Design information and technical specifications

The specifications for the waterless urinals as supplied by the manufacturer (Uridan a/s) are listed below:

- Sanitary porcelain, wall mounted (Figure 2)
- Uses oil-based blocking fluid to seal off odours from the sewer pipes

The specifications for the UDD toilet (model Villa 9000) as provided by the manufacturer (Separett) are listed below:

- High-gloss polypropylene, recyclable (Figure 3)
- Urine pipe to sewer (Ø 32 mm), no water is used for flushing
- Vent pipe (Ø 75 mm) to building's ventilation system (vent pipe shown in Figure 3)
- The faeces and toilet paper are stored in a plastic bag in a bin (23 L volume) inside the toilet, see Figure 8
- The inside of the toilet is ventilated by a small two-speed fan (11.5 W or 16.5 W) which is plugged into a 230 V power outlet (fan shown in Figure 8).

The toilet in its current configuration cannot be used by people who use water for anal cleansing since there is no provision to collect the anal washwater separately (it could potentially be collected in the urine compartment of the toilet together with the urine).

The toilet was easily retrofitted into an existing toilet cubicle. The toilet's vent pipe was connected to the existing ventilation system (duct in the ceiling).

Figure 2. Installed Uridan waterless urinals

Figure 3. Installed UDD toilet in toilet cubicle for females. Note plastic squeeze bottle on the left for rinsing urine compartment.

Figure 4. Top view of UDD toilet (the blue flap opens once the user sits down – we removed this flap in May 2007, see Section 11)

Behind this door...
You will find a sustainable toilet which uses no water!

Why doesn't it smell?
Dry faeces don't smell; urine and faeces are collected separately; a fan is drying the faeces.

Who can use this special toilet?
Female adults and children under supervision.
"Wipers" only – this toilet is not set up for "washers" yet.

What are we trying to achieve?
Raise your awareness of sustainable dry sanitation.

What are the benefits?
Urine and dried faeces can be converted into a fertilizer instead of polluting water. This is the ecosan approach of "closing the loop".

Financed by: City of Delft and UNESCO-IHE (toilet costs € 650)
Project leader: Elisabeth von Münch (e.vonmunch@unesco-ihe.org)
Implemented by: Harry Pleunes Commissioned: 8 May 2006
Manufactured by: Separett (www.separett.com)
Local supplier: Ecosave (www.ecosave.nl)

Instructions for Cleaning Staff for the dry toilet
Daily Tasks:

1. Clean urine bowl and faeces compartment with your usual detergent and a damp brush (avoid any water entering the faeces bin since this will cause odour!).
2. Check level in faeces bin by pressing on the seat to open the blue lid.
3. Empty faeces bin when half full or when it is excessively wet or smelly.
4. To empty the faeces bin: open toilet, take out plastic bag, replace with new plastic bag. Dispose the used plastic bag with concent in the normal waste collection.
5. Ensure that the fan at the back of the toilet remains switched on at all times.
6. Ensure watering can is topped up.
7. Clean tiles surrounding the toilet and other parts of the toilet as usual.

Summary
- No water or urine into blue faeces compartment at the back (a couple of drops are OK)!
- No faeces into white front urine part!
- Menstrual blood: no problem
- Do not use this toilet if you use water for anal cleansing

4 easy steps to use this toilet

1. Sit down or use your hand to push down on the toilet seat: this will open the blue lid of the faeces compartment.
2. You can now use this toilet: ensure that your urine is collected in the white front compartment; ensure that your faeces drop into the blue back compartment (ideally, the faeces should not touch the sides).
3. Deposit used toilet paper into the faeces compartment or separate bin (tampons or sanitary pads should be deposited in the waste disposal bin).
4. Check if any cleaning-up is necessary: Please use a moist brush to clean away faeces stains (brush can be rinsed over urine compartment). You can rinse the urine compartment by using the squeeze bottle provided.

→ Well done - you have just saved 10 litres of drinking water and also did not produce 10 litres of wastewater!

Please report any problems to the reception or Harry Pleunes
Comments welcome: e.vonmunch@unesco-ihe.org

Figure 5. Explanatory posters at the toilet for users and cleaning staff

11 Practical experience and lessons learned, comments

Our experiences with the waterless urinals during April 2006 to June 2007 are summarised below:

- The odour level from the urinals has been satisfactory (57% of users reported "not more odour than usual" in a survey of 83 users conducted by MSc students in February 2007), but could probably be reduced further if the urinals were cleaned a fourth time in 24 hours.
- The blocking fluid needs to be replaced more frequently than originally anticipated (see Section 9); fortunately its cost has recently been reduced (see Section 8).
- Pipe blockages with urine precipitates are occurring from time to time (Figure 7).
- Most Muslim students at our institute do not use these (or any public) urinals because they need privacy to wash with water after urinating.
- We have decided to also try out a different type of waterless urinal, and are therefore installing one waterless urinal from Keramag (model Centaurus) in July 2007, which uses a membrane / collapsible rubber tube smell stopping device rather than a blocking fluid.

Regarding the UDD toilet, we have made the following experiences in the period May 2006 to June 2007:

- In general, the feedback from students and staff members about this project has been positive; in a student-administered survey in July 2006, an overwhelming majority answered with "yes" when asked "should this toilet stay for the foreseeable future?", and only 12% said it "is a bad idea" when asked whether this toilet was a good or a bad idea (out of 50 females who took part in the survey).
- Some females do not like to use this toilet because they think it is not hygienic and they do not like the concept of sitting over an open bag of faeces (some are even "horrified" by the idea, according to a user survey).
- There have been occasions when too much urine had been discharged to the faeces bin, but this has become much rarer after about 2 months of operation.
- Approx. twice in 13 months of operation, somebody defecated into the urine collection front part of the toilet where the faeces got stuck, blocked the urine outlet and resulted in a very unsightly look.
- Some of the contract cleaning staff are refusing to carry out the daily task of faeces bin emptying, even though their supervisor has accepted this task for the cleaning company.
- The capacity of the toilet has been reached when there was a large gathering in the evening. Once the faeces bin is full with toilet paper, the blue cover flap can get stuck and either not open or not close.
- There have been some isolated occasions when somebody defecated onto the blue cover flap over the faeces bin (probably because the cover flap was jammed or because that person did not sit down on the toilet seat). - For this reason (and because the opening mechanism had broken), we removed the cover flap in May 2007. This now reduces the possibility for user error and results in fewer moving parts (some females reported however that they would prefer the flap back on for aesthetic and psychological reasons – so there is a trade-off here).
- 81% of 36 users in a survey in February 2007 stated that they only urinate into this toilet and do not use it for defecation (in effect treating it like a female urinal).

It has become clear to us that the cleaning staff needs constant support, encouragement and checking up on, particularly since there is a high turn-over of cleaning staff and little understanding regarding the purpose of this UDD toilet.

Figure 6. Break-through of blue blocking fluid in waterless urinal, indicating that the blocking fluid needs to be replaced.

Figure 7. Urine precipitates causing a blockage in the urinal outlet pipes of 3 urinals after 6 months of operation (one long thin tube is placed inside of one short thick tube for each urinal)

Figure 8. Open UDD toilet showing bin with toilet paper and faeces and urine drain pipe at the front. Note small fan inside the toilet at the rear.

Figure 9. Dirty UDD toilet after careless user (note faeces stains) – some users do not use the brush provided

12 Available documents and references

von Münch, E. and Panesar, A. (2007) Awareness raising for ecosan by use of waterless urinals and a UDD toilet at a water education institute in the Netherlands, *Advanced Sanitation Conference* (poster presentation), Aachen, 12-13 March 2007

13 Institutions, organisations and contact persons

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Supplier of waterless urinals:
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http://www.uridan.com

Supplier of UDD toilet:
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data sheets for ecosan projects

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