4th International Dry Toilet Conference

A New Learning Environment for Sanitation and Wastewater Use at Tampere University of Applied Sciences

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Tampere University of Applied Sciences has built a learning environment about dry sanitation and water treatment in the new laboratory facilities at the main campus. The building consists of water and wastewater laboratories, a greenhouse and various toilet facilities. These include two different types of dry toilets: one being a commercial urine-separating model Biolan Naturum and a two-story model, where the toilet seat is on one floor and the composting bin is downstairs in the basement. The learning environment also includes two water-saving toilets: a vacuum toilet and a source-separating Eco-Flush model. These toilets are used for demonstrating alternative sanitation solutions for indoor purposes and they are in everyday use at the university. The aim is to demonstrate that there are functional alternatives to conventional flush toilets and everyone can test them. This is important especially for reducing biases towards dry and water-saving toilets. In addition, especially the dry toilets are used for research and development. The urine and faecal compost will be used in growing crops in the greenhouse in the winter and outdoors in the summer and study different features of these fertilisers and evaluate the possible health risks for the consumers.
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Keywords: *dry toilet, faecal compost, greenhouse, grey water, source separation*

Introduction

Tampere University of Applied Sciences has built a learning environment about dry sanitation and water treatment in the new laboratory facilities at the main campus. The learning environment was built during a project for the renovation of the laboratory facilities at the university, funded by the European Regional Development Fund. In addition to the dry toilets, the learning environment was equipped with a geothermal heating system, two solar panel systems and wind power plants for studying renewable energy production (OPI ENEMPI, 2012).

The toilet facilities at Tampere University of Applied Sciences will be used for demonstrating alternative sanitation solutions for indoor purposes and they are in everyday use there. The aim is to demonstrate that there are very functional alternatives to conventional flushing toilets and everyone can test them. This is important especially for reducing biases towards dry and watersaving toilets. The university encourages the students and staff members to try the alternatives and the learning environment has also been very popular site for professional excursions from outside of the university. In addition, especially the dry toilets are used for research and development projects.

Description of the learning environment

The learning environment for water and sanitation opened in autumn 2010. The building consists of water and wastewater laboratories, a greenhouse and various toilet facilities. These include two different types of dry toilets: one being a commercial urine diverting model (Biolan Naturum) and a two-storey model, in which the toilet seat is on one floor and the compost container is downstairs in the basement. In addition, the learning environment includes two water-saving toilets: a vacuum toilet and a source-separating Eco-Flush model. These are the first indoor dry toilets to be placed in a public building in Finland. The facilities have raised a lot of interest among the university staff and students, as well as among the general public and experts from outside the university.

Biolan Naturum Dry Toilet

The commercial model of Biolan Naturum is installed as a urine-diverting dry toilet (UDDT). The urine from the toilet seat is stored in a tank located in the basement of the building. In the same toilet cubicle, there is also a waterless urinal, which is also drained to the same urine tank in the basement (Figure 1).

Two-story composting dry toilet

The two-storey composting dry toilet consists of two parts. On the first floor is the seat, which does not divert the urine, and all the excreta and papers are collected together in the same compost container in the basement. After every use, the user adds a mixture of peat and wood chips through the seat into the container. This way of using a dry toilet is typical, when composting (Figure 2). This model is a pilot and is not yet in commercial use.

Figure 1. Biolan Naturum UDDT (left) and Falcon waterless urinal (right).

Figure 2. Two-story composting toilet seat in the first floor (left) and compost container in the basement (right).

The ventilation of the dry toilets is through the toilet, via the fecal duct, and in the toilet cubicle there is no competing ventilation. In the ventilation pipe in the basement, there is an automatic gas monitoring system that measures O_2, CO_2, CH_4, NH_3 and H_2S concentrations in the outgoing air (Figure 3).

Wastewater treatment in the laboratory

In the laboratory, facilities for testing different wastewater treatment systems, and analysing the wastewater quality results are organised. In addition, very good chemical laboratory facilities are available. A greenhouse with heating and adjustable lights makes it also possible to implement growth experiments using urine and compost as fertilizers (Figure 4). So far, experiments using biological wastewater treatment systems have been implemented.

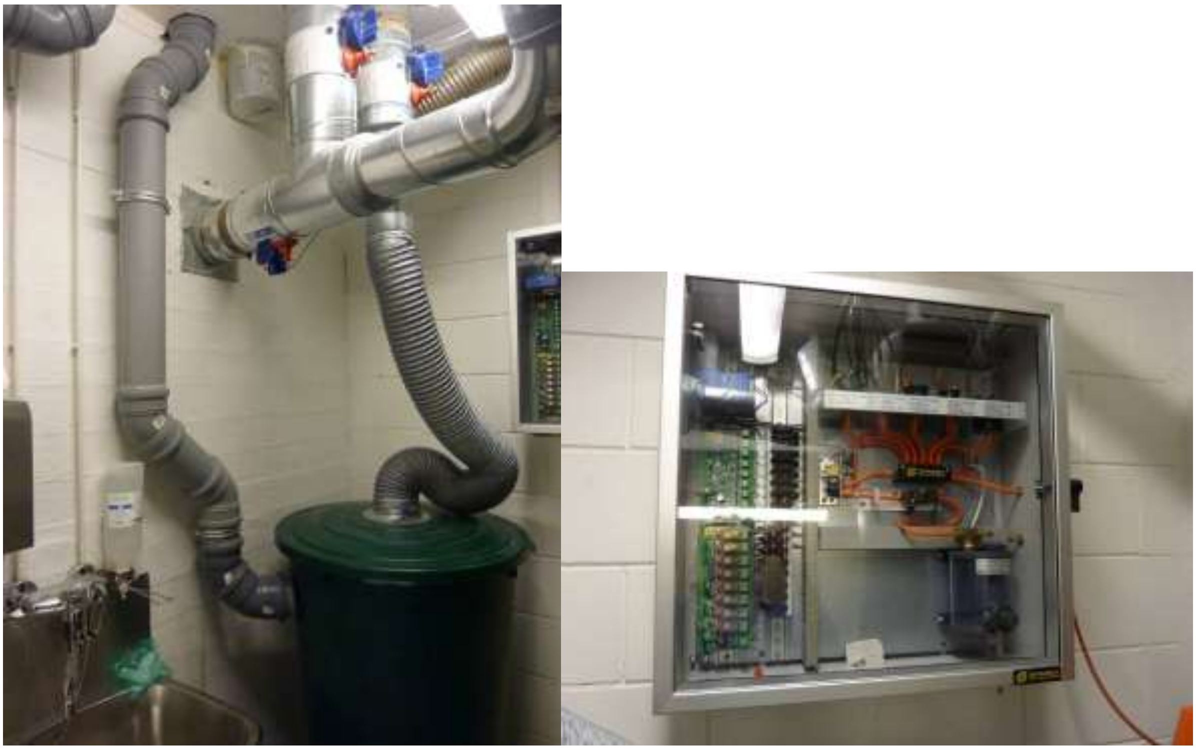

Figure 3. Urine tank and drain pipe from upstairs (left). In the same room is the gas monitoring system of the compost container of the two-story dry toilet (left).

Figure 4. Greenhouse and laboratory from outside (left) and tests of managing wastewater using willow stack tower (see text) inside the laboratory (right).

Water-saving toilets

Two water-saving toilet options are also installed into the laboratory facilities. They are an Eco-Flush urine-diverting toilet seat and a Jets vacuum toilet. These toilets are not used for research at the moment, but instead used as demonstration models of water-saving alternatives. the vacuum toilet uses only 0,5 litres of water to flush the excreta. It requires electricity and a pump to work. The Eco-Flush needs 0,5 litres of water for flushing urine and 3 litres for flushing faeces. (Figure 5).

Figure 5. An Eco-Flush urine-diverting and water-saving toilet (left) and a Jets vacuum toilet seat with its pump (right).

Research and experiences

After initiating the use of this learning environment, several different research and development projects have been implemented. They include an analysis of users' experiences and giving feedback to the manufacturers of these dry toilets. So far, a number of things have been modified, especially with the two-story toilet. The user feedback will be used in improving these models. The biggest problems in the beginning were related to the ventilation and odours in the dry toilet. The smell of urine was rather strong in the beginning in the Naturum toilet. This was because the urine hose was not sealed properly in the toilet cubicle. Thus the hose was like a chimney that pushed the smells into the toilet. The ventilation through the toilet was also too strong in the beginning, thus causing an unpleasant feeling for the user and drying the compost too much. After adjustments, a balance was found and currently both dry toilets are working without odour problems.

The two-story model was emptied for the first time 1,5 years after entering into use. Black, fertile and earthy-smelling compost was transferred out for post-composting, according to the WHO guidelines (WHO, 2006). This compost will be used for plantings in the university grounds, as well as in research within the greenhouse and laboratory.

A comparative study of the hygienic quality and cleanliness level between dry toilets and flushing toilets was implemented (Kouri, 2012). The hygienic quality of the all different toilets (Eco-Flush, Jets vacuum toilet, Naturum dry toilet and two-story composting dry toilet) and the waterless urinal was also studied and compared to the hygienic quality in flushing toilets and urinals at the same facilities. The study was done using Hygicult TPC –test. It was found that in all the dry toilets, the Eco-Flush toilet and waterless urinal the hygienic quality was good or excellent and they were equally clean as their flushing counterparts. Only the Jets vacuum toilet had a bit poorer results, in which the hygienic quality was classified as poor. This might be related to the material or function of that toilet, since the cleaning was done by the same person in all toilets. Apart from the vacuum toilet, it can be concluded that the type of toilet does not affect the hygienic quality. What counts is the maintenance and cleaning. At these TAMK facilities, the cleaners have instructions on how to clean the toilets and they are maintained regularly. Thus there are mostly no problems in the cleanliness of the toilets.

In addition, the gas formation, ventilation and other technical points have been monitored and reported from the toilet. This includes gas monitoring with different user rates and user feedback and suggestions for improving the systems. These results are presented in this conference (Tsang et al., 2012).

The learning environment is built in a way that enables closing the nutrient loop within the facilities. The urine and faecal compost will be used in growing crops in the greenhouse in the winter and outdoors in the summer, to study different features of these fertilisers and evaluate the possible health risks for the consumers. First tests using urine as a fertilizer were implemented in the winter of 2011-2012, using lettuce as model plant and these are presented in this conference (Viskari et al. 2012).

Users' experiences at the dry toilets

Even though the learning environment has been the pride of the university and several Finnish and foreign visitor groups have been visiting it, attitudes towards the use of these toilets are apparently still not easy to change. From January 20 till May 31, 2011, a user experience study was implemented. Twenty members of the staff were recruited to use the dry toilets during the study time. During this time, they reported their use via a form posted on the toilet room wall to be filled out every time the toilet is used. The user was asked to make a mark under ‘small thing’ (urine) or ‘big thing’ (faeces) after each use. A space was also left in the form for general instant comments to be given if the user wished to do so. At the end of the study period, a feedback questionnaire was completed by each user.

Results

The usage frequency of the dry toilets is presented in Table 1. As can be observed the user frequency was not very high compared to a toilet use at household. The total use was one to two times a day for the Naturum and once a day for two-storey composting toilet. It could be that some of the users forgot to mark the use of the toilet and thus the user rate result was quite low. In the future some other, more accurate method of estimating the use could be implemented. This could be for example measuring the volume of material collected.

Table 1. Instance of use in the two dry toilets.

	Number of visited times	
	Urine	Faeces
Naturum UDDT	129	60
Two-story composting toilet	116	15

Almost all the users (80 %) had previous experiences using dry toilets. Dry toilets are very common in Finnish summer cottages, where most users had used them. Indoor dry toilets, however, were a new experience for most users. ((It is not proper to start a sentence with a number in English.)) Eighty percent of the users considered dry toilets to be equally hygienic to flushing toilets. Sixty percent of the users said that the toilets did not smell and that they would consider getting a dry toilet in their household. Sixty to seventy percent were also ready to change their working and cleaning habits, in order to maintain a dry toilet in the household, even though 40 % thought that the maintenance was more laborious than maintaining a flushing toilet.

Seventy percent of the respondents said that the future of composting dry toilets is bright. They reasoned
that the presence of less waste-water treatment infrastructure, the increasing need for sanitation improvements in developing countries, the increase in the rationality of citizens and the need to save water would all propel the use of dry toilets to become more and more common in the future.

Discussion

In spite of the encouraging results of the user experiences of the dry toilets, there was a significant change in the users' behavior after the study ended. The user frequency of the dry toilets went down remarkably. Many users that were committed to use the dry toilets during the experiment, switched back to the flushing toilets. One reason could be that the location of the toilets is challenging, because some users needed to come from a long distance to use the toilets. Nonetheless, some people who had easy access to the dry toilets, also switched back to the flushing toilets. This indicates that taking part in the study was more like a duty and did not result in any permanent change of behavior. The idea of dry toilets is understood and considered worth developing, but in many cases that was not seen to be one's own opportunity or duty. It seems that the biggest obstacle in using dry toilets is in attitudes and prejudice (e.g. Duncker, 2006). Therefore, we cannot state that using dry toilet for about five months would necessarily change anything permanently.

From a technical point of view, the toilets have proven to be reliable and easy to use. After solving the main issues with ventilation and maintenance, the use has been easy. Some more effort is needed in the maintenance, since emptying the toilets is now and in the future our own job. Thus the start has been very promising. Yet more detailed research is needed about the user experience as well as function of the toilets.

In addition to user experiences and influencing people's attitudes, the learning environment serves education in many other ways as well. The technical development, testing and closing the nutrient loop still has many knowledge gaps that can be filled in this environment. Thus we welcome all parties interested in developing this environment to work with us, since it seems that we are only in the beginning.

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