



## Assessment of a Waterless Toilet

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### Author's contribution

The sole author designed, analyzed and interpreted and prepared the manuscript.

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### ABSTRACT

Waterless toilets are decentralized compost toilet systems that process human wastes within its own confinement. The aim of this research was to assess the current status of a waterless toilet at the Federal University of Technology, Akure (FUTA) and to propose a solution to the identified problems. Data were collected using both informal and formal surveys. The informal survey was done via direct observation while the formal survey was undertaken by administering and analysis questionnaires. Direct observation was undertaken to access the physical state and sanitary condition of the toilet and its environment while questionnaires were administered to 50 respondents in order to corroborate the informal survey. The informal survey revealed the poor hygiene condition within the toilet facility due to lack of maintenance and non-provision of cleansing material. Also, outside the toilet facilities, the environment was littered with human waste. The result from the formal survey expressed the user's fear of catching germs. Findings from the survey show that over 70% of respondents would be comfortable in using the toilet if it is well maintained. Some of the remedies recommended to improve the hygienic condition of the toilet include provision of instructional material to orientate users on the use of toilet, constant maintenance and provision of buckets of ash / wood shavings and scoopers to be applied to the faeces to act as a bulking agent and also to reduce unpleasant odour.

**Keywords:** Waterless toilets; waste; compost; odour; treatment.

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## 1. INTRODUCTION

Waterless toilets are decentralized compost toilet systems that process human waste and toilet papers on site [1]. It is known by a number of names such as dry toilets, biological toilets, or compost toilets. Waterless toilets work on the principle of composting i.e waste is broken down under anaerobic and aerobic conditions in a chamber. This type of system uses bacteria to break down organic materials, destroy pathogens, disease organisms and can even degrade toxic chemicals, thereby turning the waste it into a nutrient-rich fertilizer that can be applied to trees, flower beds and other plants [2,3]. Waterless toilets offer a remarkable solution to the problem of waste disposal as it does not only eradicate the problem of pollution due to the discharge of wastewater into water bodies but they also reduce the volume of the waste to about 10% of its original volume thereby reducing the footprint [1]. With increased pressures from water scarcity and population growth, the advantages of composting toilets have become more appealing and sensible. The benefits of waterless toilets are numerous, and have therefore been implemented in numerous domestic and non-domestic institutions [3].

The re-use of human excreta and organic waste as fertiliser is not new in the world. Many communities have developed systems for containing waste and using it in their fields, but this practice is disappearing as people adopt modern systems of sanitation where waste, urine and excreta are disposed of through a sewer system or other waste collection and disposal systems [4]. A modern example of waterless toilet is the concept of EcoSan toilets (Ecological Sanitation Toilets) which was first introduced in Nepal in 2002, and since then various models have been constructed in different parts of the world. Several organisations, including governmental and non-governmental agencies as well as some international agencies have adopted different technologies and are involved in promoting this technology. It has also increased the level of awareness about this technology and its benefits among professionals and policy makers [2]. Waterless toilets have gained recognition and have been listed in the 2006 World Health Organisation Guidelines for the Safe Use of Excreta and Greywater [5] and recognised by the Joint Monitoring Programme of the Millennium Development Goals as one of five possible systems of improved sanitation [6].

However, despite this positive development in waterless toilets there remains a lot of work to be done before a paradigm shift in sanitary provision from ordinary toilet to an ecologically sound sanitation. Over the years, users of the waterless toilet have been plagued with the interaction with faeces and the offensive smell of the toilet due to lack of maintenance. The ascertainment of the hygiene and sanitation condition of the waterless toilet has been questioned, as fears have been raised that frequent use of the toilet could cause a number of toilet diseases. Poor toilet hygiene has been found to be responsible for quite a number of diseases such as cholera, typhoid, and staphylococcus, amongst others [7,8]. In view of this, in order to encourage the use of these toilets, there is need to optimise the designs, raise awareness and develop systems to scale up the application. There is also a need to develop environmental and ecological arguments for waterless toilet and illustrate that it does make sense to recycle our waste including human faeces.

This paper looks at the current status of a waterless toilet in the Federal University of Technology, Akure (FUTA) and proposes a solution to the identified problems. The assessment was aimed at providing information about the current state of the sanitation and hygiene condition of the toilet and user's perception of the toilet. The information from the assessment could also serve as basis for further research work in terms of design, management and use of the toilet. These toilets were commissioned on 3<sup>rd</sup> of December, 2002 and were put into use the following week.

## 2. METHODOLOGY

### 2.1 The Study Area

This project was carried out within the premises of Federal University of Technology, Akure, Nigeria. The waterless toilet (Fig. 1) is located behind the Centre for Research and Development, CERAD and opposite to the 3-in-1 lecture theatre at Obanla, FUTA. The toilet lies with the coordinates 7°15'0"N 5°11' 42"E and it was designed with the aim of providing a sanitary facility for defecating and urinating for students using the 3-in-1 lecture theatre and CERAD staff. There is no user barrier as students, workers and passers-by are all privileged to use this facility.

The waterless toilet has both male and female compartments. Directions are clearly written on

the wall in order to indicate each compartment. Both compartments have two toilet receptacles and one urinary.

However, the waterless toilet has its limitations. It was not designed to meet the needs of handicapped. Hence, one with disability such as lameness, blindness, etc., is not able to make use of the toilet facility. Another limitation is that it cannot accommodate more than 3 users at a time. This is not adequate as compared to the population of the area it's meant to serve.

## 2.2 Sampling Technique

For the purpose of this research work, simple random sampling was used while selecting persons for administration of the questionnaires. Several locations were selected around the area of the Enviro-loo waterless toilet and beyond. Questionnaires were administered to persons in 3-in-1 lecture hall, ETF lecture theatre and also at Obakekere inside the campus. A few of the questionnaires were administered off-campus in order to get an accurate result. Over two-thirds of

the questionnaires were distributed on the campus because most of the users are resident on campus.

## 2.3 Data Collection

Data was collected using both informal and formal survey. The informal survey was done via direct observation while the formal survey was done via administering questionnaires.

### 2.3.1 Informal survey

#### 2.3.1.1 Direct observation

Visit was made to the Enviro-loo waterless toilet behind CERAD in order to carry out on-the-spot assessment involving the physical examination of the toilet surroundings and also its sanitation and hygiene condition. The observation was done using visual and photographic aids of objects and site. The observation helped to obtain unbiased information that would corroborate information obtained through formal survey.



**Fig. 1. Waterloo toilet, Federal University of Technology, Akure**  
(Source: Google Earth)

### 2.3.1.2 Formal survey

This was done to support the data gathered through informal survey and also to quantify specific issues. The questionnaire administered had earlier been validated through a test run and was administered to 50 respondents. Several questions relating to sanitation and hygiene were carefully selected for use in the questionnaire. The sample population was based on the estimated population of staff and staff that will likely use the toilet in a day. The toilet is within the premise of CERAD which houses about 30 staff and 3 in 1 lecture theatre which could accommodate over 60 students a time. A confidence level of 95% and interval of 10 were considered.

### 2.4 Data Analysis

Data from the questionnaires were entered into Microsoft Excel worksheet. Data was entered in form of codes after which they were transferred into SPSS for analysis. Frequencies of responses were calculated in the Microsoft Excel, while Statistical Package for the Social Sciences (SPSS 16®) was used to analyze socio-demographic pattern and other aspects. Responses were subjected to descriptive statistics which include frequencies, charts, etc.

## 3. RESULTS

### 3.1 Physical Environment

Informal survey as at the time of inspection showed the poor sanitation condition of the toilet as there was presence of flies in the toilet facility. It was also noted that there was presence of paper, cartons and waste water in the toilet facility. This shows evidence of poor maintenance as the floor and wall of the toilet also had presence of waste and faecal material. The surrounding of the toilet facility was unkept as there was presence of tall bushes and debris around the area (Figs. 2 & 3). The existence of tall grasses also makes the toilet facility vulnerable to snakes and other deadly crawling animals. This makes the toilet unsafe for use as users could be attacked by snakes or get poisoned by other deadly crawling animals. There is evidence of solid wastes on the floor of the toilet. The sight and smell of the toilets does not look appealing due to the present of urine and faecal material in the toilet hole sand seat thus showing the toilet is not properly used and maintained (Figs. 3 & 4). It is an evidence of poor maintenance culture and nonchalant attitude by users. An intending user would be greatly displeased at the sight of dirt and faecal material on the toilet seat. This will of course discourage people from using the toilet.



Fig. 2. Surroundings of the Enviro-loo waterless toilet behind CERAD



**Fig. 3. Littered surrounding of the toilet facility**



**Fig. 4. Toilet bowl stained with faeces**



**Fig. 5. Littered floor of the toilet**

### 3.2 Sanitation and Hygiene

There is lack of provision of tools for proper hygiene practice at the site of the toilet. As at the time of inspection, there was lack of soap for hand washing after toilet use. There was unavailability of water though there was presence of a wash-hand basin. It was also noted that the wash-hand basin was dirty. This shows that users do not practice proper toilet hygiene which can expose users to toilet diseases such as cholera and typhoid. They also stand the chance of contacting viral and bacterial diseases causing numerous infections. It was also noted that there were presence of flies in the toilet facility. The sight of flies and the irritating sounds and noise are offensive to users, thus users tend to prefer alternative toilets. Presence of flies in the toilet facility also shows lack of adequate maintenance. That is, it is a visible evidence of poor maintenance of the toilet facility. Houseflies are vectors capable of transmitting deadly diseases such as cholera, typhoid fever, dysentery and a number of other diseases. Although only one of the respondents claimed that he might have contacted a disease from the toilet, it is a fact that there is a high tendency of users being infected with any of the deadly diseases mentioned above.

## 4. FORMAL SURVEY

### 4.1 Gender of Respondents

68% of the respondents were male while 32% of the respondents were female. This dispersion is due to the fact that there are more male students in FUTA than females (Table 1).

**Table 1. Distribution of respondents in terms of Gender**

	Frequency	%	Cumulative%
Male	30	68	68
Female	14	32	100
Total	44	100	-

### 4.2 Status

18% of the respondents were in their first year. 27% were in their second year and 14% were in their third year. However, there were no respondent in the fourth year which was due to the fact that such categories of students were on their Industrial Training as at time of this research. 39% of the correspondents were in

their fifth year while only 2% was in Post graduate level. No academic staff was available (Table 2).

**Table 2. Status of respondents**

	Frequency	%	Cumulative %
1 <sup>st</sup> year	8	18	18
2 <sup>nd</sup> year	12	27	45
3 <sup>rd</sup> year	6	14	57
4 <sup>th</sup> year	1	2	59
5 <sup>th</sup> year	17	39	98
Post graduate	1	2	100
Total	44	100	

### 4.3 Age Bracket

11% of respondents were between the ranges of 14-18 years. 55% of the respondents were in the bracket of 19-23 years. 27% were between 24-27 years old while only 7% was 28 and above years old (Table 3).

**Table 3. Age of respondents**

	Frequency	%	Cumulative %
14 - 18 Years	5	11.4	11.4
19 - 23 Years	24	54.5	65.9
24 - 27 Years	12	27.3	93.2
28 Years & above	3	6.8	100.0
Total	44	100.0	

### 4.4 The Toilet is not Different from a Pit Toilet

18% of respondents strongly agree to the statement that the toilet is not different from a pit toilet. 23% simply agreed while 32% were neutral in their opinion. 25% disagreed while only 2% strongly disagreed. It could be inferred that majority of the respondent believes that waterless toilet is not the same as pit latrine (Table 4).

### 4.5 Flush Toilet is Better than the Waterless Toilet

45% of respondents strongly agreed that the flush toilet is better than the waterless toilet. 9%

also agreed while 25% were neutral in their opinion. 16% however disagreed while only 5% strongly disagreed that the flush toilet is better than the waterless toilet. The result shows that majority of the respondents believe that the flush toilet system is better than that of the waterless toilet (Table 5).

**Table 4. Respondent’s reaction to comparing waterless toilets to pit toilets**

	Frequency	%	Cumulative %
Strongly agree	8	18	18
Agree	7	16	34
Neutral	8	18	52
Disagree	12	27	79
Strongly disagree	9	21	100
Total	44	100	

**Table 5. Respondent’s reaction to if flush toilets is better than the waterless toilets**

	Frequency	%	Cumulative %
Strongly agree	20	45	45
Agree	4	9	54
Neutral	11	25	79
Disagree	7	16	95
Strongly disagree	2	5	100
Total	44	100	

#### 4.6 Fear of Catching Germs when Using the Toilet

Respondents were asked if they had any fear of catching germs from the toilet when using it. 89% of the respondents claimed they had fear of catching germs while 11% stated they had no fear (Table 6).

**Table 6. Respondent’s fear of catching germs when using the toilet?**

	Frequency	%	Cumulative %
Yes	39	89	89
No	5	11	100
Total	44	100	-

#### 4.7 The Toilet is not Clean Enough

39% of the respondents strongly agreed that the toilet is not clean enough. 27% simply agreed to this statement while 27% were neutral in their opinion. However, 7% disagreed while 4% strongly disagreed to that the toilet is not clean enough (Table 7).

**Table 7. Respondent’s response to the cleanliness of the toilet**

	Frequency	%	Cumulative %
Strongly agree	17	39	39
Agree	12	27	66
Neutral	10	23	89
Disagree	3	7	96
Strongly disagree	2	4	100
Total	44	100	

#### 4.8 The Use of the Toilet should be Discontinued due to Poor Hygiene Condition

18% of respondents strongly agree to this fact. 16% simply agrees while 18% of the correspondents were neutral. 27% disagreed to this fact while 21% strongly disagreed as shown in Table 8.

**Table 8. Respondent’s response to discontinuity of the toilet due to poor hygiene condition**

	Frequency	%	Cumulative %
Strongly agree	8	18	18
Agree	7	16	34
Neutral	8	18	52
Disagree	12	27	79
Strongly disagree	9	21	100
Total	44	100	

#### 4.9 Do you think users Abuse the Toilet?

80% of respondents claimed they think that users abuse the toilet while only 20% does not think so (Table 9).

**Table 9. Respondent's response to abuse of the toilet**

	Frequency	%	Cumulative %
Yes	35	80	80
No	9	20	100
Total	44	100	

#### 4.10 Would a Method of Sanitizing the Toilet Before use Make you Feel More Comfortable Using the Toilet?

43% of the respondents stated definitely. 18% were unsure while 30% said yes. However 9% claimed that no method of sanitizing the toilet would make them feel more comfortable using the toilet. This findings show over 70% of respondents would be comfortable in using the toilet if it is well maintained as shown in Table 10.

**Table 10. Respondent's comfort level to using sanitizer**

	Frequency	%	Cumulative %
Definitely	19	43	43
Unsure	8	18	61
Yes	13	30	91
No	4	9	100
total	44	100	

#### 4.11 The Use of the Toilet should be Discontinued due to Poor Hygiene Condition

18% of respondents strongly agree to this fact. 16% simply agrees while 18% of the respondents were neutral. 27% disagreed to this fact while 21% strongly disagreed. Evidence here shows, students will use the toilets if the present poor condition is improved as shown in Table 11.

**Table 11. Respondent's response to if the toilet should be discontinued**

	Frequency	%	Cumulative %
Strongly agree	8	18	18
Agree	7	16	34
Neutral	8	18	52
Disagree	12	27	79
Strongly disagree	9	21	100
Total	44	100	

## 5. PROPOSED MODIFICATION OF THE WATERLESS TOILET AND ITS ENVIRONMENT

While there is no doubt that students will prefer to use flush toilet, the constraint of water to maintain flush toilet have serious implications. Waterless toilet has advantage on the campuses where water is a luxury. The only problem of this toilet is maintenance. It is therefore be appropriate to direct our attention to this important aspect. The next section of the paper thus makes proposal to improve the toilet and encourages its use.

After the evaluation of the toilet, there was need for improvement in certain areas. Provision was made for the enlightenment of users as regards the proper use of the toilet. This was done to change their perspective to a more positive one which will eventually bring about good maintenance and better hygiene culture on the part of users. Modification was done via provision of materials. These suggestions were needed for effectiveness and proper improvement of the toilet facility and its environment. An important suggestion is the constant clearing of the toilet surroundings by the University management. This is due to the long grasses behind the toilets which make people to be afraid of entering the toilets due to snakes and scorpions. Others are provision of materials for the improvement of the toilet facilities. List of materials provided include:

1. Toilet usage Instructional poster
2. Tissue papers
3. Hand washing soaps
4. Buckets of ash or wood shavings plus scoopers
5. Hand washing directional poster

The toilet usage instructional poster was hung on the wall where it could be read by all (Fig 6). This was done to orientate users as regards the use of the toilet and also to encourage them to assist with the maintenance of the toilet. The postal clearly states user's role in the maintenance of the toilet. The postal also creates a sense of awareness to responsibility for users. Lack of cleansing materials was evident as at the time of inspection. Tissue papers were made available for users as cleansing materials after using the toilet and also after hand washing. This will help to improve the sanitary and hygiene condition of the toilet. Bucket of ash and scooper was provided for the purpose of improving the sanitary condition of the (Figs. 7 & 8). The smell

of the toilet facility as at the time of inspection was intolerable as the odour oozing from the toilet was highly offensive. Ash has been found to be a very effective tool in the control of odour in a waterless toilet. The ash when applied to the toilet hole after the use toilet tends to serve as a covering for the faeces in the hole. It not only serves as a cover but also speeds up the rate of composting. The ash or wood shavings absorbs the water in the faeces and increases the

temperature in the vault, making the rate of composting to increase and hence clears out the intolerable offensive odour of the toilet facility. The application of ash or wood shavings also helps to control houseflies and vinegar flies. Once the fresh faeces are covered, there will be little or no housefly in the toilet facility. Hand washing directional poster was hung on the wall. This was done so that users could wash their hands properly after using the toilet.



Fig. 6. Toilet usage instructional poster



Fig. 7. Bucket of ash placed in the toilet



Fig. 8. Tissue paper placed in the tissue stand for cleansing

## 6. CONCLUSION

Water scarcity issues are only just beginning to have an impact on the way we live our daily lives, and the way we navigate the world and our place in it. In a very alarming way also, pollution has crept up in almost every part of the world to remind us of how interconnected everything really is. Climate change is now pressuring our environment, our economy and us to adapt to more conscious way of living and interacting. While this does not mean we have to throw everything we have known out the door, it does mean we need to continue down the path of innovation and ingenuity, but with a heightened awareness of our actions and their consequences from start to finish.

The assessment of the waterless toilet has helped to understand the advantages of waterless toilet and the health risk associated with the implementation if not properly managed. It has assisted in determining the perception of users towards the toilet and various measures to be implemented in improvement willingness to use the toilets. It has also provided information for further research work as regards the challenges users face when using the waterless toilet. With improvement in the sanitation and hygiene condition of the toilet facility, more users will be comfortable to use the toilet without the fear of catching germs from the toilet.

## COMPETING INTERESTS

Author has declared that no competing interests exist.

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