

Evaluation of a composting toilet prototype for people in slum area in Indonesia

Ryusei Ito^{*}, Mei Tanie^{**}, Ken Ushijima^{***}, Dewi Nilawati^{****}, Jovita Triastuti^{****}, Neni Sintawardani^{****} and Naoyuki Funamizu^{*}

^{*} Laboratory of sustainable sanitation, Faculty of Engineering, Hokkaido University, Sapporo, Japan,
e-mail: ryuusei@eng.hokudai.ac.jp

^{**} Laboratory of sustainable sanitation, Graduate school of Engineering, Hokkaido University, Japan

^{***} Hokkaido Research Organization, Japan

^{****} Indonesian Institute of Sciences, Indonesia

Abstract

To install value chain sanitation system, a composting toilet is the most important technology as producing value of fertilizer from waste. A survey on the current practices in toilets, assessment of new protocol to operate the prototype of the toilet and evaluation of the interface design was performed to 20 people in Indonesian Institute of Science (LIPI), Indonesia and a mosque in Sapporo city, Japan to assess our prototype of the toilet on the view point of interface design. As a result, half of the people answered that bad smell is a point to be checked, 70% minds the rest of excreta on the toilet bowl. The smell can be solved by the ventilation system, the new operation protocol was acceptable, the impression on the body of the toilet was good and acceptable, 70% was unsatisfied on its size, the yellow color of the cover implicates garbage or something polluted, 40% had discomfort for the impression on the feeling for sitting on the toilet seat, like falling into the hole and small space for washing their body with the hands. The modification of the toilet was discussed.

Keywords

Muslim; feces-urine-water separation; solid-liquid separator; acceptance; interface design

Introduction

In the urban slum area in Indonesia, 87% of people has water closet toilet which directly discharges excreta to the water channel passing through their living area (Ushijima, 2013). This situation is concerned to cause a serious endemic and bad environment, though the people are satisfied the situation and the government and local government do not have enough budget to improve sanitation in the area. Therefore, the order of priority of improving the sanitation is low resulting in the situation as no treatment of excreta. To overcome this problem, we founded incentives like increasing income gives a strong motivation to installing the new technologies to the people. Thus, the system design concept with consideration of value chain, as shown in Fig.1, is proposed to improve sanitation in the slum area in Indonesia. In this system, urine and feces are separately collected then feces are transformed to a compost and urine is concentrated. The compost and concentrated urine are transported to the agricultural area and reused as fertilizers (Ushijima, 2015). Here, the toilet system has very important key technologies on interface of the system from people, separation of feces and urine, producing fertilizers. The interface design is a main part of evaluation of the whole system from the people, so that user friendly design is required on the development process of the toilet. Therefore, the objective of this research is to assess our prototype of the toilet on the view point of interface design.

Experimental methods

Prototype

The illustration and photograph of the prototype developed in our laboratory are respectively shown Figs. 2 and 3. It is a sitting style toilet to adopt for Muslim people while has

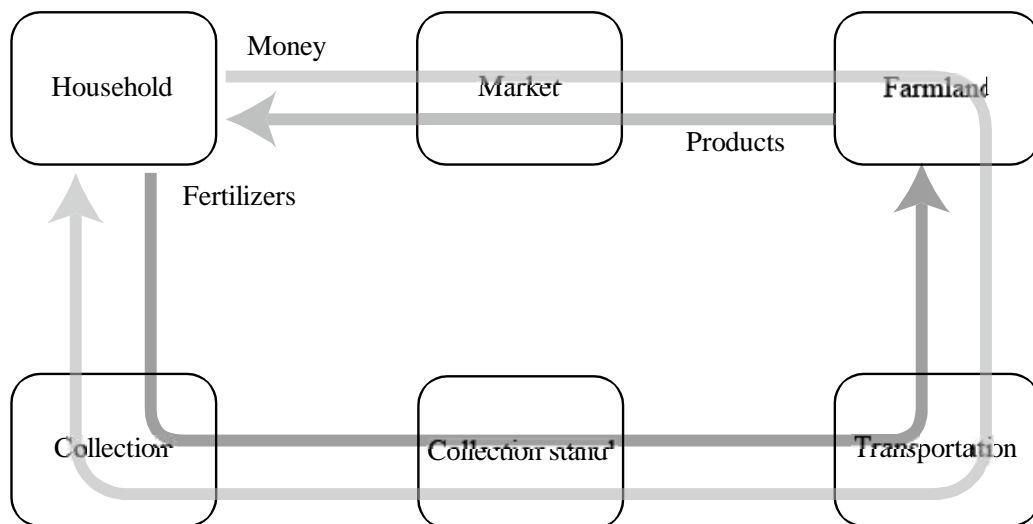


Fig. 1. Value chain sanitation system

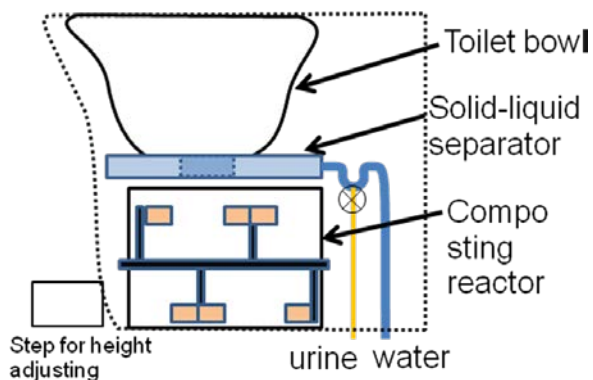
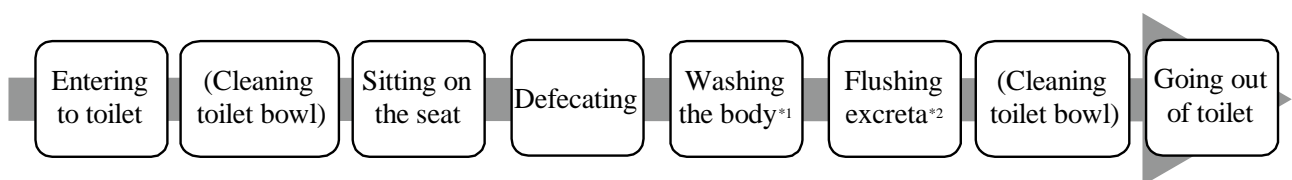


Fig. 2. The illustration of the prototype



Fig. 3. The photograph of the prototype

Conventional toilet



New toilet

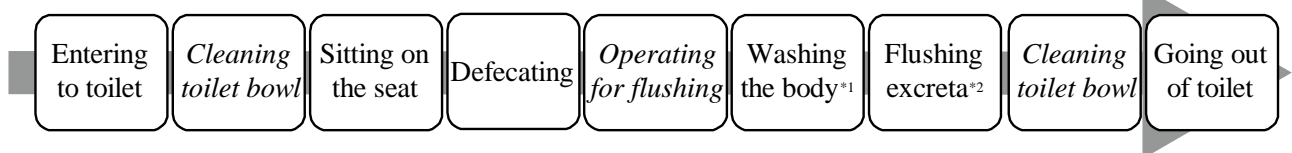


Fig. 4 Change in operation flow from conventional toilet to new one

enlarged toilet bowl from conventional toilet to give enough space to wash the body with water and the hands. A solid-liquid separator is under the toilet bowl. The solid feces remain on it while liquid goes to discharging tube. After defecation, the feces moved to the composting reactor under the separator by operating a lever, then the feces mixed with a composting matrix for rapid composting. The separated liquid passes the flow channel changer to be separated urine and washing water. A

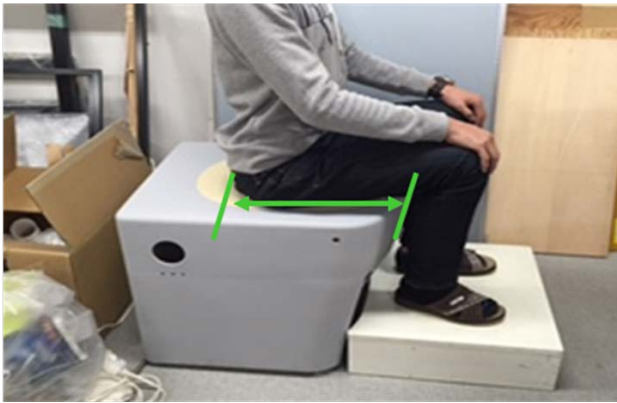


Fig. 5. Evaluation of the sitting position

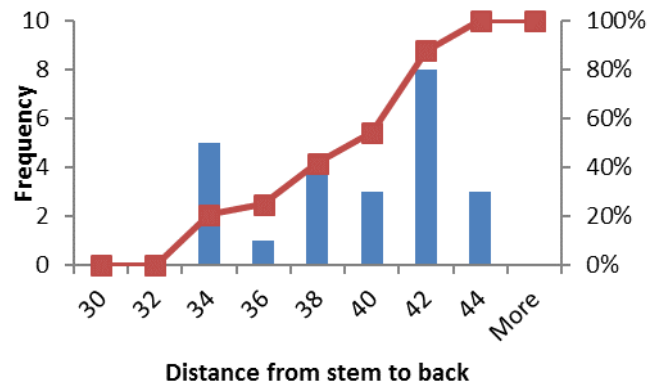


Fig.6. The distribution of sitting position

ventilation system provides fresh air to the reactor and to remove exhaust gas. Fig. 4 shows the change of protocol for using new toilet from conventional one.

A hearing survey on the current practices in toilets, assessment of new protocol to operate the prototype of the toilet and evaluation of the interface design was performed in Indonesian Institute of Science (LIPI), Indonesia and a mosque in Sapporo city, Japan. The sheets of questioner gave to the respondents, then the questioner asked them step by step. All collected response were gathered to a spread sheet for further analysis.

An experiment to evaluate the distribution of sitting position was conducted with 25 students in Hokkaido University. The students sit on the toilet, then take pictures of side view shown in Fig. 5. The position of the back from the stem of the toilet was evaluated by the image analysis method.

Results and discussions

The number of answerer was 8 in LIPI and 12 in Sapporo. Most of them were in age range of 20-39. 25% in LIPI and 33.3% in Sapporo were ladies. They used a brush for cleaning of toilet bowl and acidic detergents. So, the material of the toilet should have resistance against scratch by a brush and chemicals. They also clean the toilet where they can see. Then, the shape inside toilet bowl should be simple for easy cleaning. Half of the people answered that bad smell is a point to be checked, while 70% minds the rest of excreta on the toilet bowl. The smell can be solved by the ventilation system, although the development of antifouling property for the solid-liquid separation system. The new operation protocol was acceptable. The impression on the body of the toilet was good and acceptable, though 70% of the people was unsatisfied on its size. Some misunderstood as sitting type resulting in climbing up. The yellow color of the cover, which was for the promotion, implicates garbage or something polluted, then the different color should be changed. 40% had discomfort for the impression on the feeling for sitting on the toilet seat, like falling into the hole and small space for washing their body with the hands. For the impression of falling, the width of the seat is same as conventional toilet seats and this is caused by the physical force balance on the legs. The additional test suggested high level for the sitting surface from the floor can solve this problem. The other experiment on the sitting position showed big variation of the position as illustrated in Fig. 6 and they feel small space when they sit on the forward of the seat. So, people can adopt by gathering experiences to use the toilet.

Conclusion

A survey on the current practices in toilets, assessment of new protocol to operate the prototype of the toilet and evaluation of the interface design was performed to 20 people in Indonesian Institute of Science (LIPI), Indonesia and a mosque in Sapporo city, Japan to assess our prototype of the

toilet on the view point of interface design. As a result, they used a brush for cleaning of toilet bowl and acidic detergents, and cleaned the toilet where they can see. Half of the people answered that bad smell is a point to be checked, 70% minds the rest of excreta on the toilet bowl. The smell can be solved by the ventilation system, the new operation protocol was acceptable, the impression on the body of the toilet was good and acceptable, 70% was unsatisfied on its size, the yellow color of the cover implicates garbage or something polluted, 40% had discomfort for the impression on the feeling for sitting on the toilet seat, like falling into the hole and small space for washing their body with the hands.

References

- Ushijima, K., Funamizu, N., Nabeshima, T., Hijikata, N., Ito, R., Sou, M., Maiga, A. H. & Sintawardani, N. (2015). The postmodern sanitation – Agro-sanitation business model as a new policy-, *Water Policy*, 17:283-298.
- Ushijima, K., Sato, R., LERAY, L., Hijikata, N., Ito, R., Funamizu, N. (2013) Resource Recycling System for Human Excreta Based on the Analysis of Material Flow Related to Agricultural Production in Rural household of Burkina Faso, *Journal of Japan Society of Water Policy and Integrated River Basin Management*, 2(1), 33-41. (in Japanese)