RECENT DEVELOPMENT OF DRY TOILETS IN JAPAN

Zhen LIU*, Katsuyoshi ISHIZAKI**, Jinwei HU**, and Kei YAMADA**
*Faculty of Human Environment, Nagasaki Institute of Applied Science, Japan,
Tel.: +81-95-838-4094, FAX: +81-95-839-4400, E-mail: liuzhen@cc.nias.ac.jp
**Faculty of Environmental Studies, Nagasaki University, Japan, Tel./FAX: +81-95-843-1808

1. Environmental loads of flush toilets

1.1 Water resources and water environment

The flush toilet invented by modern civilization provides us a hygienic and comfortable life. However, the pollution problem brought about with the conventional waterborne sewage system has lately attracted drawn considerable attention. The untreated sewage is polluting groundwater, rivers, lakes and coastal areas. And water used in toilets take 20% to 25% of that used in family. In the dirty loads, nitrogen and phosphorus are in proportion to 80% and 60% respectively [1].

1.2 Organic matter resources

Many nourishments and organic matters are included in human excreta. Up to now, those human excreta of world cities are thrown away into rivers, seas and lakes as wastes. In the matters included in the drainage, the nutritious salts, such as nitrogen and phosphorus, can not be removed by ordinary sewage treatment facilities, and bring about serious problems eutrophication problem of lakes and coast areas.

1.3 Energy resources

In Japan, the energies consumed in water utilization including the construction of water resource development facilities, the arrangement of water service and sewage, and the use of water service and sewage are 109 trillion kcal. The electric power consumed in water service and sewage in 1997 is 137 hundred millions. It takes 1.5% of total electric power of Japan of 9265 kWh [2]. And electronic power used in sewage is increasing obviously.

Therefore, we undertake a double task of trying to improve the imperfections in sanitary condition of conventional toilet systems on one hand and protecting the environment against the waterborne sewage pollution on the other. We are face with another challenge of extreme water shortage problem. Globally, some 80 countries with 40% of the world's population are already suffering from water shortages at some time during the year. China alone has 300 cities facing serious water shortages.

For protecting environment and saving water resource, various dry toilets have been developed and come to being sold in Japan. Here, the principles of the dry toilets are introduced. The dry toilets are classified and compared each other. Also, the possibility of dry toilet applications is discussed.

2. Classification of dry toilets

Generally, the dry toilets can be classified into three types shown as in Table 1: (1) Water circulation, (2) Incineration/desiccation, and (3) Bio decomposition (bio toilet). The development of dry toilets began in 1995 after the big Hansin earthquake. At that time, flush toilets could not be used as the lack of water. The common property of dry toilets is that they can be used in the case of no water supplying.

2.1 Water circulation

In the water circulation toilet, water is used to wash the toilet in recycle. There are more than 20 kinds of water circulation toilet in commercialized products in Japan. The

carbohydrate and the protein in human waste are decomposed with washing water, and the salt, the phosphate and the mineral are accumulated in the water. It can be used feel as traditional flush toilets.

2.2 Incineration/desiccation

There is incineration/desiccation toilet for a long time. Now, the developments of the incineration/desiccation toilet lay stress on saving energy and cleaning up stink. In particular, portable incineration/desiccation toilets are developed. The portable incineration/desiccation toilets can be moved to anywhere when it is placed in a car. The use of washing water could be reduced with increasing a little more energy. But, compared to the water circulation toilet and the bio decomposition toilet, the price of this type toilet is more expensive and it uses more energy.

2.3 Bio decomposition (bio toilet)

The principle and the structure of the bio decomposition toilet are the same as that of family garbage processing machine. Human waste is decomposed directly along with the slow rotation of the wood tips or sawdust in a box. The decomposition of the human waste bring about by the microbe (mainly the soil bacteria) settled in the wood tips and the sawdust. A motor is used to stir the wood tips and the sawdust. It consumes only a little power. Generally, the stink can be cleaned up in this way. This type of dry toilet is selling by several companies in Japan. It is also called bio style toilet or bio toilet. It can be designed to various sizes from a large toilet such as public toilets to a portable size for the use of nursing. The used wood tips and sawdust can be re-used as organic fertilizer.

Table 1 Comparison of Dry Toilets

Type	Hygiene/comfort		Envir. Burden		Resources		Utilization			Products
	Hygiene	Stink	Water	Effluent	Organic matter cycle	Energy	Space	Maintenance	Price	
Water Circulation	◎	◎	◎	○	△	○	○	○	△	TOYO, UNILETTO, NONALETTO, BellBio INCINOLET, DRILET MLET, SANITA CLEAN Bio Lux, Refreshment
Incineration/desiccation	◎	◎	◎	◎	○	△	○	○	△	
Handy type	◎	◎	◎	◎	△	△	◎	○	△	
Bio decomposition using Wood tips or sawdust	◎	◎	◎	◎	◎	◎	◎	◎	○	

3. Possibility of dry toilet Applications

3.1Ecological sanitation

As the reason for sanitation, new approach of toilets appeared. It is concerned

that the most difficult problem of modern society is how to treat human excreta [4]. The families that have not proper sanitation equipments and people who could not use toilets are increasing. Now people who could not use toilets reached 20 hundred millions in the world. It is inferred that the number will increase to 30 hundred millions in 21 century. By using traditional flush toilets, the sanitation problem could not be solved. And it certainly will bring about environmental pollution problems. Therefore, the development of dry toilets is a important way for sanitation and environmental protection.

3.2 **Application examples** of bio toilets in Japan

(1) In family. Bio toilets are improved to many types to use in families. In the case of improved bio toilet is set up, existed traditional toilet can be improved so that it need not to use water. And, it can also be used to treat family garbage. Sawdust is exchanged 2 or 3 times one year.

(2) In mountain. About 30 ten thousand people use toilets in Fuji Mountain one year. Between 14th July and 27th August 2000, bio toilets were set up in 2000 meter high of Fuji Mountain, evidence and experiment were carried out [5]. Subjects added up to 8042. Average of 179 people used the bio toilets one day. The capacity of the bio toilet is 500 liter. Four 390 W heaters and one 300 W quick heater were added. 270W and 200 W generators were used. Many subjects have a good impression of the bio toilets.

(3) For nursing. Three companies are selling bio toilets for nursing in Japan. One among them design bio toilets as a common chair. It could not be noticed as a toilet from outward appearance. This type of toilet could be used for old people and patients. It can be placed in living room or sickroom. Deodorization method of toilets for nursing is to use pipe to exhaust stink.

4. Reference

[1] Katsuyoshi Ishizaki, Haruhiko Masaki, Kiyosi Toda, Yu Kamisachi, Naoko Nakagawa and Takanori Itonaga, The Possibility of Resource Recycle Toilets, Proceeding of Environmental System, Japan Society of Civil Engineers, 2000

[2] White Paper of 2000 National Land Agency Government of Japan: Water Resources of Japan, 2000 version.

[3] Anders Liljencrants, Options to Deal with a Resource Turned into a Problem, Critical Review of Dry and Wet Treatment of Human Excreta, Stockholm University, 1996.

[4] Toilet Society of Japan, Tomiyama International Symposium’99, 1999

[5] Masanari Kobayashi, Katsuyoshi Ishizaki, Evaluation of Bio Toilet’s User – Evidence and experiment in Fuji Mountain, 2001 Japan Society of Civil, 2001.