Technologies toward zero emission community: urine separating toilet and co-digestion of feces with food waste.

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**Theme:** Innovation in FS Treatment

**Keywords:** zero emission, co-digestion, feces, food waste, urine separation

People inevitably produce human excreta and food waste, the wise treatment of which has been the challenge for the history of mankind. In most developed countries, traditional concept of treating wastewater has been toward centralized system, which requires costly sewer system for the transportation and they use too much energy and resource are wasted. Sometimes nutrient such as N, P can make problems in the lakes and rivers with eutrophication. The collecting food waste from each household is also a big social problems to separate, transport and treat, resulting in smell and aesthetic problems at the neighbours. It is hard to recover the resources when they are mixed with other wastes.

New emerging concept of treating human waste and food waste is toward decentralized system to separate and collect near the source and recover and utilize the resources, which requires less cost and energy to transport and sometimes produce energy or valuable resources. The size of the community may be small to medium (a building, apartment, village, etc)

The core technologies for the community based source will be the separation of urine and feces, and utilize the pure urine and co-digestion of feces and food waste. (Figure 1)

Figure 1. Community based resource oriented Source separation technologies
1. Urine and feces Separation technologies

Urine separating toilet is a key factor for further utilization of feces with food waste. Urine separation toilets have been introduced, which are physical separation type and centrifuge type (Fig. 2. (a), (b)). However, those toilets have low separation efficiency and availability. In this study, we found that urine separating toilet with less water is favorable for weight reduction of urine. In addition, with 90% separation efficiency, urine separating toilet can help the co-digestion system operate efficiently by methane. Based on these results, new urine separating toilet with intentional slope (Fig. 2. (c)) has been developed. In addition to this, a new toilet system has been developed which uses only 3 liters per flush without blockage. With this new toilet, only feces and food waste can be discharged to a co-digestion system.

Collected urine contains high nutrient; nitrogen, phosphorus and potassium contained in urine account for 88 %, 67 %, 71 % of those in human excreta respectively. Knowing its value, recovery of phosphorus, using struvite can be considered. For a better recycling method, separated urine can be used as liquid fertilizer. It can be used in close vegetable garden, realizing resource recycling.

2. Co-digestion of feces with food waste

Co-digestion system has been invented for innovative and efficient treatment of feces and food waste. There are many methods to enhance the efficiency of the system, such as utilizing disposer, gas and mixing. Complete digestion and no sludge emission were achieved with wet digestion of TS 4.2 % and relatively long HRT in the system of feces and food waste. Carefully designed lab scale experiment is being made using different combination of feces and food, and some of the operation parameter will be introduced.

Acknowledgment

This work is supported by Korea Ministry of Environment (MOE) as “Knowledge-based environmental service (Waste to energy) Human Resource Development Project.