# Current status and the prospect of anaerobic digestion of Korean food waste

K. Chandrasekhar[1], Jong-Hun Park[1], Gopalakrishnan Kumar[1], Sang-Hyoun Kim[1,2 *]

[1]School of Civil and Environmental Engineering, Yonsei University, Yonsei-Ro, Seodaemun-gu, Seoul 03722, Republic of Korea

[2]Institute of Chemistry, Bioscience and Environmental Engineering, Faculty of Science and Technology, University of Stavanger, Stavanger 4036, Norway

Keywords: Biogas, Energy recovery, Food waste reduction, Valorization routes, Waste-to-energy

Presenting author: Sang-Hyoun Kim, Associate Professor, sanghkim@yonsei.ac.kr

Korean government banned all kinds of food waste directly in 2005. The amount of food waste in 2017 is 14,400 ton/days. Food waste is collected separately and recycled mainly as an animal feed and compost. However, the market value of the recycled products is low due to quality issues and high operating costs. In addition, wastewater from composting and animal feed production processes contain more than half of the original food waste. If food waste is not properly managed, it releases odor and leachate during collection and transportation because it has high volatile solids (VS: 85–95%) and moisture content (75–85%). However, due to its high energy content, the generation of fuel and chemicals seems ideal while reducing waste (Breunig et al., 2017). Thus, anaerobic digestion has recently been widely adopted in the treatment of food waste and its process wastewater (Kumar et al., 2016).

Regarding the portion of organic matter in the waste, only food waste and animal manure are considered in this study, although the reduction of the amount of sewage sludge is very important. Biogas potential estimated from this food waste and animal manure is about 0.7 billion $m^3$ of biogas per year, which covers around 0.34% of the total electricity demand corresponding to approximately 1300 GWh per year or 65% of total CNG demand by approximately 18,000 Buses in 2008 (Kim et al., 2012). Anaerobic digestion can recover the chemical energy of food waste into heat, electricity, and bio-methane. Virtually, the whole energy in any form of biodegradable organics can be recovered as bio-methane (net heating value of methane is 8580 kcal/$Nm^3$ = 10 kWh/$Nm^3$). This technology is also suitable for non-sterile and constantly changing complex food waste environments.

In Korea, There are 98 biogas plants in 2017. Among them, 8 plants are fed by food waste, 13 plants by food wastewater, 7 plants by livestock manure, 35 plants by the mixture of feedstock (co-digestion), and 35 plants by sewage sludge. The electricity from the biogas process was 170,599 MWh in 2017. At the moment, biogas production – and biogas use rate is relatively very low despite its high potential. There are several biogas plants functioning as pilot plants for investigation, and some plants for commercialization in South Korea. Approximately 95% of biogas plants use a wet fermentation system, the usual substrates are food waste, animal manure or sewage sludge. But this anaerobic technology of wastewater treatment plant aims at the treatment of organic waste, not the production of biogas, as a result, low efficiency of the plant was shown regarding biogas production (Nemestóthy et al., 2018). However, there are some operating problems that can interfere with the successful digestion of Korean food waste. In addition, external wastewater can be added to the public wastewater treatment flow, so wastewater needs to be carefully managed. However, Korea is a good example of how countries can implement smart waste management systems to decrease the volume of food waste generated at the source. Korea, Germany, and France have successfully built many co-digestion projects treating food waste together with other waste sources, indicating that project operators in countries have understood the multiple benefits of co-digestion (De Clercq et al., 2017). Usually, a primary substrate such as wastewater sludge together with lesser amounts of one or more secondary substrates, because most of municipal wastewater sludge digesters have excess capacity (Ahn et al., 2019).

The objective of this paper is to review policies and strategies related to anaerobic digestion in Korea that promote the conversion of food waste to biogas. This presentation introduces the current state and perspectives of food waste digestion in Korea.

**References:**

Ahn, Y., Lee, W., Kang, S., Kim, S.-H. 2019. Enhancement of Sewage Sludge Digestion by Co-digestion with Food Waste and Swine Waste. *Waste and Biomass Valorization*.

Breunig, H.M., Jin, L., Robinson, A., Scown, C.D. 2017. Bioenergy Potential from Food Waste in California. *Environ Sci Technol*, **51**(3), 1120-1128.

De Clercq, D., Wen, Z., Gottfried, O., Schmidt, F., Fei, F. 2017. A review of global strategies promoting the conversion of food waste to bioenergy via anaerobic digestion. *Renewable and Sustainable Energy Reviews*, **79**, 204-221.

Kim, Y.-S., Yoon, Y.-M., Kim, C.-H., Giersdorf, J. 2012. Status of biogas technologies and policies in South Korea. *Renewable and Sustainable Energy Reviews*, **16**(5), 3430-3438.

Kumar, G., Sivagurunathan, P., Park, J.-H., Kim, S.-H. 2016. Anaerobic digestion of food waste to methane at various organic loading rates (OLRs) and hydraulic retention times (HRTs): Thermophilic vs. mesophilic regimes. *Environmental Engineering Research*, **21**(1), 69-73.

Nemestóthy, N., Bakonyi, P., Szentgyörgyi, E., Kumar, G., Nguyen, D.D., Chang, S.W., Kim, S.-H., Bélafi-Bakó, K. 2018. Evaluation of a membrane permeation system for biogas upgrading using model and real gaseous mixtures: The effect of operating conditions on separation behaviour, methane recovery and process stability. *Journal of Cleaner Production*, **185**, 44-51.