Bio-conversion of the OfMSW into energy and organic fertilizer: toward a zero waste society

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Redirection of organic municipal wastes away from landfills is one of the challenges that waste managers face every year. Only in Greece more than 2.7 million tons of municipal organic wastes are generated annually. Currently most of these are landfilled, resulting in wastage of a resourceful substrate, over exploitation and pollution of surface and ground waters, as well as in releases of greenhouse gases into the environment. The municipal organic wastes are mainly composed of cooked and uncooked food while their characteristics present wide temporal and worldwide spatial variability, as cooking and nutrition habits vary among different human communities. Furthermore, the characteristics of food wastes such as high nitrogen, fat, moisture and low pH (~5),may create significant problems when biological treatment methods are applied for the management of such wastes.

The anaerobic digestion process provides a waste management option for food wastes, while offers the opportunity for recovering marketable products both in the forms of biogas and slow release bio-fertilizers. AD is a waste treatment method which converts, with the utilization of microorganisms, the organic matter of wastes or wastewaters into biogas, which can be further exploited as a sustainable fuel for energy generation. As a result, fewer wastes are dumped into landfill sites, while at the same time the process can be used by local authorities to meet the waste redirection targets set by the European Community Landfill Directive (1999/31/EC).AD is commonly applied throughout the world as a wastewater treatment method for livestock manures with the methane recovery yields ranging between 12 and 13.9 m^3/m^3 of influent substrate. As a way to improve the bio-methane production of AD systems, different wastes-wastewaters can be mixed and treated together in co-digestion schemes. This mixing of different substrates is not only desirable for improving methane recovery rates and reducing life cycle costs, but it also provides better organic load removal efficiencies as an effect of C/N ratio correction, pH balancing and improvement on the buffering capacity of the treatment systems.

The experiments performed under thermophilic conditions in batch and large volume laboratory digesters, with the addition rate of food wastes to manures reaching as high as 70% based on VS loading, the total solids levels at 15.7% and the OLR at 6.85kgVS/m^3-d. In the higher addition rate the digestion process was slightly inhibited, probably due to simple sugar accumulation. In contrast waste mixtures containing up to 65.3% food wastes with the OLRs as high as 6.2 kgVS/m^3-d with the influent TS levels up to 14.3% can be accepted by CSTR systems with no signs of inhibition.

Based on the results the addition of food wastes to anaerobic digesters operating under manure monodigestion conditions can improve specific methane production by 86% and the volatile solids reduction by 19%. In a farm scale digester (3000m^3, HRT 21-d) the addition of food wastes can improve cash flow fourfold by only slightly increasing operational costs due to pasteurisation requirements. Additionally, gate fees and carbon credits can further improve the financial situation of the treatment facilities.