

Food waste treatment
technology in
singapore
environmental
sciences essay



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Municipal solid waste (MSW) volumes from modern societies have increased over the years. The annual generation of foodwaste in Singapore was 542, 700 tons in 2006 and reached about 570, 000 tons in the year 2008 (NEA, 2009). Proper treatment and management of food waste is a challenge faced by any developing nation as untreated and unmanaged food waste creates odor, hygiene concerns and cause adverse environmental impacts.

Singapore is a highly populated, industrialized city with limited land area that can be used as landfills. Semakau Landfill is Singapore's only landfill for waste disposal. Singapore's offshore landfill may only accept inert wastes that are inorganic. Therefore, no food waste is sent to the landfill and the majority of food waste is directed to incinerators (Tan and Khoo, 2006)A remaining 10–15% is sent for recycling via anaerobic digestion (AD), followed by composting of the digestate material. According to the Singapore Green Plan 2012, up to 30% of foodwaste recycling has to be achieved year 2012 (MEWR, 2008). This focus on the present and future options of increasing food waste recycling, which includes a proposed aerobic composting plant. The environmental impacts of the food waste conversion options are projected based on a life cycle assessment perspective. Since Singapore has become a signatory to the Kyoto Protocol in April 2006, energy efficient and more sustainable waste treatment methods will be sought after. The food conversion methods are: incineration, recycling via AD combined with composting of digestate matter, and a proposed aerobic composting plant.

Inceneration

Incineration is a mature technology that involves the combustion and conversion of MSW into heat and energy. Incineration or waste-to-energy has

been employed widely to generate energy from waste materials, as well as to reduce the volume of waste substantially. As land is limited, Singapore has adopted the policy of incinerating all 'incinerable' solid waste, including food waste. Incinerators are able to reduce the volume of solid wastes by 80%, which makes them popular in countries that have limited territory for landfills. Singapore's four incinerators are Ulu Pandan, Tuas, Senoko and Tuas South. The proportions of food waste input treated by the four incinerators are calculated to be 12.88%, 16.52%, 34.66% and 35.95% respectively. A typical incinerator requires the energy input of 70 kWh/ton waste and generates around 20% ash.

Anaerobic digestion and composting

The recycling of food waste is carried out by using anaerobic digestion (AD) method combined with composting. The main product, bio-gas, from the AD process is transferred into gas engines to generate energy, which is then sold to the national grid. An additional step in the process converts the residues from the anaerobic digester, or digestate material, into bio-compost. The composting process involves the use of microorganisms to break down the residues in the presence of oxygen, thus avoiding the production of methane. The bio-compost material can be used as a replacement of mineral fertilizers. From the compost products, carbon dioxide savings can be achieved by the avoided production of the mineral fertilizers. The waste food recycling process by IUT Global is separated into two phases, each with similar AD processes but different capacities. The present Phase I recycling has an installed capacity of 3.5 MW power and treats 300 tons of food waste per day. From here, the digestate material is

sent to composting plant I to produce bio-compost. Phase II has an installed capacity of 6MWpower and treats 500 tons of food waste per day; digestate from Phase II is sent to composting plant II The combined capacities of phases I and II can achieve the goal of 800 tpd (tons per day) food waste recycling for the whole of Singapore. In this analysis, we can assume that the present Phase I recycling plant is able to run at full capacity, and Phase II will be also be operating at full capacity in the near future. The recycling of food waste into electrical energy and compost is IUT Global's solution to reduce the amount of food waste entering incineration plants, and at the same time earn carbon credits from reduced greenhouse gas emissions.

Proposed small-scale composting facility

An additional composting plant is proposed for the purpose of increasing the recycling options, and also for diverting foodwaste away from incinerators. The proposed composting process is an aerobic type based on Lee et al. (2007). The only output of the composting plant is bio-compost. It is assumed that sawdust material does not impose any additional environmental impacts for the system and is not included in the investigation. The bio-compost from aerobic composting can also be used to replace mineral fertilizer. Both AD bio-compost (from digestate matter) and aerobic bio-compost products are expected to contain different nutrients.