Food Waste Total Recycling

HKPC TechDive – Green Living

8-12-2020

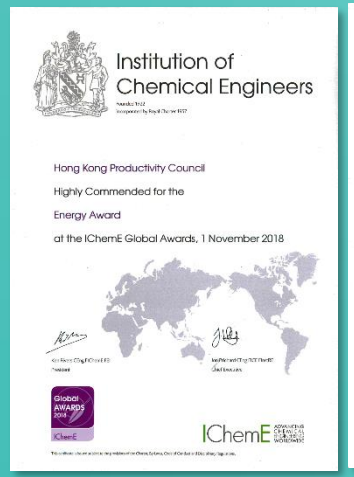
Award-winning Technology

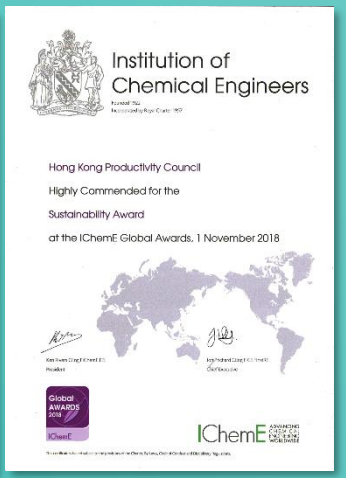
45th International Exhibition of Inventions of Geneva, 2017
Gold medals (with the congratulations of the jury)

IET Innovation Award 2017
Winner of the IET Innovation Award for Power and Highly commended in the for Sustainability

Hong Kong Awards for Industries 2016
Equipment and Machinery Design Certificate of Merit

Environmental Paper Award 2017
Champion





IChemE Global Awards 2018
Highly Commended for the Energy and Sustainability Award

Pilot Plant Visit

Marketing and Promotion

- Technical visits were organised for different groups with positive feedback.
- Promotional materials have been produced to promote the system developed.

HKIE

CIWEM, EAHK, HKIQEP

深圳工總

Promotion in Green I&T Day held by EMSD

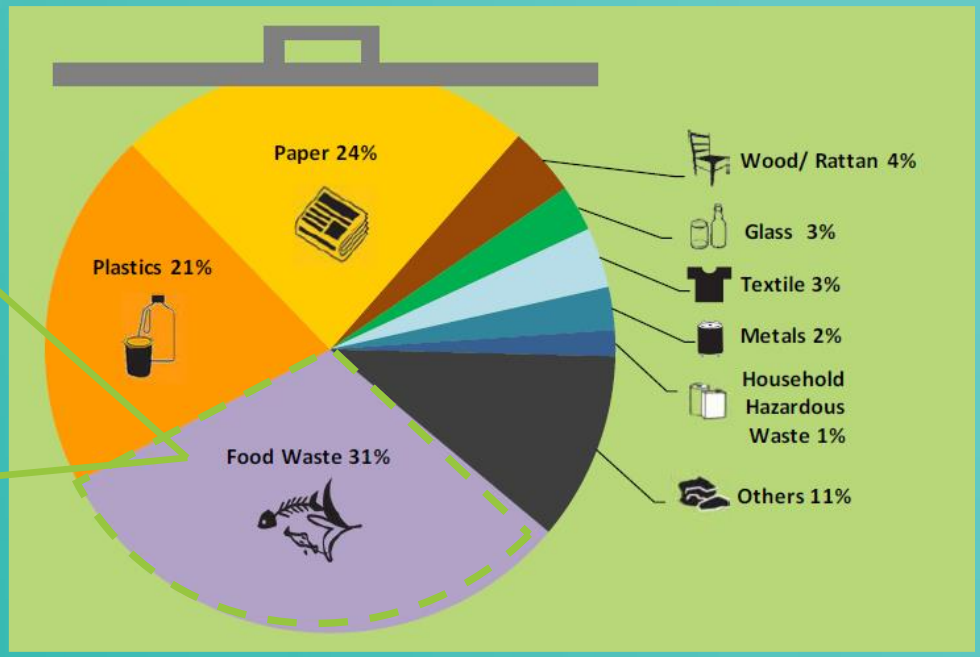
Promotion on HKPC open day

Food Waste Problem in Hong Kong

3,565 tonnes food waste to landfills each day in Hong Kong in 2018, accounting for 31% of all solid waste (11,428 tons/day)

Domestic Food Waste: **2,418 tonnes/day**

C&I Food Waste: **1,147tonnes/day**



Total MSW: 11,428 tonnes/day

Food Waste To Energy

- Anaerobic digestion of converting food waste to biogas is one of the most promising technologies to tackle the food waste disposal problem
- It is also a good source of renewable energy

If 1 tonne of food waste recycled instead of landfilled:

CO_2 emission reduced by ~1,600 kg

Energy generation of 3.3 GJ (eq. to ~$790 towngas cost)

Electricity of 363.3 kWh of electricity

Insufficiencies of Conventional Centralised Facilities

Location & Logistic	Treatment Process	End-products
• Difficult to identify suitable sites for centralised facilities and thus mostly located in remote areas • Complicated food waste collection from numerous sources and long-distance transportation of food waste	• Wet and oily Asian food waste different from Western food waste, resulting in operational problems in pretreatment and process stability in digesters, esp. single-stage process • Require skillful operation and close process monitoring	• Besides biogas, compost is produced which has limited market demand and little financial return in Hong Kong • Generates highly concentrated wastewater which requires further treatment and proper disposal

Decentralised Food Waste System

Potential Merits

- Much simpler and cheaper logistics in food waste collection due to the proximity to the food waste sources;
- More suitable sites for building decentralised systems than large centralised facilities;
- Easier control on the quality of source-separated food waste, resulting in simpler pretreatment and less process fluctuation;
- Possible in-situ use of biogas generated from decentralised systems

Prerequisites

- A new food waste conversion process that is more robust, more compact and easier to operate than the conventional anaerobic digestion facilities
- End products recovered from food waste need to have high market value in order to achieve financial viability to attract private sector's participation

Conceptual Design of the Full-scale Plant

Pre-treatment

Pre-treatment

Pre-treatment

Food Waste Tankers
(Food waste slurry)

Food Waste Decomposition
Bioreactor

Waste Oil

Solid
Residue

Nutrient
Solution

Biodiesel

Animal Feed

Wastewater
Treatment System

Biogas

Decentralised Facilities

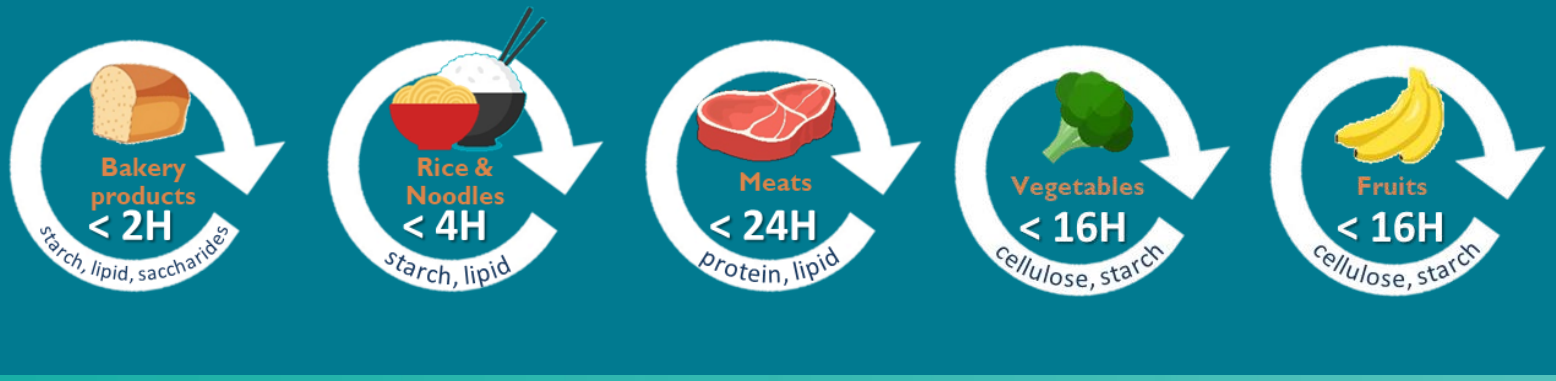
Centralised Facilities

Performance of Pre-treatment Unit

T = 0 hr

T = 2 hrs

T = 24 hrs



Protein-rich Solid Residue

Parameter	Unit	Solid Residue (dried form)	Fish Feed (Weever)	Fish Feed (Tilapia)
Moisture	g/100g	8.3	8.15	8.01
Total Carbohydrates	g/100g	20.5	17.2	46.9
Protein	g/100g	39.9	45.5	31.3
Total Fat	g/100g	17.7	16.3	5.73
Ash	g/100g	13.6	12.9	8.07
Crude Fibre	g/100g	4.03	1.71	7.26

Biogas

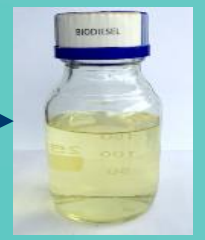
Items		Biogas (HKPC Pilot Plant)	Pipeline Gas Supply in HK	Natural Gas
Chemical Composition	CH_4 (%)	70-80	28.2-30.7	87-97
	H_2 (%)	trace-0.006	46.3-51.8	trace-0.02
	CO_2 (%)	15-25	16.3-19.9	0.1-1
	CO (%)	Nil	1-3.1	-
	H_2S (ppm)	Nil (after purification)	Nil	-
	Others (%)	-	0-3.3	5-10
Physical Properties	Calorific Value (MJ/M^3)	28-32	17	36-40

Recycling of Food Waste to Valuable Resources

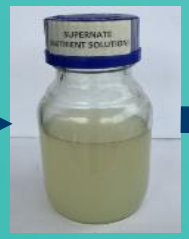
1 tonne Food Waste

Food Waste Decomposition Bioreactor

Floatable Oil (10 – 15 Liter)



Biodiesel



Nutrient Solution (1.8 tonne)

Biogas Production Bioreactor

Biogas (130 – 160m^3)

Solid Residue (0.1 – 0.2 tonne)

Eco Fish Feed

Merits

- A robust, compact and easy-to-operate system
- Food waste fully recovered into 3 high market value products:
  - (i) High purity biogas (~80% methane)
  - (ii) Protein-rich eco fish feed
  - (iii) Quality waste oil for biodiesel production
- No wastewater discharge
- Possible in-situ use of biogas
- Very suitable for decentralised recycling of food waste from local communities / a cluster of food waste sources
- Can be set up at industrial parks/refuse transfer stations/outlying islands/university campus

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