Department of Chemical and Biological Engineering

Production of Green Natural Gas From Gasifying Municipal Waste

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Background

- Mitigate environmental impacts of landfill waste
- Assist in meeting rising energy demands
- Input: 39,000 tonnes of municipal solid waste (MSW)
- Output: 12,500 tonnes of natural gas
  - Enough to power ~6000 homes*

Innovation

Operation
- 800°C-1200°C
- Three 600 kW plasma torches
- Steady state conditions

Quality
- Improved composition output
- Less ash created

Environmental Impact
- Minimal byproducts
- Cleanly powered

Process Control
- Electrically operated
- Higher degree of automation

Social Benefits

- Reduction of greenhouse gas emissions
  - Minimizes landfill usage
  - Generates value added product
- Promotes waste to energy facilities
- Encourages energy transition

Process Description

Pre-treated MSW

Gasification

Municipal solid waste is fed into a **plasma gasifier** that gasifies the municipal waste into **syngas** at a temperature of 800-1200 °C.

It is equipped with 4 temperature sensors allowing for **optimal control** of the unit and efficient **energy usage**. Input flows are automatically controlled to maximize output composition.

Fly Ash Treatment

This part of the process rinses all the **impurities** out of the fly ash post gasification. The fly ash itself undergoes a **two-stage washing** process to ensure a higher quality final product.

It is then sold to support the **construction** industry to be used as material bricks.

Sales from fly ash are estimated to bet **143,359 CAD** annually.

Hydrogen Sulfide (H_2S) Removal

Harmful **H_2S** is removed out of the produced syngas through **absorption** with a solvent before the syngas undergoes methanation.

Utilizing a LO-CAT solution almost **complete** separation is achieved. This puts the stream composition far ahead of environmental regulations.

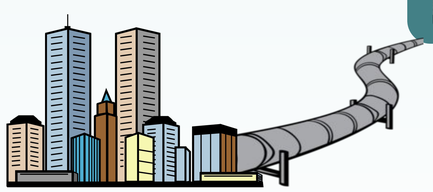
Methanation (Methane Creation)

Green hydrogen is produced from the electrolysis process to react CO_2 to completion.

After removing water via a flash vessel, clean syngas, **H_2**, **CO**, and **CO_2** is reacted in a packed bed reactor into **methane (CH_4)**.

Sales from methane are estimated to be **3,510,000 CAD** annually.

Power ~6000 Homes
12,500 tonnes of natural gas



Coastal GasLink Pipeline
Completed construction by 2023

Reactions

$$CO + 3H_2 \rightarrow CH_4 + H_2O$$

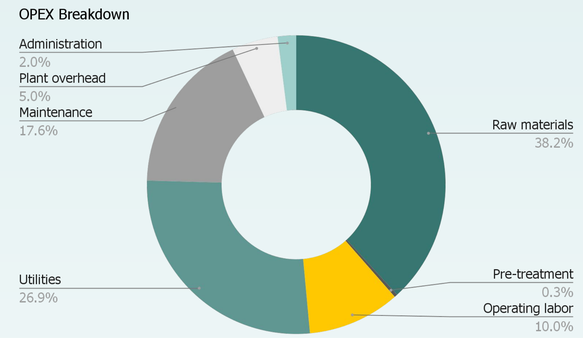
$$CO + 3H_2 \rightarrow CH_4 + H_2O$$

$$\text{(RWGS)}\ \ H_2 + CO_2 \rightarrow CO + H_2O$$

Economics

Comparison of cost of MSW disposal methods

Landfill	Incineration	Proposed process
$73.21/ tonne	**$680/ tonne**	**$33.89/ tonne**



Environmental Analysis

No Emissions
Methanation procedure consumes CO_2

Liquid Waste
Process & utility water for washing & equipment

Solid Waste
Impurities from gasification: Slag, sulfur

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