Converting Plastic Waste into Electricity Using Solar Gasification Technique

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INTRODUCTION

- **Problem Statement:**

➢ The amount of plastic waste is increasing every year due to population growth and industrial development.

➢ Traditional waste disposal methods, such as dumping and landfilling, pose environmental and economic issues due to the slow degradation of plastics, causing pollution and climate concerns.

➢ These methods also require significant land areas, contributing to urban land scarcity, and resulting in drawbacks like energy consumption and wasted petrochemical resources.

➢ On the other hand, solar gasification offers an innovative and eco-friendly solution by converting waste plastics into syngas, reducing hazardous chemical emissions.

➢ This method supports resource recovery through syngas utilization for electricity or chemical production.

➢ Solar gasification represents a step toward sustainable waste management, providing a promising alternative to traditional practices.

➢ Aligning with global efforts for eco-friendly waste solutions, the method promises a cleaner and greener future. Potential applications in waste-to-energy initiatives globally.

- **Specifications:**

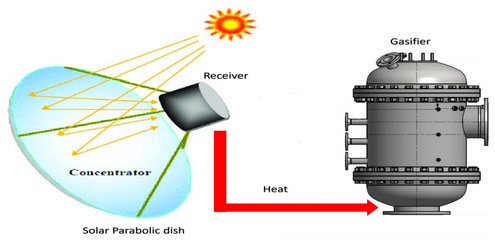
➢ Waste to electricity ratio equals 2.5

➢ The capital cost should not exceed 10,000,000 SR

➢ The temperature produced by solar dish reaches 800 °C

PROJECT DESIGN

- **Solar Dish:**



Solar Dish Specifications	
Solar Dish Radius	2 m
Focal Length	1.8 m
Radius of The Receiver	0.25m
The Surface Material	Aluminum
Θ_{rim}	31.05 °
Distance from Vertex to The Aperture	0.556 m
Concentration Ratio	64

CONSTRAINTS

The project occupies a large area.

Collecting and sorting plastic waste is a challenge.

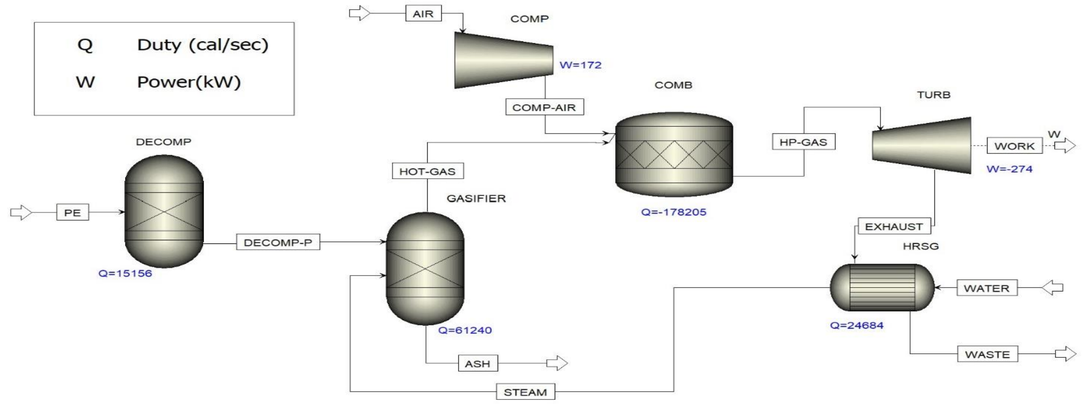
The solar dish is weather-dependent.

The solar dish needs frequent cleaning.

TESTING/ VALIDATION

- Waste to electricity ratio equals 2.73
- The capital cost between 6 – 7 Millions SR
- Solar dish can produce between 800 – 850 °C at noon

- **Aspen Plus Simulation:**



RESULTS

Gasification Result:

	Units	HOT-GAS	ASH	STEAM
Temperature	°C	800	800	800
Pressure	bar	1	1	1
Total Mass Flowrate	kg/h	216.797	8.203	125
H2	kg/h	25.495	0	0
CO	kg/h	164.448	0	0
CO2	kg/h	11.848	0	0
CH4	kg/h	5.473	0	0
H2O	kg/h	9.534	0	125
Residual	kg/h	0	8.053	0
ASH	kg/h	0	0.15	0

Gas Turbine Result:

	Units	AIR	COMP-AIR	HP-GAS	EXHUAST
Temperature	°C	25	507.2228	1200	631.059
Pressure	bar	1	20	20	1
Total Mass Flowrate	kg/h	1100	1100	1316.797	1316.797
H2	kg/h	0	0	6.229	6.229
CO	kg/h	0	0	40.177	40.177
CO2	kg/h	0	0	218.446	218.446
CH4	kg/h	0	0	1.337	1.337
H2O	kg/h	0	0	190.998	190.998
O2	kg/h	256.208	256.208	15.818	15.818
N2	kg/h	843.791	843.7913	843.791	843.791

CONCLUSION

Innovative Concept:

- Implementation of direct solar gasification of polyethylene (PE) for energy production equals 273kWh.
- This leads to a significant reduction in CO2 emissions, contributing to environmental sustainability.
- Provide a sustainable approach to converting plastic waste into valuable energy resources.

Promise for the Future:

- The project represents a step toward a circular economy and a cleaner energy future.
- Innovative technology with potential applications in waste-to-energy initiatives globally.