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An Innovative and Sustainable approach for Global Waste Management using Plasma Gasification

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Abstract:
A rapid growth in economic development has led to an increase in municipal solid waste annually and intricate a serious problem in developing countries. A comprehensive analysis of waste treatment method including the treatment of hazardous waste, solid waste, slag and heath care waste treatment is presented. A staggering huge amount of solid waste is produced by one person annually however there solid waste could be converted into green fuel as energy applications by plasma gasification so plasma gasification makes us to practice sustainable cleaner technology for world. This paper overview some of plasma gasification system using worldwide. And yield the situation as expedient to produce by-products and energy applications, which suits the needs of developing countries.

Keywords **— plasma gasification, solid waste, intricate, slag.**

I. INTRODUCTION

During the last few decades, numerous research and intensive efforts have resulted in substantial improvement in order to resolve contemporary solid waste management challenges. Now hazardous waste issues have been recognised as a global issue rather than states environmental problem. So integrated solid waste management is one of the accepted approaches which specify waste management goals and objectives [1]; Rapid growing economy have accelerated the municipal solid waste (MSW) in developing countries after practiced half of the century operationally and technically plasma gasification technology is generally preferred for disposal of hazardous waste, municipal waste. Plasma gasification can completely breakdown all organic and inorganic waste into their structural molecular atoms for recovery and recycling. Energy recovering from solid waste bring

II. T ECHNOLOGIES FROM WASTE TO ENERGY

A. Disposal through landfilled; landfilled has been adopted and most precisely practiced in many countries. But landfill area often highly polluted so it's hard to put chemicals on that area, and need for cover big area.

B. Composite; the decomposition of organic waste such as food or plant material by bacteria, fungi, worms and other organisms under controlled aerobic. It's time consuming process and not effective as much.

C. Incineration; it is a waste treatment system which involves high temperature and convert into fly ash, heat. Flue gases must be free from pollutant and gaseous before dispersed into atmosphere.

We need to invention advance techniques in the direction of disposal of solid waste.

III. PLASMA GASIFICATION

A. plasma- plasma is an ionised form of gas that exist in nature and electrically conductive.

When dc current passed in between plasma torch and suddenly passing of air in between them, it creates extreme temperature in surroundings from 5000°to 10,000°C. Which is capable to distort molecular structure of toxic compounds simultaneously.

B. process of plasma gasification; The extreme temperature generated by using plasma torch system which completely turn out the organic waste into gases such as synthesis gases which is a mixture of hydrogen and carbon monoxide gas. The conversion of solid waste after gasification transform in a green fuel, further which is used via innovative gas turbines for generating electricity, energy applications. After purification process it becomes cleaner gas than natural gas. Heating values also depend on feed stock as treated. The inorganic waste also turn out simultaneously in melted form or into molten slag which could be used by Construction Company like roads, pavement brick [4];

IV. Types of waste that have been used for recover energy and recycling in the world by plasma gasification;

A. Municipal solid waste- a plasma waste recycling process which uses high temperature plasma to convert MSW into syngas, molten metal, vitreous slag and emission on this process are very less than combustion of natural gas. The products of this process are used very effectively. The syngas produced is used to generate electricity. Developments of less expensive technology or progression for sophisticated value additional products which would assist gasification to turn into a cost-effective alternative for waste recycling. Generally gasification is known for low emissions to Environment.

B. Biomass- gasification of biomass have prestigious benefits over other process, syngas is much less toxic compounds, dioxins, after treatment process it is essentially a clean fuel[5] It has high energy density and temperature which provides a potential solution for biomass waste.

C. Coal gasification- coal gasification in steam and atmosphere under arc plasma investigated by Galvita ET al.by using podmoskonyi brown coal. Low grade coal can be used to generate electricity in plasma gasification [6-8];

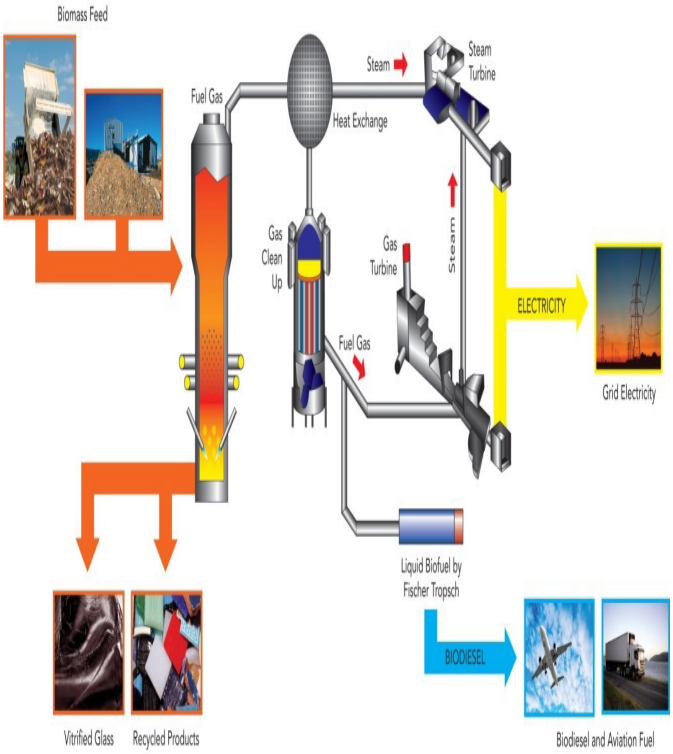

Fig 1-plasma gasification process.

V. Plasma gasification system using worldwide; Top global corporation company using plasma gasification system;

A- Westinghouse Plasma Corporation (WPC). Plasma gasifiers can process up to 330,000 tons per year of waste material, and producing syngas of up to 3.5 million btu per year. Westinghouse technology is already at work in several countries which produces electricity from municipal solid waste, commercial waste.

Japan- Hitachi metals waste to energy facility, commissioned in 2002 at mihama-mikata as commercial project. It gasifies 24 tpd of MSW and

4tpd of waste water treatment plant sludge. Which produces steam and scorching water intended for local industries.

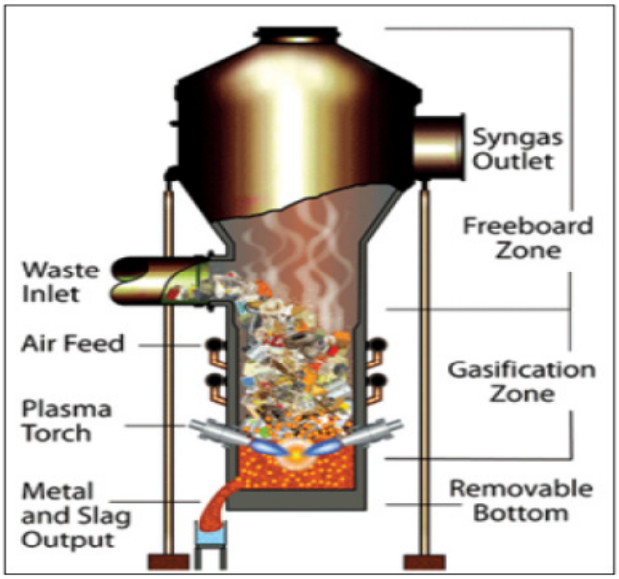

Fig. 5: Westinghouse Plasma Corporation's proprietary plasma gasification vitrification reactor

Fig 2 –Westinghouse plasma gasification

India. Two hazardous solid waste plants which gasifies 72/tonnes day and using WPC gasification technology to produce energy applications.
Operationally it produces 5 mw of electricity. And helps to reduce the amount of solid waste with reducing landfilled.

B- Integrating environmental technology (IET); using plasma enhanced melter to turn waste into highly vitrified glass, recoverable metals, and synthesis gas. Which can further proceed to meet requirement accordingly. It mostly sustain the waste and makes it environmental attractive. It is interested in treating radioactive waste, hazardous, industrial, etc.

C- The solena group; WPC AND Solena group are strategic partner. Uses the integrated plasma gasification combined cycle (IPGCC). Low value feed from coal waste, bio-mass, MSW, into a low heating syngas. Firstly feed stock gasifies in plasma gasification by using high temperature. After cleaned and combusted it's ready to produce electricity. Achieve higher efficiency. Provide lower operation cost.

D- Solena group ongoing projects-
Five 40mw renewable energy plants in California. Two 90 mw renewable energy plants for two major European cities.

E- STARTECH; it uses extremely high energy plasma. Waste into the system is broken down into its molecular containment, deals with also a excellent means of hazardous waste. Zero waste scenario fig 3 given below to represent complete gasification. Startech plants installed in japan, South Carolina, USA [9];

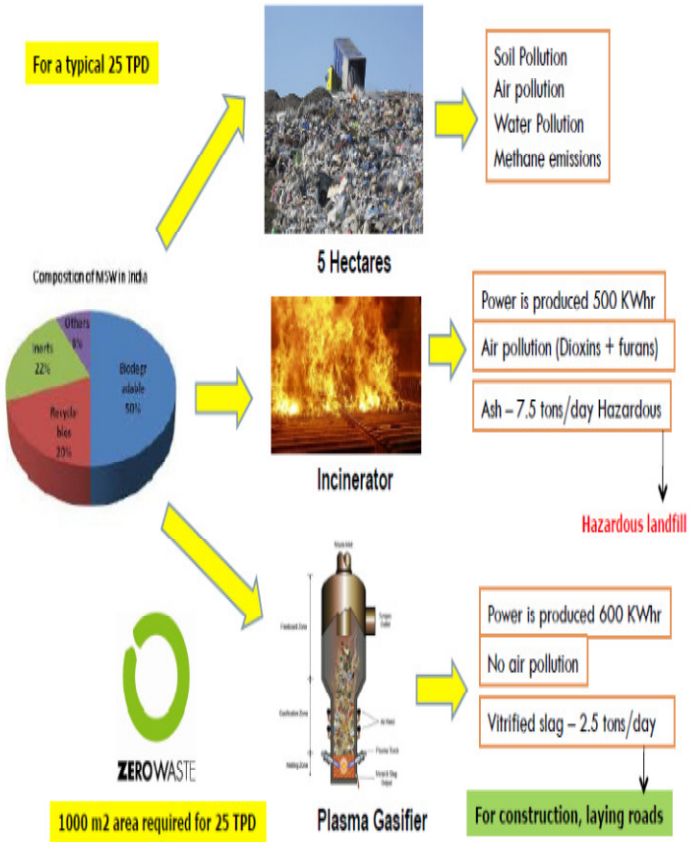

Fig 3-zero waste scenario

COUNTRIES	Waste generation rates	
	current	2025
Bangladesh	0.43	0.75
China	1.02	1.70
India	0.34	0.70
Malaysia	1.52	1.90
Pakistan	0.84	1.05
Nepal	0.12	0.70
Phillipines	0.50	0.90
Thailand	1.76	1.95
Vietnam	1.46	1.80

Table 1- waste generation rate (kg/capital/day) global

VI. Global scenario;

Presently the huge amount of solid waste from urban centres of the world is around 1,300 million tonnes per year (1.2 kg/capital/day) in future it's expected to increase to 2,200 million tonnes per year by 2025(world bank 2012). Table 1 shows waste generated by developing countries.

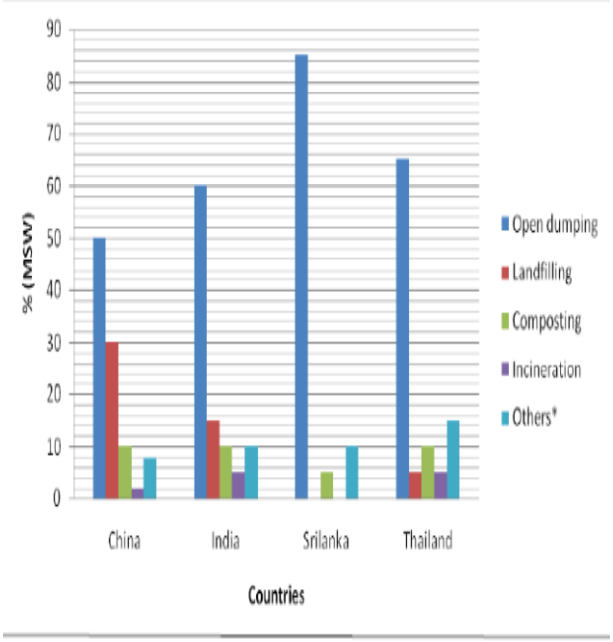

Fig-4 MSW disposal practiced methods in countries

Looking at the most disposal practiced methods in world fig 4 [10-12];

VII. Indian scenario;

In India around 30 million tonnes of MSW and about 4400 million cubic litre of liquid waste are generated annually. In India most of solid waste dumped into land without proper treatment which cause water problem. A potential for generating 1700mw of power from urban and municipal wastes. And about1000 mw from industrial waste. Emission rate is very low in plasma gasification because of closed chamber. We can take advantages from this situation and convert waste into electricity [13];

Parameters	Units	USEPA standards	EPA standards	Plasma emissions
Nox	ppmvd	150	250	35-40
PM	mg/dscm	20-24	34	<5
SO2	ppmvd	30	55	<2
HCl	ppmvd	25	15	<10
CO	ppmvd	100	40	<20
Hg	Micro g/ dscm	50-80	55	<2
PCDD/ PCDF	Nano g/ dscm	13-30	25	0

Table 2- emissions ratio

VIII. Heating value of plasma gasification;

The heating value or calorific value is energy content of biomass fuel. Highly calorific synthesis gas from plasma gasification consist of carbon monoxide and hydrogen. The HHV refers the heat released from the fuel combustion with the condensed and generated water into steam. Table 2 shows emission ratio during plasma gasification. LHV refers gaseous water as the product. So higher heating value varies according to types of plasma

Annual economics	
Revenue	
Electricity production	$13,320,200
Tipping fees	$9,187,500
Recycling sales	$8,568,375
Slag sales	$315,000
Sulphur/hcl sales	$ 1,750
Total	$31,302,625
Expenses	
Operating expenses	($9,829,330)
Debt payment	($14,407,225)
Taxes	$0
Total	$7,067,070

used but thermal plasma contains high heating value rather than conventional methods which is 228.4 kj/mole [14];

IX. Financial viability of plasma plant;

- Foreign firms like startech, operating cost, net cost of operation should be taken into account. Operating cost; the conversion of one tonne of municipal solid waste intro metals, slags, hydrogen, Required 670 units (kWh). At Rs 3 per unit, conversion cost comes out to be Rs 2000 per tonne, by reducing running cost or selling the by-products, the running would be still as Rs 750 per tonne.

- Capital cost- startech plasma converter handles 2000 tonnes of waste daily which roughly cost $250 million. Like Delhi would require eight huge plants at a cost of $1000 million, being a populous country or by segregating various types of waste and treating each other with appropriate technology we could create better environment and emission free zone [15]

The statistics of the progression offers its upper hand for other development.

X. CONCLUSIONS

Traditional methods are not providing sufficient waste management results like composting, landfilling, incinerator. So upgraded is needed in this situation. Plasma gasification is an emerging technology based on extreme thermal process which transform the solid waste into electricity as energy application. We can generate syngas from various waste treatment from plasma gasification. And economically it would help to reducing the landfill area and make it viable. Plasma gasification be able to generate more renewable energy than the estimated energy like solar, wind, geothermal etc. Adoption of latest technologies have to be taken into consideration while selection of a waste management system .it can be viable with developing economies like India, china, Malaysia where it could be strongly implemented and always continued towards the further development of process.

FIG 3- PLASMA ECONOMICALLY REVENUE

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