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## Application of Plasma Gasification Technology in Waste to Energy Conversion

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### Research Article

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#### ABSTRACT

Plasma gasification is very useful technology which can be used to convert waste in to energy. In this method, plasma arc is used to gasify carbon of waste materials. The gas generated in this process is used to produce energy through engine generators and boilers. Non -carbon part of waste material is used to produce vitrified glass and reusable metal. The main aim of this technology is to face challenges and opportunities in future. It is mainly aimed at producing pollution free technology.

### INTRODUCTION

The main reason for energy crisis today is fossil fuels cost and burning of fossil fuels. The high rates of fossil fuels and conflicts in oil producing regions and high demand in countries have led to need of alternative sources of energy. Green-house gases have also caused a change in climate and global warming. Alternative sources of energy that are sustainable, environmentally friendly and easily available should be found. Municipal solid waste is considered one source of renewable energy and plasma gasification technology is a good technology to harness this energy.

Plasma technology is an economic and abundant source of energy and a reliable source of power. This type of technology helps to minimize cost and environmental pollution. It is effective in producing large amount of renewable source of energy.

### BACKGROUND AND CONCEPT

#### Plasma

When the atoms in gas becomes ionized , a electrically conducting medium in which there are roughly equal number of positive and negative charged particles are produced. This is called the plasma. It is also called fourth state of matter. Lightning is also natural form of plasma. Plasma can be formed in industry by heating a gas to very high temperature of 7000°F.

### POTENTIAL FUTURE APPLICATIONS OF PLASMA TECHNOLOGY

#### Animal Carcass and Wastes

One of the major gases produced is methane which causes green house effect. Plasma technology is to properly destroy the animal wastes.

#### Agricultural Waste

Wood materials and other agricultural wastes can be put in plasma reactor vessels and syngas is produced to generate electricity or heat.

## **Paper and Pulp Wastes of Industry**

Different garbage and paper produced in the industry can be processed through gasification technology to destroy them. It produces heat and electricity.

## **Disposal of Carpet**

Carpet is very difficult to dispose. Plasma arc is used to melt carpet. The heat produced is used for various purposes.

## **Coal Gasification**

Coal can be used in plasma gasification to generate syngas. This can be used to produce heat and electricity.

## **Soil In Situ (Borehole) Vitrification**

At high temperature for decontamination of underground waste and hazardous materials is required. With the help of plasma technology, it is possible to lower a plasma torch deep in to ground and pyrolysis the contaminated wastes. It helps to melt them to convert it in to magma or lava material when it is cooled.

# **PLASMA GASIFICATION TECHNOLOGY**

Artificial Plasma can be created by passing gas between objects with large differences in electric potential. For ex, in lightning, heating gases to high temperatures, in the case of arc welding or graphite electrode torches. Very high intensity energy produced by the torch is powerful to break the municipal solid waste into component elements. The reaction produces syngas and by products consisting glass substances which can be used as raw materials for construction purposes and reusable metals. Syngas is basically composed of hydrogen and carbon-monoxide. These gases can be converted into fuels such as hydrogen, natural gas or ethanol. The steam so produced in the process is used to run steam turbine which produces electricity. The cooled gas can also be used to drive the second turbine to produce more electricity. The integrated gasification combine cycle (IGCC) produces excess electricity to drive plant's load [1-5].

# **CHALLENGES AND OPPORTUNITIES**

## **Opportunities**

**Reducing the need for landfills:** Wastes should be reduced and should not be sent to landfills. Plasma gasification technology has full potential to convert large source to electricity, liquid fuels or plastic.

**Disposal of hazardous waste:** Proper care and careful handling is required to dispose of waste in plasma gasification chamber. It is required to completely destroy the waste without leaving ash.

**Syngas:** It can be used as a raw material to generate fuel for gas turbines and boilers. It can be used to generate methanol, ethanol, gasoline, diesel, plastic and many other materials.

## **Challenges**

**Lack of standards:** The lack of standards and efficiency by national and international organization has led to downfall of plasma gasification technology.

**Initial cost and return of investigation:** The cost of installment of plasma gasification technology is very high it is about \$5000, per kW. Due to the high cost of operation and maintenance, amount of syngas produced is difficult. The return on investment time for these plants is very long as compared to similar size industrial facilities.

**Skepticism on environment effects:** It occurs due to lack of historical data, limited number of prototype units and absence of government regulations.

**Confusion between plasma gasification and incineration:** Incineration is simply burning of wastes producing toxic fumes and toxic ashes. While in plasma are chamber, the solid waste is gasified or melted immediately and sludge is almost a rock like a inert material.

## **Suggested Roadmap**

**Establish standard organization:** Try to initiate a standard group inside the technical community. By laying emphasis on the renewable energy profit of plasma gasification IEEE power and Energy traditions and IEEE engineering purpose Society should establish a joint technical committee. This committee can perform various tasks such as the development of the standards of the design, manufacture and the safe operation of the plasma gasification plants.

**Certifying the plasma gasifying plants:** Try to regulate plan, setting up and function of plasma gasification power plants. This process will check the existence of these plants and it will create a strict rules and regulations as well as monitored accordingly.

**Certifying the vitrified materials:** Create the criteria and test methods to determine the composition of the slag exiting the plasma gasification chamber. This should be started at the government level and used as guideline for the states and the countries.

**Government intervention:** Government should take active part in determining the harmful effects of the waste generated and gases released. Government should try to solve the issues with the landfills, energy crisis and the adverse effects of the current generation all over the world.

## **CONCLUSION**

The background and basic concepts of plasma gasification technology is discussed in this paper. Future applications, challenges and opportunities have also been have also been discussed. It is mainly aimed at improving technology and producing environment pollution – free conversion of wastes.

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