SGVU J CLIM CHANGE WATER
Vol. 1(1), Jan 2014 pp 86-89
ISSN: 2347-7741

PLASMA TECHNOLOGY: A SAFE DISPOSAL OF WASTE

YOGENDRA PATEL*
Suresh Gyan Vihar University, Jaipur, India
**Corresponding Author, email: yogendra_patelph@rediffmail.com*

Abstract – Proper and effective decomposition of solid waste is one of the major problems faced by our nation. More than 25% of the municipal solid waste is not collected at all; 70% of the Indian cities lack adequate capacity to transport it and there are no sanitary landfills to dispose of the waste. India generates around 7 million tonnes of hazardous wastes every year. Surveys carried out by various agencies show that the health care establishments in India are not giving due attention to their waste management. Plasma gasification refers to a range of techniques that utilize plasma torches or plasma arcs to generate extreme temperatures that is particularly effective for highly efficient gasification. When utilized for waste treatment, plasma torches are very efficient at causing organic and carbonaceous materials to vaporize into gas. Non-organic materials are melted and cool into a vitrified glass. Waste gasification typically operates at temperatures of 1500°C and at those temperatures materials are subject to a process called molecular disassociation. Due to the high operating temperatures, plasma is very effective at vaporizing very difficult waste materials. Plasma gasification is also more robust than other gasification systems which are closely engineered to match the feed stocks being used. India is facing problem for safe disposal of waste. The country is generating about 188500 tons of M.S.W per day which is either dumped into landfills or burnt. By utilizing plasma technology not only the safe disposal of waste is carried out but we are generating eco friendly fuel in the form of syn gas. And by utilizing this fuel we are generating electricity and this green fuel can also be used in internal combustion engines in automobiles and harmful emissions can be reduced to great extent.

Keywords – Plasma Technology, Solid Waste, Disposal of waste.

INTRODUCTION

Proper and effective decomposition of solid waste is one of the major problems faced by our nation. The high volatility in fuel prices and resulting turbulence in energy market give rise to thought on alternative sources of energy using waste treatment by various methods. By these methods the quantity of waste is reduced and energy can be generated from it using various techniques. Among various wastes the solid waste is not easy to dispose and creating problem for society. Solid waste can be classified into different types depending on their source:

a) Household waste is generally classified as municipal waste,
b) Industrial waste as hazardous waste, and
c) Biomedical waste or hospital waste as infectious waste.

MUNICIPAL SOLID WASTE

Municipal solid waste consists of household waste, construction and demolition debris, sanitation residue, and waste from streets. This garbage is generated mainly from residential and commercial complexes. With rising urbanization and change in lifestyle and food habits, the amount of municipal solid waste has been increasing rapidly and its composition changing. In 1947 cities and towns in India generated an estimated 6 million tonnes of solid waste; in 1997 it was about 48 million tonnes.

More than 25% of the municipal solid waste is not collected at all; 70% of the Indian cities lack adequate capacity to transport it and there are no sanitary landfills to dispose of the waste. The existing landfills are neither well equipped nor well managed and are not lined properly to protect against contamination of soil and groundwater.

Over the last few years, the consumer market has grown rapidly leading to products being packed in cans, aluminium foils, plastics, and other such non-biodegradable items that cause incalculable harm to the environment.

GARBAGE: THE FOUR BROAD CATEGORIES

Organic waste: kitchen waste, vegetables, flowers, leaves, fruits.

Toxic waste: old medicines, paints, chemicals, bulbs, spray cans, fertilizer and pesticide containers, batteries, shoe polish.

Recyclable: paper, glass, metals, plastics.

Soiled: hospital waste such as cloth soiled with blood and other body fluids.

HAZARDOUS WASTE

Industrial and hospital waste is considered hazardous as they may contain toxic substances. Certain types of household waste are also hazardous. Hazardous wastes could be highly toxic to humans, animals, and plants; are corrosive, highly inflammable, or explosive; and react when exposed to certain things e.g. gases. India generates around 7 million tonnes of hazardous wastes every year, most of which is concentrated in four states: Andhra Pradesh, Bihar, Uttar Pradesh, and Tamil Nadu. Household wastes that can be categorized as hazardous waste include old batteries, shoe polish, paint tins, old medicines, and medicine bottles.

Hospital waste contaminated by chemicals used in hospitals is considered hazardous. These chemicals include formaldehyde and phenols, which are used as disinfectants, and mercury, which is used in thermometers or equipment that measure blood pressure. Most hospitals in India do not have proper disposal facilities for these hazardous wastes. In the industrial sector, the major generators of hazardous waste are the metal, chemical, paper, pesticide, dye, refining, and rubber goods industries. Direct exposure to chemicals in hazardous waste such as mercury and cyanide can be fatal.

HOSPITAL OR MEDICAL WASTE

Hospital waste is generated during the diagnosis, treatment, or immunization of human beings or animals or in research activities in these fields or in the production or testing of biologicals. It may include wastes like sharps, soiled waste, disposables, anatomical waste, cultures, discarded medicines, chemical wastes, etc. These are in the form of disposable syringes, swabs, bandages, body fluids, human excreta, etc. This waste is highly infectious and can be a serious threat to human health if not managed in a scientific and discriminate manner. It has been roughly estimated that of the 4 kg of waste generated in a hospital at least 1 kg would be infected.

Surveys carried out by various agencies show that the health care establishments in India are not giving due attention to their waste management. After the notification of the Bio-medical Waste (Handling and Management) Rules, 1998, these establishments are slowly streamlining the process of waste segregation, collection, treatment, and disposal. Many of the larger hospitals have either installed the treatment facilities or are in the process of doing so.

CONVERSION OF WASTE TO ENERGY BY PLASMA GASIFICATION

Plasma gasification refers to a range of techniques that utilize plasma torches or plasma arcs to generate extreme temperatures that is particularly effective for highly efficient gasification. Plasma is a superheated column of electrically conductive gas. In nature, plasma is found in lightning and on the surface of the sun. Plasma torches burn at temperatures approaching 10,000°F and can reliably destroy any materials found here on earth with the exception of nuclear waste, since radioactive isotopes are not broken down by heat.

When utilized for waste treatment, plasma torches are very efficient at causing organic and carbonaceous materials to vaporize into gas. Non-organic materials are melted and cool into a vitrified glass. Waste gasification typically operates at temperatures of 1500°C and at those temperatures materials are subject to a process called molecular disassociation, which means that their molecular bonds are broken down, and in the process all toxins and organic poisons are destroyed. Plasma torches have been used for many years to destroy chemical weapons and toxic wastes, but it is only recently that these processes have been optimized for energy capture and fuel production.

METHODOLOGY

Due to the high operating temperatures, plasma is very effective at vaporizing very difficult waste materials. Plasma gasification is also more robust than other gasification systems which are closely engineered to match the feed stocks being used. Many forms of gasifiers are used for coal and biomass, but plasma systems are unique in their ability to mix and match feed stocks, and even vaporize raw municipal waste, which may include metals, glass and electronics. Tires, medical waste, petroleum refinery wastes, low grade coal, railroad ties and phone poles are all examples of materials that are currently considered toxic and difficult to dispose of and yet are ideal fuels for plasma gasification and can be used to produce clean energy. All of the non-organic materials contained in the feed stock are melted and pour out of the bottom of the gasifier. This material is called slag, and cools into vitrified glass similar in appearance to obsidian. Slag is very stable and safe, due to its tightly bound molecular formations.

In the late 1990's the first pilot-scale plasma gasification projects were built in Japan to convert MSW, sewage sludge, and auto shredder residue to energy. The Japanese pilot plants have been successful, and commercial scale projects are under development now in the U.S., India, Turkey and other countries. The Westinghouse Plasma Corp. was independent until 2007 when it was purchased a Canadian energy firm named AlterNRG that intends to use the plasma gasification technology to convert tar-sands, coal, and MSW into energy. Plasma gasification is advantageous because of the high temperatures produced and its ability to utilize mixed feed stocks. Garbage and sewage can be mixed with coal and biomass in any combination. Requirements for the output gas will determine the precise recipe of the feed going in Gasification is an oxygen-controlled reaction where the air mix inside the reactor is carefully controlled.

Steam may be injected to induce water-shift reactions and raise the ratio of hydrogen to carbon in the syngas. It is desirable to limit nitrogen in order to reduce formation of nitrogen oxides. Nitrogen is reduced by using an Air-Separator Unit (ASU), which separates oxygen from regular air and injects it into the gasifier. Oxygen ratios are very important to manage in gasification because some oxygen is required to create syngas, but if there is too much then combustion occurs instead of gasification and oxides form. In practice, a small of amount of combustion is utilized in gasification reactions to provide

heat. Gasification of MSW requires temperatures above 1200°C (2200°F) and systems are targeted to operate around 1500°C. As the hot gasses exit the reactor they are cooled through a combination of quenching and heat exchangers.

The heat is very valuable and is recycled back into the system to generate steam for multiple purposes including generating electricity, injection into the gasification reaction, or facility heating. There are however, engineering challenges in using heat exchangers at 1500°C; as such temperatures strain steel and other materials. The heat exchanging subsystem is one of the areas that can benefit from further development and maturity so that maximum efficiencies can be achieved in the overall system.

ECONOMIC FEASIBILITY OF A TYPICAL 300 T/DAY PLASMA ARC GASIFICATION PLANT

Following is the economic feasibility of a plasma arc gratification plant:

- Capital Cost : Rs 85.52 crores
- O & M Cost per day :Rs 6.7 lacs
- Total Power generation (MW):10.8
- Power consumption for the plant (MW):1.2
- Net Power available to grid (MW): 9.6
- Other factors:
  - The landfill disposal will be reducing to zero.
  - Carbon credit under CDM project.
  - The revenue from the sale of vitrified mass (around 42 MT/day) will be additional source of income to the plant.

CONCLUSION

India is facing problem for safe disposal of waste. The country is generating about 188500 tons of M.S.W per day which is either dumped into landfills or burnt. On burning it releases very harmful toxic gases directly into the atmosphere and its dumping in landfills releases methane gas which causes green house effect and contribute to the global warming. By utilizing plasma technology not only the safe disposal of waste is carried out but we are generating eco friendly fuel in the form of syn gas. And by utilizing this fuel we are generating electricity and this green fuel can also be used in internal combustion engines in automobiles and harmful emissions can be reduced to great extent.

REFERENCES

U S Environment protection Agency Region 4 clean and sustainable energy conference Dec 11-12 2007 Atlanta Georgia

G W Carter and A V Tsangaris 2008 "Plasma Gasification of Municipal solid waste"

Masoud Pourali "Application of Plasma Gasification Technology in waste to energy challenges and opportunities "

EdberthoLeal- Quiros Plasma Processing of Municipal Solid waste Braz. J Phys Vol 34 no .4b Saopaulo Dec 2004.