

Waste Treatment in Cities Using "Plasma Gasification "as an Environmentally Friendly Technology

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Abstract: The reduction of the environmental pollution is one of the important challenges faced by the city planning process, especially waste disposal hazardous kinds of them and non-hazardous and which have a significant role in polluting the environment additional to the costs. The problem of the research is the limited effectiveness of the traditional methods used in waste collection and disposal that some of which is had been scrapped environmentally. The research aims to put modern technological methods to get rid of waste in cities out of the traditional methods to enforce the use of the Plasma Reactor in the treatment of all kinds of solid and gaseous and liquid waste without sorting, which saves sorting costs and time required for that, and leads to getting rid of all harmful compounds of the waste and get benefit from the outputs completely. The Plasma Reactor can reprocess sanitary landfills which had been existed many years ago and treatment of Waste water and the results of the backfill such as the toxic gases.

Key Words: Plasma Gasification, waste treatment

Introduction

The environmental problems and finding solutions to them has become big challenges faced by the city administrations, especially after the population growing and significantly increasing the requirements of the life because of the economic and social changes and most important of these problems are the waste because of its relationship to human health and the environment in which this problem has become one of the basic issues that require the use of modern technological methods in the collecting, disposal and under the control of a successful environmental management. Research tries to showing some well-known of t strategies of waste collection and disposal and its positives and negatives to enable showing an important technologies of the waste treatment of all kinds which is the using of a gasification plasma technology and preceded by displaying some theoretical concepts and information which is the base from which the research starts towards achieving its target in advance. "Getting rid of the wastes by using the plasma gasification" for more comprehensive and

active treatment comparing with the traditional methods.

1- The concept of plasma gasification

The plasma gasification principle based on the idea of dismantling the waste components in a –"free space- practically "of oxygen so that decompose waste into basic elements and by breaking (break down) molecular bonds under very high temperatures." [1]

2. Varieties of waste

Wastes are classified into hazardous waste and other non-hazardous according to the level of seriousness and purpose of the classification and in general classified to:

a- Hazardous waste such as dual and triple multi biphenyls and the waste of ozone-depleting substances.

b- Medical wastes.

c- Non-hazardous municipal waste such as organic waste, paper, textiles etc... Dangerous ones such as containers, paint, batteries, etc.

d - End-of-life Electrical and electronic equipment.

e- Agricultural waste and waste fertilization and pesticides.

f- Marine waste that posed to the sea and abandoned wild wastes in the environment.

g- Industrial non-hazardous waste and waste water produced from the non-hazardous ones such as paper and textile..

h- Waste of construction and demolition [2]

3- Waste Management Strategies

The most important strategies that have been developed for the management of waste in cities is the Four Golden Rule (4Rs):

3-1 Reduction the production of waste at source.

They reduce the size of the waste raised from the source process this strategy aims to reduce the consumption of materials and the reduction of production and the most important benefits of this strategy is to reduce the energy consumption and reduce the cost of production. The success of this strategy depends on the extent of awareness at of the consumer and producer there is a need to awareness campaigns to change the individual's behavior towards the environment they live in and through the issuance of legislation and regulations related to environmental protection and the use of economic instruments for its role in reducing consumption and then reduce the volume of waste production posed to the environment.

3-2 Reuse

Re-use of the material produced more than once, such as plastic and glass containers. The hazardous wastes and radioactive materials transported to a special places to be sorted and re-use of some of them by some industrial plants and damaging the danger ones in special ways which is not with out of some risks to the environment in the absence of precise control of the implementation process. The characteristic of this strategy is that it re-uses what can be re-used and not all materials that make up the waste.

3-3 Recycling

Recycled products used, which poses to environment as solid wastes to produce new other Industries for different uses these residues are (car wheels, paper, plastic, spare parts, etc.). Required cost may available for manufacturing of many

industrial products by this strategy and reducing the cost resulting from these products of solid waste after consumption and turn it into a solid residue [3] which is an economically feasible process in the case of the low amount of what is available of the supplier, such as paper recycling but recycle this waste depends on the economic feasibility of this process and the demand for the product [4] and the capability of the substances of this process and the recycling management department, as well as sorting selective in sorting centers and the study of the costs of them. Recycling electrical appliances and computers not included because the recycling to be dismantled and separated and then recycling. Materials consisting of one element can easily be recycled, such as plastic materials.

3-4 Recovery Strategy

The application of this strategy through the burning of hazardous and non-hazardous waste in special incinerators and Thermal recovery technology used for the disposal of solid and liquid hazardous waste and such a strategy is characterized by to get rid of 90% of the solids and converted into thermal energy utilized in generating steam or electricity are also used in Industrial operations and can take advantage of the ash resulting from the incineration in road construction [5] in the case of errors in implementation or that these incinerators are not identical to the required specifications, will be there possibility risk of environmental contamination.

Municipalities in the cities of developing countries, pay high proportions of their budget for waste treatment and disposal, according to World Bank estimates, developing countries spend 20% -50% of its rotating budget spent on solid waste management, even what is collected is 30% -60% only of size waste in urban areas is what is less than 50% of the population in most developing countries use open landfill dumps and waste burned in the open air. [6]

We conclude that the waste collection cost is the largest proportion of the total costs in addition to the social costs and negative environmental effects incurred by the society that these costs should be included in the accounts and added to the overall costs. [7]

The landfill is the inevitable result for all solid waste disposal without damage to the environment and this requires knowledge of how

to control requirements that meet the sanitary landfill and landfill is a difficult operation in countries that suffer from the scarcity of land, so the use of technical backfill becomes required "where pumping gas emitted from these landfills by pipeline and is used to generate electricity are also groundwater protection and the reduction of greenhouse gas emissions, waste treatment, juice by evaporation, in the sub- continental climate regions.[8]

With population growth and the expansion of cities and increasing the production of factories, hospitals in addition to the per capita consumption As can be seen from the above that the methods used are of limitation in paybacks with positives and negatives and determinants in addition to the costs borne by the cities budgets so searching for a new technologies become of great importance in order to create a clean and safe environment at present and for future generations is to use a plasma method, called the "plasma gasification" which is an advanced, safe and friendly operation environment for the disposal of waste of all kinds and the restoration of all the materials and inherent energy and converted into outputs of value in economic , industrial and commercial terms, as well as it is possible develop some of their parts in military use and at a low cost a and thus protect the society and the environment.

4- Physical plasma

It is the Fourth State of matter described as ionized gas in which electrons are free and not connected to an atom or molecule [9] as shown in Figure 1

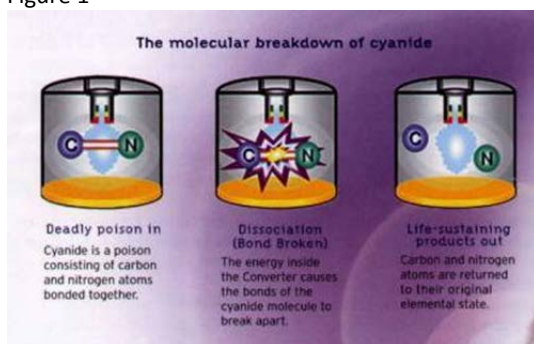


Figure -1- Ionization of the gas [9]

Grabbing electrons from atoms plasma is be formed so when you shine a high temperature or subjected high magnetic like a laser to the field or a wave of a microwave where shooting electron away "from the nucleus of the external orbitals of the atom negative ions charges and the other

positive ions will results from this process and accompanied by the disintegration of the molecular bonds [10] that found.

Below most important physical properties of the plasma are: [11]

- 1- Very strong electrical conductor, "as a result of the carrier particles for the shipment.
2. Affected by magnetic fields shall be in the form of packages or double layer or lines.
3. Consists of three particles Electron and a positive ion or neutral particle or lines.
4. Plasma act independently according to the speed and size and heat.
5. Has a regular movement with super- speed up to 60 km / sec
6. Affected by heat, so temperatures controls the degree of ionization of the plasma.
7. Classified as severe temperatures or low temperatures the degree of the plasma temperature measured by ev or kelvin K.
8. It is of enormous energy.
9. Do not have a certain mass or a particular form.
10. It is of a high-frequency compared to the frequency of the electrons in the neutral condition.

According to the electromagnetic theory, the plasma spreads and the resulting magnetic field electro generates effort "tremendous" up to a few thousands or millions of volts so resembles influence the effect of lightning or a storm in just a few hundred Nanosecond (part of the one billion fraction of a second). Plasma is used in the fields of science, such as plasma physics and chemical applications and used in many of the important technical applications and what this research – focus on is the practical application of scientific plasma in the treatment of waste in all its forms. [12]

5-The principle of plasma gasification

The principle of gasification of the plasma based on the idea of dismantling the waste components in free space practically "of oxygenated and dominated by a plasma reactor so that decompose waste into its basic elements and by (break down) molecular bonds under very high temperature" up to 4000-7000 C leading to energy production and gas of synthetic fuels (synthesis gas) to create electricity and carbon monoxide CO and hydrogen H₂, nitrogen N₂ in addition to some impurities and side products (hydro chloride acid HCL and sodium sulphate₂ (Na (SO₄)₂ in addition to stable metals and generate large electric energy and the

production of glazed slag which is chemically inactive, used in construction of bridges, roads, pavements and walls and ceilings ... etc.) [13] As in Figure -2-



Figure 2. Vitrified Slag

Fig. 2. Production of vitrified slag [13]

By modern technology to deal with waste by plasma processes, traditional methods become void and no longer necessary for the reasons below:

- 1 - Costly sorting operations from the source and the length of time needed for sorting and labor cost and trucks stressful to collect and transport the waste after sorting with small compressed sizes and this process is no longer necessary as long as the plasma reactor will deal with the wastes that has been sorted or non-sorted.
- 2 - Fertilization process of organic material is not encouraging because it is useless and it needs work and effort in addition it has become undesirable.
3. Burning process: It is a very expensive process and results emissions of gases which are very toxic and polluting the environment, which consist of furans and dioxins, Sulphur Dioxide and other oxide, all these materials lead to cancer, and the remaining ash from the burning process. 30-35% of the volume of waste by incineration is very toxic and the difficulty of controlling, it contains Carbon deposits and coal, which requires sanitary landfills for burial, and this leads to groundwater and environmental pollution and contamination of rivers.
4. Dumpsites and landfills: become non-existent in presence of a plasma reactor, which converts the entire waste to energy and metals and glass and which all are idle chemically. The plasma reactor may reprocess all waste in landfills which are from many years earlier in the ground which produces toxic gases out into the atmosphere and is very

toxic liquids seep into groundwater. Plasma reactor convert it into energy and get rid of the adverse effect and treatment of toxic gases through the gas outlets of the reactor when a temperature of about 1250 ° C and then cooled and purified to be used again. Fig.3 [14]

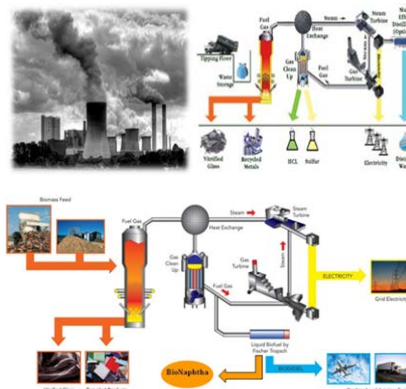


Fig3 Plant of plasma gasification waste treatment [14]

6- Conclusions and Results

1. Using the plasma method efficiently to handle four types of hazardous and toxic waste and lethal as a result of high temperature enable them to break the molecular bonds of waste vehicles.
2. Applied plasma method within an elaborate system without blowing out or loss of ash and waste residue of dust and gases into the environment and restore minerals to the mining industry and beneficial uses of slag and convert toxic gases to other non-toxic and stored in special containers (gas cylinders) to be used well as fuel for energy production.
3. Plasma technology is the only way to reduce the electronic waste that is not subject to biological decomposition.
4. Using method of plasma gasification PGP in waste treatment, which are classified as thermal and non-thermal are all producing inexpensive electric power and creating an environment of products, namely:
 - a- Production syngas which is used to generate electricity.
 - b- Directing the heat produced to generate steam which is directed to generate electricity.
 - c- Glazed slag resulting from the decomposition of non-volatile components of the waste which is idle chemically.
 - d- Producing fuel combustible such as ethane, methanol, methane, hydrogen and other types.
5. Using plasma method to reduce the elements that are below environmental standards and the remains of malice and pollutants will be glazed.

6. The way of using the plasma, ensure a total destruction and irreversible for all toxic compounds that pose a significant risk to the environment.

7. The creation of a clean environment is not the unique goal of Plasma Process but improving public health, to combat climate change and the most important greenhouse gas.

8- Sanitary landfill and landfill is a difficult operation in countries that suffer from the scarcity of land so plasma process is better.

7- Recommendations

1- Attempt to abandon the traditional methods of waste management and facing towards modern technology.

2 - Preparation and implementation of an integrated strategy and a plan for waste management that takes into account the legislative requirements of social, financial and technical basis for the success of this project.

3- Creating an environmental awareness and create a conscious for community about environmental issues.

4 - Encouraging investment in the private sectors with expertise to build such plants.

5- Encouraging theoretical research and studies which support development of new plasma gasification.

6- Mathematical and statistical operations and the theoretical data must be accurate to achieve good results to the establishment and using plasma method.

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