

NEW PLASMA STEAM TECHNOLOGY FOR ORGANIC WASTE RECYCLING (INCLUDING MEDICAL AND OTHER HAZARDOUS WASTES) WITH CONCURRENT SYNTHETIC FUEL GENERATION

Problem.

At present there are two basic problems, among others the most critical for the human society:

- Environmental protection with hazardous wastes destruction;
- Development of new methods for the generation of alternative energy resources.

Organic substances constitute a considerable share amongst waste (plastic bottles and other articles, medical wastes, car tires, etc.). These substances are huge in volume and commonly are practically nondegradable ones. They are often hazardous to humans and environments. Medical wastes is one of the most dangerous categories that come first in the list of 45 hazardous waste types according to 1989 Basel Convention on control of trans-boundary movements of hazardous wastes and their disposal.

Based on published data available, the USA accumulate over 3 million tons of medical wastes per year; Russia and China up to 1 million tons; France - about 600.000 tons. The estimation for Ukraine gives us around 350.000 tons of medical waste per year. Not less dangerous are such waste as forbidden or unsuitable for use pesticides (based on official date in Ukraine they make up around 20.000 tons), and a series of other hazardous waste types. Their treatment and destruction problem is still needs to be solved and takes on special significance.

The problem of birds lost as a result of fowl pest and dead animals destruction, is posing a threat and no less serious today. This problem is still needs to be solved, and assumes a new meaning.

Commonly used regular waste treatment technologies more and more come in clash with the environmental safety growing demands, and generally are being rejected on construction of new waste treatment facilities by most of the countries. Meanwhile, the mentioned substances could be an additional important source for synthetic fuel production in the form of Syn-gas or diesel fuel, ranging up to 700 kg out of 1 ton of wastes.

The way to solve the problem.

As our investigation shows (see enclosure), one of the most promising approaches that is about to take the leading position in the world in the field of hazardous waste treatment and destruction is the application of technological processes using plasma arc power. These hazardous wastes plasma treatment technologies are recent developments, and several companies from the USA, Russia, India etc., focus their activity in this direction.

Plasma technology, as an alternative to any trash burning methods, lies in decomposition (breakdown) of all substances' complex molecules into simple ones, due to extremely high temperatures and lack of free oxygen. Plasma jet temperature is able to completely destroy any organic and biological substances, to actually annihilate the most hazardous toxins, to melt and evaporate the most heat-resistant compounds, and to substantially reduce waste volume as a whole. Even high temperature resistant components cannot withstand the plasma treatment process.

Plasma gasification (pyrolysis) process guarantees environmentally friendly materials treatment void of resins, dioxins, aerosols, etc. pollutions, with complete extraction of carbon from the materials under the treatment, whereas application of any incineration process provides up to 30 % of carbon fixed residue. Plasma gasification process provides super high purification of the treated materials up to 99, 99%.

Plasma gasification provides huge reduction of solid initial material mass. Waste weight to fixed residue ash ratio makes up 400:1 that is noticeably higher than with other known processes.

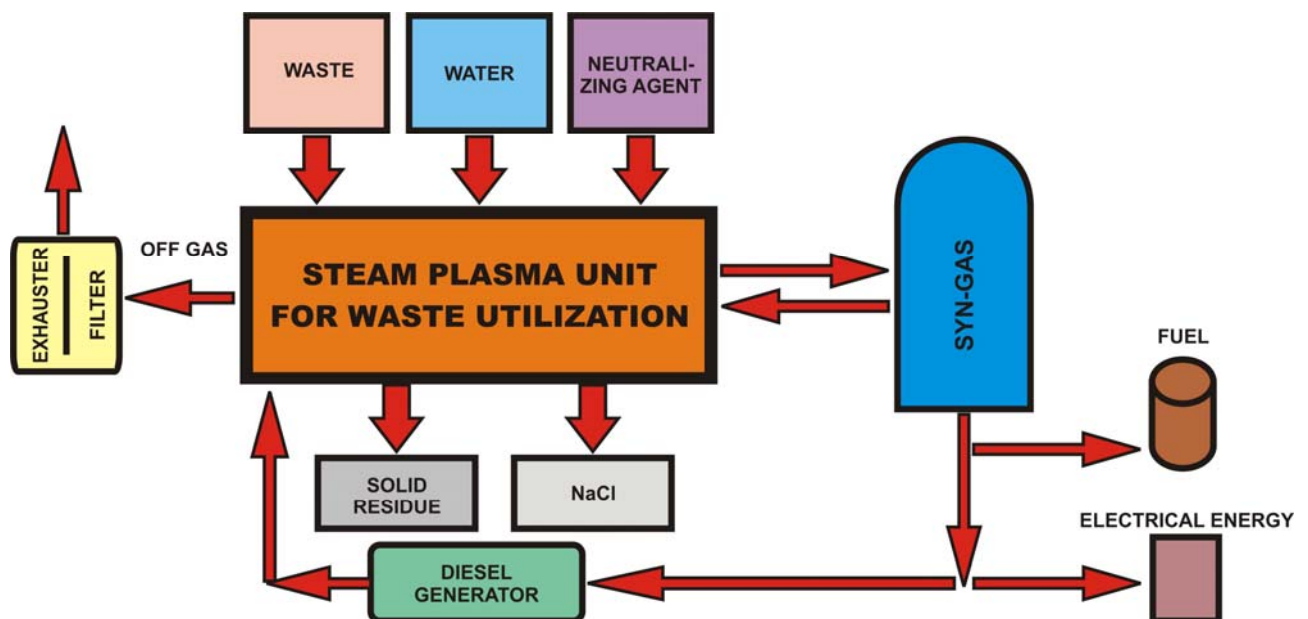
Plasma gasification product is high-energy gas ($H_2 + CO$ mixture) and indifferent fixed residue in the form of glazed slag. This gas could be applied either as an efficient power source for electric energy production, or as raw material synthetic petrol production, and etc. Obtained gas could be used right away, kept in tank, or transported to a distant consumer.

Liquid ashes removed from reactor are safe for land burial. Melted slag under tap could be granulated and used in construction, and melted metal could be applied for alloy and foundry alloy production, for remelting, and etc.

Application of plasma technology means a step from the destruction of hazardous organic wastes to their recycling. With plasma technologies waste burial becomes a thing of the past.

What we propose.

The E.O.Paton Electric Welding Institute and the Gas Institute both of the National Academy of Sciences of Ukraine propose a basically new technological process for treatment of organic including medical wastes, based on pyrolysis (high-temperature gasification) with application of so called "steam " plasma (that is plasma with water steam of high thermodynamic parameters used as plasma forming gas). Flow block of the steam plasma utilization process of the hazardous waste presented in the figure.



Detailed process description is given in enclosed article.

Why the proposed process is better than others

The proposed process named PLASER has a lot of advantages over regular plasma gasification technologies and ensures high-performance (up to 100 percent) recycling of the organic wastes (medical and other hazardous waste including) void of the emission such detrimental impurities as dioxins, resins, phenol, aerosols, and etc., with the generating of syn-gas as a target product, being important energy carrier, and also safe solid treatment products suitable for further application, for instance, in construction.

Plasma steam conversion provides total thermal and concentration uniformity all over the treatment area. Within the whole treatment period, all surface solid phase and liquid phase elements are under equal thermodynamic conditions due to high steam transportation power. This ensures guaranteed material treatment all over the reactor volume.

Plasma gasification process treats the work material of any composition as well as of the moisture level. Destruction efficiency under this process is independent of these parameters' change.

Within the treatment process, such dangerous elements as chlorine, fluorine and etc. that are often in various plastic materials compositions are being linked and easily moved away.

When processing coal-based substances with water steam gasification under high thermodynamic parameters in gas phase, sulfur compounds are entirely remain in fixed residue (slag).

Generated within the treatment process, high quality syn-gas does not require additional gas separation and treating operations.

The steam plasmatrons (steam plasma generator) service life is substantially higher as compared to traditional one. The equipment is compact and reliable. It can be designed and manufactured either in stationary or mobile version (for example on a track) to process the wastes utilization at their generation (accumulation) site.

Use of Syn-gas generated during the treatment process for the unit self-contained power supply feed, enable to essentially reduce power supply costs, thus making the process practically energy-independent, moreover, to organize, at one time, electric power or/and a fuel production.

Using process PLASER, various organic wastes could be proposed for treatment, namely high-toxic and hazardous including:

- Medical wastes – syringes, gloves, dressing materials, organic wastes, etc.;
- Birds carcasses to be processed as a result of birds flue;
- Homeless animals (dogs, cats, groundhogs etc.) carcasses;
- Used plastic bottles and containers;
- Car tires;
- Pesticides and chemical pest killers;
- Wood chips;
- Other organic wastes.

Present status

We have developed the basic process and prototype plasma equipment for steam plasma destruction of organic wastes, which is at the tests now.

At present we are working on the development of a pilot machine for the hazardous wastes processing to be used for study, development and demonstration of the process with limited services for such wastes processing.

As the next step we are looking for the arrangements for the commercial equipment (stationary and mobile version) for medical and other hazardous waste plasma treatment manufacturing and/or for the creation of service center network. These sales can be for both – Ukrainian and the foreign markets, with regard to increased demand for such equipment all over the world. Only Ukrainian estimated market demands for medium-capacity (1000 tons per year) industrial steam plasma units for utilization of medical and other hazardous (highly toxic) wastes are on 300-350 machines level. The European and the world market demand (with regard to published data on accumulated hospital wastes) are practically unlimited. The estimated manufacturing cost of 1000t capacity machine is \$1.2M with the sales cost on \$1.5-1.8M level. All the details are negotiable.