MODERN METHOD OF OBTAINING ELECTRICITY FROM UNCONVENTIONAL SOURCES

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ABSTRACT

The paper presents an evolved method, based on Waste-To-Energy (WTE) technology that uses household waste as a raw material to obtain electricity. This technology is developed and implemented following the principles of sustainability, thus obtaining both a correct waste treatment strategy and an appropriate environment for energy production. The financial impact of such a system must not be neglected.

Keywords: municipal waste, renewable electricity, DCS

INTRODUCTION

The concept of Waste-To-Energy (WTE) is found in developed countries that have begun to successfully implement this as a measure of waste management, as well as energy security. Increasing development leads to a change in lifestyle and status, leading to generations that will produce more and more waste.

Municipal Solid Waste (MSW) is classified and defined in different ways, depending on the country and the practices used in the waste management domain.

Differences in the definition of the Municipal Solid Waste (MSW) concept create both uncertainty, when assessing waste management and national performance, and inconsistency in data collection, as there is an overlap between waste categories in different countries, making it difficult to disaggregate.

When considering a waste as an energy resource, it is important to take into account the composition of the different types of waste available. Municipal solid waste (MSW) from residential, industrial and commercial sources is the most common waste stream used for energy recovery. However, construction waste, biological waste from agricultural and forestry activities, hazardous waste and much more can be considered feasible for energy recovery, depending on their specific composition, energy content and the specific needs of society in terms of disposal. waste. [7]

Figure 1.1 illustrates the fractions that are found in the composition of MSW (Municipal Solid Waste).

The transformation of energy with solid waste as raw material can be achieved through various technologies. Each of these WTE (Waste To Energy) solutions has specific characteristics and can be more or less feasible depending on different parameters. Factors include the type and composition of the waste, the energy content, the final shape of the desired energy, the thermodynamic and chemical conditions in which a WTE (Waste To Energy) installation can operate and the overall energy efficiency.

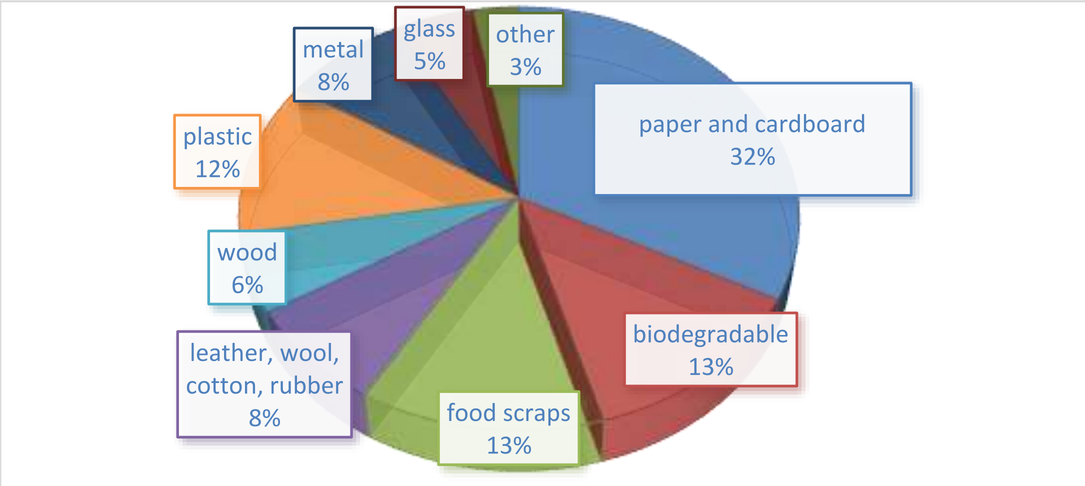

Figure 1 MSW (Municipal Solid Waste) Component Fractions [1]

Thermo-chemical conversion technologies are used to recover energy from municipal solid waste (MSW) by using or involving high temperatures. These include burning or incineration, gasification and pyrolysis.

The main difference between these technologies is the amount of air and temperature in the process that leads to the conversion of the final product and water or useful intermediates, taking into account other technological differences. Dry matter is the most suitable raw material for thermochemical conversion technologies.

The first technology, waste incineration, is the most common form of transformation of municipal solid waste into energy. The waste is burned, and the heat or biogas created is recovered and either distributed in the form of heat or transformed into another form of useful energy, steam or electricity.

Combustion processes are classified as mass combustion, if the waste is not pre-sorted, or Refuse Derived Fuel (RDF) combustion, a more expensive process where RDF is a fuel produced by treatment (e.g., chopping and dehydration). solid municipal waste. This process is also known as the Solid Recovered Fuel (SRF) gasification process.

Another heat treatment process is gasification, which is effective in minimizing air pollutants. Gasification takes place in the presence of limited oxygen and generates a synthetic gas to be used in a production of heat and electricity by the gas turbine.

A third process, pyrolysis, is a well-known technological process of a thermochemical nature, consisting in the thermal decomposition of waste in the presence of atmospheric oxygen, in order to obtain a gaseous fuel. Anaerobic digestion of biodegradable waste is a biological treatment of organic matter, and the resulting biogas is rich in methane. Biogas can be treated and used, transformed into heat and electricity, or used for methane.

Figure 2 illustrates the production of electricity through the WTE (Waste To Energy) method, using current treatment methods.

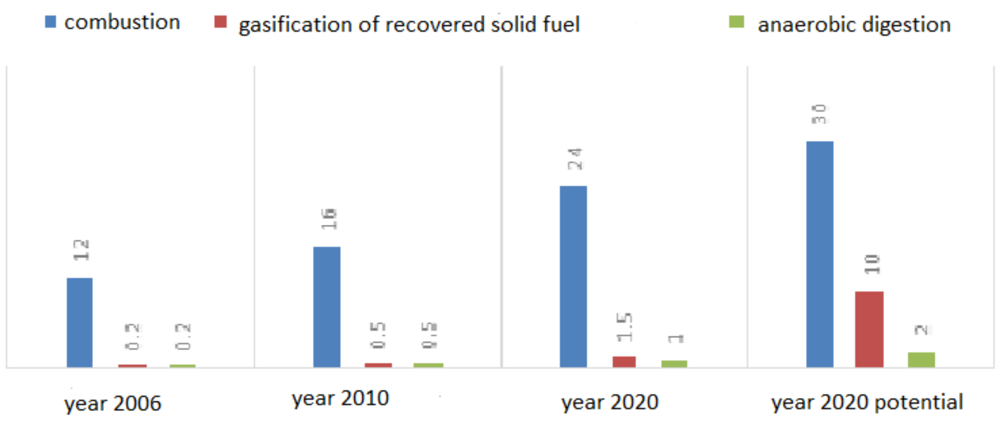

Figure 2 Production of renewable electricity by the WTE (Waste To Energy) method for the treatment of municipal solid waste [1]

DESCRIPTION OF THE PROCESS OF OBTAINING ENERGY USING MUNICIPAL WASTE

Energy from municipal waste treatment uses waste as fuel to generate energy, just as other power plants use coal, oil or natural gas. The burned fuel turns the water into steam, and electricity is obtained by using a turbine. The process can reduce the volume of waste in a community by up to 90% and can prevent the release of one tonne of carbon dioxide for every tonne of waste burned.

Fig. 3 illustrates the entire process to which urban waste is subjected to its transformation into energy, according to Waste-To-Energy (WTE) technology.

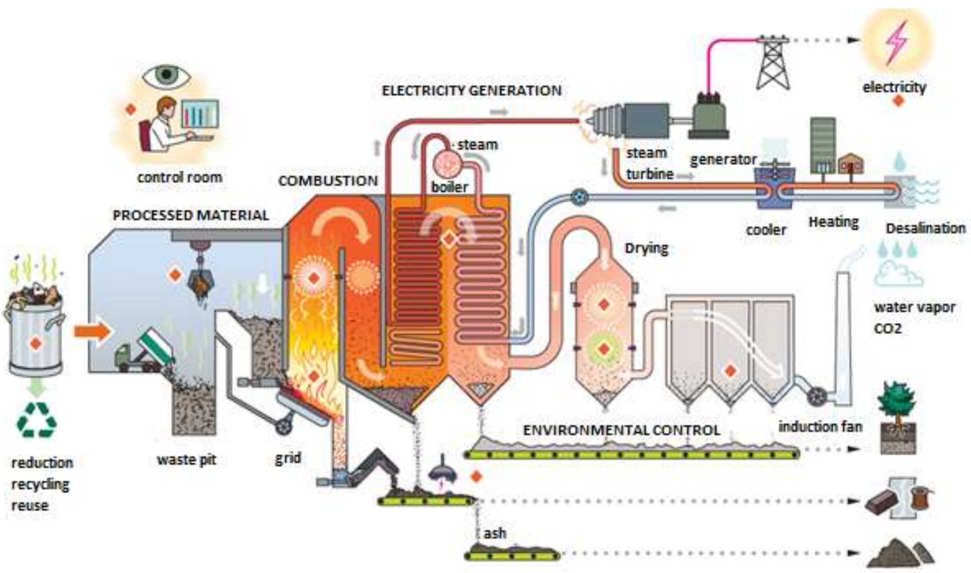

Figure 3 The process of obtaining energy using municipal waste [2]

Best practices are based on the rule of the "three R-s": reuse, reduction and recycling. Recycling plastics, glass, paper, metals and wood reduces the amount of carbon and pollutants created in the combustion process. Materials such as food scraps, biological and commercial waste are ideal for the combustion process.

Through the monitoring and control chamber, the airflow that rises to the chimney is constantly monitored to ensure compliance with air quality standards. The whole process can be controlled to optimize efficiency in the generation of combustion, heat and steam, electricity and environmental control processes.

The residual material is taken up in an isolated receiving area, where it is subjected to the mixing process, being prepared for combustion. The negative air flow will carry dust and odor into the combustion chamber in the reception area, in order to eliminate the possibility of their spread outside the installation.

The mixed waste is introduced into the combustion chamber by means of a constantly moving grill, which rotates repeatedly to maintain exposure and combustion. A measured injection of oxygen and gases from the receiving area makes the combustion as complete as possible.

Although the ash is collected throughout the process, the finest particles of air are removed into the filtration chamber, where an induction fan draws air through textile bags to the chimney. This process removes 96% of the remaining particles. The bags are vibrated at regular intervals to shake and detach the trapped particles on the inner and outer surfaces. "Flying" ash is often returned to landfills.

The acid flue gases are neutralized with an injection of lime or sodium hydroxide, this process removing 94% of the hydrochloric acid.

The remains of the combustion process are subjected to swirling magnets and current separators to remove ferrous metals (steel and iron), as well as other metals - such as copper, brass, nickel and aluminum - for recycling. The remaining ash can be used for rails and railings. The ash is generated in a ratio of about 10% of the initial volume of waste and 30% of the initial weight of the waste.

Highly efficient superheated steam feeds the steam turbine generator. Cooling steam is recycled into water through the condenser or is returned as a heat source for buildings or desalination plants. The cooled flow is reheated in the economizer and superheater to complete the steam cycle.

Activated carbon (coal treated with oxygen to increase its porosity) is injected into the flue gases to absorb and remove heavy metals such as mercury and cadmium.

Nitrogen oxide from flue gases is neutralized by injecting ammonia or urea. Dioxins and furans are destroyed by exposure to flue gases at a sustained temperature of 1,562 ° F / 850 ° C for two seconds. This process removes more than 99% dioxins and furans.

A 1,000 tonnes-a-day energy plant produces enough electricity for 15,000 households. Each ton of waste can feed a household for a month. If combined with a cogeneration plant project, the plants can also provide heat for nearby businesses, desalination plants and other purposes.

The simplified scheme for obtaining energy from urban waste is illustrated in Fig. 4.

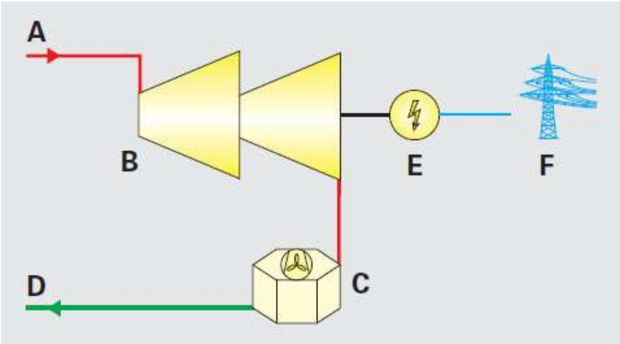

Figure 4 Simplified scheme for obtaining energy from municipal waste [3]
A -Superheated steam from the steam generator; B - Extraction-condensation turbine; C - Air cooled condenser; D - Power hose to the steam generator; E - Generator; F - Export to the electricity network.

DCS CONTROL OF THE SYSTEM FOR OBTAINING ELECTRICITY FROM URBAN WASTE

The concept of Distributed Control System (DCS) is currently indispensable in every industry worldwide.

DCS systems first appeared in the industry in 1980 and developed with the exponential evolution of the technological level, encompassing the newest and best performing products in many industries, such as electronics and telecommunications. The concept of DCS is generally recognized as referring to a control system of an industrial unit, a process or any type of dynamic system in which the control elements are not physically centralized, but are distributed within the system [4].

The main feature of the distributed control system is the introduction of programming using the FBD language (Function Block Diagram), a programming mode that has survived until now.

The possibility of digital communication between controllers, workstations and other elements of the network is the main advantage of DCS.

The evolution of the Internet and the development of Ethernet technology using the TCP / IP stack have led DCS systems to adopt this mode of communication. Distributed control systems are implemented in various industrial applications, connecting existing transducers and execution elements. The distributed system receives both process information - via transducers - and feedback information to ensure the proper functioning of the automation elements.

Regarding the ability to support control loops, modern distributed control systems incorporate both traditional regulators (PID) and logical or sequential control modes and even have the ability to implement applications with neural networks and fuzzy systems.

One such system is called the CENTUM VP, which does not have a separate architecture compared to existing DCS systems. Regarding the architecture of the CENTUM VP software package, it includes: Human Interface Station (HIS), Field Control Station (FCS), network equipment. Among the main advantages of the CENTUM VP software package, we list: very low number of errors, fault tolerance, recovery from the error state in a short time.

The architecture of such a system applied to obtain energy from urban waste is presented in Fig.5, where the main components of the installation are highlighted, providing an overview of the operation of the installation and process values.

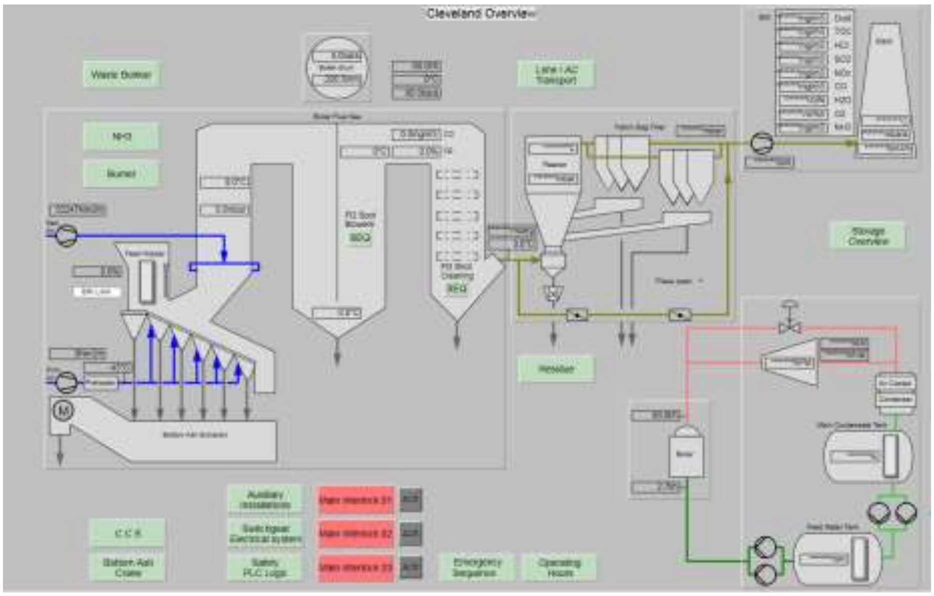

Figure 5 Functional block diagram of the urban waste energy generation system [3]

CONCLUSIONS

Today, waste is an inevitable product of society, and one of the biggest challenges for future generations is to understand how to manage large amounts of waste in a sustainable way. The integration of process elements in a distributed control system has become, in the current context of industry development, a common practice, but one that requires a high degree of knowledge in different fields.

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