From Waste to Energy: A New Way to Use Non-Recyclable Waste

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***Abstract*— The global energy crisis, driven by population growth and industrialization, necessitates sustainable energy sources. This paper explores converting non-recyclable waste into energy, providing dual benefits: waste management and energy generation. Aligned with Sustainable Development Goals, this approach reduces environmental impact produced by waste and aids urban waste management. The paper highlights the global impact of solid waste, details the waste-to-energy process, and discusses its advantages and disadvantages. Although it is a good idea, it requires careful consideration and simultaneous waste reduction efforts to address energy and environmental challenges responsibly. It is expected that this paper may inform about the energy problem and show a new technique for obtaining energy that gives a useful purpose the burning of waste so as to have a new form of energy supply.**

Keywords: energy crisis, waste to energy, waste management , energy generation.

***Resumen*— La crisis energética mundial, impulsada por el crecimiento de la población y la industrialización, exige fuentes de energía sostenible. Este artículo explora la conversión de residuos no reciclables en energía, ofreciendo dos beneficios: la gestión de residuos y la generación de energía. En coincidencia con los Objetivos de Desarrollo Sostenible, esta aproximación reduce el impacto ambiental de los residuos y contribuye a la gestión de residuos urbanos. El artículo destaca la importancia mundial de los residuos sólidos, detalla el proceso de conversión de residuos en energía y analiza sus ventajas y desventajas. Aunque presenta una idea prometedora, requiere una consideración cuidadosa y esfuerzos simultáneos de reducción de residuos para abordar de manera responsable los desafíos energéticos y ambientales. Se espera que este artículo genere conciencia sobre el problema energético e introduzca una nueva técnica para obtener energía que utilice la incineración de residuos para crear una nueva forma de suministro de energía.**

Palabras claves: crisis energética, conversión de residuos en energía, gestión de residuos, generación de energía.

I. INTRODUCTION

The global energy problem has become one of the most pressing challenges facing our society today. The demand for energy continues to increase due to the growth of the world population, economic development, and industrialization. In most of the countries both energy systems are under change. The changes are largely driven by environmental considerations and one driving force is the threat of global climate change. When making new strategic decisions related to energy systems it is, therefore, of importance to consider the environmental implications.

The increasing global demand for energy has prompted researchers and scientists to explore alternative sources of energy production. One such method gaining significant attention is the generation of energy through the incineration of non-recyclable waste materials. This approach offers a promising solution to two critical challenges: waste management and energy generation. By harnessing the potential of burning non-recyclable waste, the environmental impact of landfills can be mitigated while simultaneously generating energy.

The production of energy from non-recyclable materials plays a significant role in advancing the objectives outlined in Sustainable Development Goals (SDGs) 7 and 11 set forth by the United Nations. Firstly, SDG 7 aims to "ensure access to affordable, reliable, sustainable, and modern energy for all". Secondly, SDG 11 proposes as a target the "use of solid waste, which is generated by the population, by reducing the adverse per capita environmental impact of cities, by paying special attention to air quality and municipal and other waste management" [1, p. 37]. The production of energy from non-recyclable materials plays a vital role in urban waste management and the reduction of the amount of waste ending up in landfills. By harnessing these materials as an energy source, the challenges associated with waste accumulation in cities can be addressed, thereby promoting more efficient and sustainable waste management.

The objective of this paper is to address the problem of energy scarcity and how to take advantage of solid urban waste. In order to achieve this aim, this paper is organized as follows. In the first place, the impact generated by solid waste worldwide and in Argentina will be developed. Secondly, with this information already defined, the discussion will move on to the process of transformation of garbage into energy, developing step by step the different instances from the collection of waste to obtaining energy. Thirdly, the advantages and disadvantages of the application of this procedure will be presented. It is expected that this paper may inform about the energy problem and show a new technique for obtaining energy that gives a useful purpose the burning of waste so as to have a new form of energy supply.

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II. SOLID WASTE IMPACT

The side effects of human society and industrial development are air pollution, depletion of the ozone layer (fuel consumption for power production), excessive soil erosion and its pollution by various substances, as well as water pollution among others. Another significant side effect

which increases at alarming rates is the production of municipal solid waste (MSW).

With the upgrading of urbanization and improvement in living standards, the volume of MSW is increasing on a global scale. This waste can be of residential, urban, commercial, care, health, industrial or institutional origin and has long-term repercussions on human health and the environment [2, parag. 3].

Open dumpsites are locations where solid waste is indiscriminately deposited without operational control or environmental protection measures. These dumpsites lack minimum safety measures and may contain hazardous and pathogenic waste, leading to several environmental issues:

1) Soil and water contamination: The lack of soil impermeability at open dumpsites allows for the generation of leachate, which contains harmful substances that can contaminate groundwater and surface water, posing a risk to sources of drinking water.
2) Greenhouse gas emissions: Waste decomposition at open dumpsites produces biogas, primarily methane, a potent greenhouse gas. The release of methane contributes to climate change and ozone layer depletion.
3) Impact on human health: Open dumpsites attract pests and disease vectors, and improperly disposed waste can lead to the proliferation of various diseases such as dengue and cholera.
4) Social issues: Many open dumpsites become sources of employment for informal waste pickers who work without personal protection or safe conditions, exposing themselves to health risks.
5) Impact on biodiversity: Soil contamination can negatively affect the surrounding flora and fauna. [2, parag. 4].

In summary, open dumpsites represent a serious environmental and public health problem due to the lack of adequate measures for solid waste disposal. These sites contribute to soil, water, and air pollution, as well as social and health problems. Proper waste management is essential to address these issues and protect the environment and public health.

Globally, the issue of open dumpsites persists, particularly in developing countries, where approximately 40% of waste is still deposited in this manner. In Latin America and the Caribbean, significant amounts of waste are directed to open dumpsites, contributing significantly to air pollution and climate change [2, parag. 11].

In Argentina, according to the "Ministerio de Ambiente y Desarrollo Sostenible", the population concentrated in the urban sector (90%), reports a MSW collection coverage of 99.8%, a final disposal rate in sanitary landfills of 64.7% and a generation rate of 1 .15 kg/inhab/day of MSW [3, parag. 6]. This country has approximately 46 million inhabitants, who generate 53,000 tons of MSW per day.

Municipal Solid Waste (MSW) contains organic as well as inorganic matter. Part of organic matter is more when compared to inorganic matter. The latent energy present in its organic fraction is recovered for gainful utilisation through adoption of suitable Waste Processing and Treatment technologies.

For many countries around the world, which, just as Argentina, generate a lot of daily waste, the incineration of MSW is an alternative for its management, which will be developed below.

III. From Waste-to-Energy: The transformation

MSW, also called household waste, accounts for only about 10% of the total waste generated. This is waste collected by municipal authorities and disposed of through waste management systems. Although MSW is mainly generated by households, it also includes similar waste from offices, shops, and public administrations.

The waste transformation plants use household garbage as a fuel for generating power through incineration, much like other power stations use coal, oil or natural gas. The waste transformation process has several steps, shown in [4, Fig.1], which are described below:

1- Waste solid material is received in an enclosed receiving area, where it is thoroughly mixed in preparation for combustion.
2- Mixed waste enters the combustion chamber on a timed moving grate, which turns it over repeatedly to keep it exposed and burning.
3- Fine airborne particulates (fly ash) are removed in the filter baghouse. The acidic combustion gasses are neutralised with an injection of lime or sodium hydroxide. The unburned remains of combustion — "bottom ash"— are passed by magnets and eddy current separators to remove both ferrous (steel and iron) and other metals, such as copper, brass, nickel, and aluminium, for recycling. The remaining ash can be used as aggregate for roadbeds and rail embankments.
4- Superheated steam drives a turbine to generate electricity.
5- The cooling steam is cycled back into water through the condenser or diverted as a heat source for buildings or industry. Cooled stream is reheated in the economiser and superheater to complete the steam cycle.
6- Activated carbon (charcoal treated with oxygen to increase its porosity) is injected into the hot gases to absorb and remove heavy metals, such as mercury and cadmium. Nitrogen oxide in the rising burn gases is neutralised by the injection of ammonia or urea. Dioxins and furans are destroyed by exposing flue gases to very high temperatures [5, parag. 3].

There are many options for MSW incineration plant technology. The range of equipment varies from experimental to well-proven, though only the well-proven is recommended. Development problems with new technology are complicated and costly to solve, as developing countries lack the internal technical expertise to overcome them. Such problems could cause the entire project to fail.

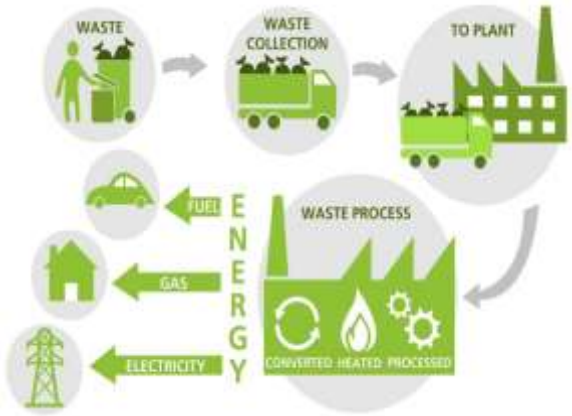

Fig. 1 Waste To Energy Process [4]

IV. Waste-To-Energy: Advantages and Disadvantages

Incineration is an efficient way to reduce the waste volume and demand for landfill space. Incineration plants can be located close to the centre of gravity of waste generation, thus reducing the cost of waste transportation. Using the ash from MSW incinerators for environmentally appropriate construction not only provides a low-cost aggregate but further reduces the need for landfill capacity. The recovery of energy from solid wastes also offers a few additional benefits which are as follows:

a. reduction in the total quantity of solid waste, which gets reduced up to 90%, depending upon the waste composition and the adopted technology;

b. decrease in demand for land, which is already scarce in cities, for land filling;

c. reduction in the cost of transportation of waste to far-away landfill sites;

d. reduction in environmental pollution;

e. generation of power (electricity);

f. generation of heat. [6, p. 2].

Waste reduction is essential to preserve natural resources and, by converting them into energy, we also contribute to environmental sustainability. This energy can be used in industries, homes, offices, businesses.

Changes in waste management legislation, such as the phasing out of landfilling, has caused WTE incineration to grow dramatically. The waste-to-energy plants have some disadvantages worth mentioning, such as:

a. It involves heavy investments and high operating costs. The resulting increase in waste treatment costs will motivate the waste generators to seek alternatives.

b. The complexity of an incineration plant requires skilled staff.

c. The residues from the flue gas cleaning can contaminate the environment if not handled appropriately and must be disposed of in controlled well-operated landfills to prevent ground and surface water pollution and must be disposed of in controlled and well-operated landfills to prevent ground and surface water pollution.

d. Incineration does not encourage recycling or waste reduction. The focus should be on reducing waste and recycling most of it. [7, parag. 4].

V. Conclusion

In conclusion, addressing the global energy problem while tackling solid waste issues is a multifaceted challenge. The transformation of municipal solid waste into energy holds promise for sustainable development, waste reduction, and reduced environmental impact. However, it requires careful consideration of its advantages and disadvantages, along with ongoing efforts to reduce waste generation and promote recycling. This approach aligns with global sustainability goals and underscores the importance of responsible waste management in the context of energy production.

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The present manuscript is part of the research activities in the Inglés II lesson at Universidad Tecnológica Nacional, Facultad Regional Paraná. Students are asked to research into a topic so as to shed light on a topic of their interest within the National Academy of Engineering’s Grand Challenges or the United Nations’ Sustainable Development Goals frameworks. If sources have not been well paraphrased or credited, it might be due to students’ developing intercultural communicative competence rather than a conscious intention to plagiarize a text. Should the reader have any questions regarding this work, please contact Graciela Yugdar Tófalo, Senior Lecturer, at gyugdar@frp.utn.edu.ar