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Environmental Governance through the Utilization of Waste Methane Gas into Renewable Energy

Thuerry Prak Sevann[1], Muny Chanthia[1]

[1]*Chemistry Department, Royal University of Phnom Penh, Cambodia*

**Corresponding Author: Thuerry Prak Sevann*

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Abstract

The purpose of this article is to examine the conversion of waste methane gas to renewable energy through environmental management. Processing organic waste is one kind of alternative energy that may be generated and regenerated. Garbage is a major issue for the majority of people, particularly the vast volume of market garbage. Waste processing and utilization technology is required. Implementing the 3R process of reduce, reuse, and recycle on fresh garbage not only generates useful goods, but also addresses the waste issue and generates revenue for those who wish to manage it. As a result, it is critical to evaluate the design of organic waste burners that convert methane gas to methane and to estimate the rate of combustion and heat produced by organic waste biogas.

Introduction

The growing demand for fuel has depleted energy supplies such as natural gas, oil, and coal, resulting in further price increases. Alternative energy sources have enormous promise. Processing organic waste is one kind of alternative energy that may be generated and regenerated. As we can see, organic waste is just thrown away. As a result, the researchers considered converting organic waste into energy. The alternative energy source that we can create to replace fossil fuels is organic materials that are renewable by people. One of them is organic waste, the volume of which is rising on a regular basis. Husks, market debris, maize sheaths, coconut shells, and wood sawdust are all examples of organic waste. The 167 thousand tons of garbage disposed of daily is capable of creating 8,800 tons of methane gas per day in 2008. It is created by 220 million individuals, or an average of 800 grams of garbage per person every day.

Garbage is a major issue for the majority of people, particularly the vast volume of market garbage (Brown, 2015). Waste processing and utilization technology is required. Implementing the 3R process of reduce, reuse, and recycle on fresh garbage not only generates useful goods, but also addresses the waste issue and generates revenue for those who wish to manage it. Numerous advantages have been extracted from trash to create gas fuel; this innovation addresses two issues concurrently, namely addressing environmental pollution caused by waste trash and assisting in overcoming the constraints of fossil fuels. Organic waste is utilized in two ways: as organic fertilizer and as a source of energy. Composting organic waste may be utilized to nourish the soil. Composted garbage typically contains 30% carbonic material or biodegradable trash. Meanwhile, organic waste may be utilized to generate two forms of energy: bioethanol and methane gas. There are two methods for producing methane gas from biological waste: fermentation and gasification. The fermentation process begins with the decomposition of organic waste and is followed by the distillation of methane gas, which yields an average of 60% methane gas and 40% CO2. In terms of the gasification process, it is the conversion of solid fuel to gas through a restricted oxygen combustion process that creates combustible gases such as CH4, H2, and CO. As a result, it is critical to evaluate the design of

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organic waste burners that convert to methane gas and to measure the rate of combustion and heat produced by organic waste biogas.

Environmental Management Goals

The establishment of harmony, balance, and equilibrium between people and their environment; The recognition of humans as environmental beings with attitudes and behaviours geared toward protecting and enhancing the environment; Assuring the current and future generations' interests are protected; Sustaining environmental functions; Conscious resource management; The protection of the Republic's Unitary State against the negative effects of enterprises and/or activities conducted beyond the state's borders that result in environmental degradation and/or destruction.

To avoid and prevent conflicting human activities as a result of the aforementioned, the government has established rules via the Environmental Law. Among other things, environmental law encompasses the following rights, responsibilities, powers, and criminal provisions: (1) Everyone has the same right to a safe and healthy living environment; (2) Everyone has the right to environmental information about their roles in environmental management; (3) Everyone has the right to participate in environmental management in accordance with applicable laws and regulations; and (4) Everyone is obligated to preserve environmental functions and to prevent environmental degradation. (6) Every member of the community has an equal and broad chance to participate in environmental management. Develop the community's involvement by: Increasing community independence, empowerment, and collaboration; Developing community capabilities and pioneers; Promoting community responsiveness in order to conduct social surveillance; Provide your opinion and/or offer information and/or reports.

The management efforts that have been encouraged and the regulations that have been enacted are worthless without human understanding of the critical nature of the environment in order to enhance its quality and understanding that the existing environment is a legacy from future generations (Daily & Huang, 2001; Cardona, 2013; McKinley et al., 2017)

Recycling is a waste management strategy that is now being advocated. Recycling allows for the conversion of waste materials such as plastic, metal, and paper into valuable products.

Solar energy is another way to minimize pollution. Solar thermal energy is stored in solar cells and may be used for cooking, heating, and motion energy in the future (Renwick et al., 2013). Solar energy produces no pollutants.

In addition to solar energy, wind energy may be harnessed via the use of windmills. In certain industrialized nations, considerable effort has been made to separate organic and inorganic trash for recycling reasons. Each residence has a distinctively coloured garbage can that corresponds to its categorization. Management is separated into two divisions: environmental administration management and environmental management management (Christmann, 2000; Hellawell, 2012). Human-regulated environmental administration is linked to social, long-term, policy, and harmony, among other things. Environmental management, namely management of the environment via environmental engineering or rehabilitation

Environmental management is associated with three management lines: (1) input management, which includes managing production, reducing growth, and diversification; (2) process management, which includes managing the system and the people who operate it ethically; and (3) output management, which includes managing waste through recycling.

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Environmental management must be comprehensive in nature. A holistic view of the elements that is interdependent, diversified, harmonious, and sustainable (Bacon et al., 2012; Alkier, et al., 2015; Huang & Zhao, 2021). As a result, the solution must be thorough; it cannot be half-heartedly implemented. For instance, the issue of flooding in Jakarta cannot simply be attributed to excessive rainfall or rain shipments from Bogor; rather, the numerous elements that contribute to flooding must be evaluated and the link between them established. Following that, a priority scale is created to determine which component should take precedence. Priority factors are determined by examining which variables have the greatest impact on the interests of a large number of individuals. Following that, parties convene to collaborate on resolving the issue.

Management is referred to as management in economics. When implemented in the environment, management approaches are inextricably linked to SWOT (Strength, Weakness, Opportunity, and Toughness), POAC (Planning, Organization, Actuating, and Controlling), and TQM (total quality Management).

Environmental SWOT analysis requires us to understand the environment's strengths, weaknesses, opportunities, and threats. For example, while creating an urban forest, it is vital to assess the benefits of doing so, the consequences of doing so, the possibilities created by creating an urban forest, as well as the obstacles that may occur while creating an urban forest.

Environmental POAC entails planning, organizing, acting, and supervising when we make environmental decisions, such as house building in marshy regions. Before housing construction begins, environmentalists must first determine if they want to build it. If they do, there must be a replacement area for drainage or the housing must have an effective water absorption system; otherwise, flooding will occur in the housing. Planning must also be coordinated with the developer, the community neighbourhood, and local government. Then, environmental specialists must urge developers to follow through on recommendations, and lastly, developer activities must be supervised to ensure they do not breach the requirements that have been established.

TQM (total quality management) is a contemporary management concept that examines an issue holistically and resolves it by focusing on the aspects that have the greatest impact on it. For instance, the social environmental disaster that has befallen this country is very complicated, beginning with rising inflation, a stagnant real sector, investor flight, community disorder, illegal logging, and forest fires. through enhancing the quality of human resources.

Potential Environmental Disaster

Singh & Singh, (2017); Economy, (2011) stated that Human behaviour in utilizing nature that depletes natural resources (deforestation, indiscriminate surface mining, pesticide use, fuel use, settlement expansion) results in significant damage to natural resources, waste, and environmental pollution as a result of cumulative damage resulting in flooding disasters and drought, warming of the earth's temperature, and the destruction of native species. When economic expansion and output are discussed, the possibility of this devastation is hardly acknowledged.

Health Disaster

Acute respiratory sickness caused by air pollution in industrial regions, cities, and commercial airports (Rovira et al., 2020; Merzenich et al., 2021). Digestive disorders are caused by the water that is consumed or utilized, as a result of water pollution and the rise in disease vectors that emerge in the waterways. Toxic chemical poisoning resulted in the manufacturing of

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asbestos-containing materials for air conditioners. Suffering from mental disease and stress as a result of loudness and overpopulation. Diseases induced by excessive exposure to short waves and heat Numerous cancers are known to be caused by poor environmental quality—cigarette smoke, carcinogenic drinking water, and so on—as well as genetic abnormalities induced by chronic chemical exposure.

Basic Problems of Environmental Damage

The issue is to develop as many new items as possible that are recognized to be environmentally damaging. Production speed is increased as a result of environmental improvement initiatives; (1) The speed of knowledge production exceeds the speed of environmental management; (2) The primary causes of complex and pervasive environmental problems include the following: (3) An emphasis on quantitative growth over qualitative growth; (4) Economic failure to incorporate social and environmental costs into decision-making; (5) Planning failure to incorporate environmental factors; and (6) Institutional inability to resolve coordination problems. Utilization of squandered methane gas as a source of renewable energy. The process of converting landfill gas to energy is often divided into three parts, namely gas collection, gas treatment, and energy production.

Gas Capture System

Vertical wells, horizontal trenches, or a mixture of both may be used to collect landfill gas. The most often used technique of gas collection is to dig vertical wells into the landfill and link pipes to the reservoir through a blower or vacuum induction device. Another method of capturing landfill gas is by the use of a horizontal pipe inside the dump. Horizontal pipe systems are advantageous for deeper landfills and locations with active accumulating. Certain capturing methods use a combination of vertical and horizontal wells. The design used is determined by the landfill's unique circumstances and the time required to implement the landfill gas collection system. Examples of landfill gas extraction site layouts, vertical and horizontal extraction well designs are shown in Figures 8 and 9.

Landfill Gas Treatment System

Prior to using landfill gas in the conversion process, it must be cleansed of condensate, particulate matter, and other contaminants. Condensation occurs when heated landfill gases cool and travel through the collecting system. If the water is not separated from the gas, clogs in the pipe system might occur, interfering with the energy collection process. Additionally, landfill gas may include siloxane and sulfur compounds derived from garbage. These impurities may impair the power plant's functioning.

Internal combustion engines, gas turbines, and microturbines are the most often employed technology in landfill gas energy projects to create power. The majority (over 70%) of landfill gas energy generation projects employ internal combustion engines, which are suited for projects ranging from 800 kW to 3 MW. Gas turbines are more often employed in big projects, often 5 MW or more. Microturbines, as the name indicates, are smaller than single unit turbines and generally range in capacity from 30 to 250 kW. They are often utilized for projects under 1 MW. Small internal combustion engines are also well suited for tasks requiring a limited range.

Landfill Gas Potential Calculation

The process by which landfill gas forms has been extensively investigated. Due to the fact that the process of gas generation is impacted by a large number of variables, including important variables associated with landfill conditions, the theoretical estimate of the degree of gas

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production becomes excessively difficult. CH4 gas is the gas that is considered in landfilling processes. The IPCC approach is used to determine the quantity of landfill gas collected each year. This is the most efficient approach for determining landfill greenhouse gas emissions. The Intergovernmental Panel on Climate Change (IPCC) created the 2006 IPCC model to predict CH4 emissions from solid waste disposal facilities. This model employs the approach of First Order Decay (FOD). This approach is based on the assumption that Degradable Organic Carbon (DOC) degrades slowly, resulting in the formation of CH4 and CO2. The rate of CH4 generation is constant under constant circumstances and is proportional to the quantity of carbon present in the effluent. CH4 is created during the anaerobic decomposition of organic materials. Additionally, the CH4 generated might be oxidized on the surface of the waste soil (OXT) or collected by methane gas (RT). It might take the form of energy usage or it might simply be burnt (flaring)

Conclusion

Garbage is a major issue for the majority of people, particularly the vast volume of market garbage. It requires technologies capable of processing and using waste. Rubbish is created by 220 million individuals, or 800 grams of waste per person every day. Composting organic waste may be utilized to nourish the soil. Additionally, it may be utilized to produce two forms of energy: bioethanol and methane gas. It addresses two issues concurrently, notably environmental contamination caused by sewage waste and the constraints of fossil resources. Through the Environmental Law, the government has established policies. The law establishes the following rights, responsibilities, powers, and criminal provisions: Everyone has the right to a safe and healthy environment. The community has the same and broadest chance to participate in environmental management as does the government. The community's involvement may be enhanced through increasing self-reliance, communal empowerment, and collaboration.

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