TYPES OF MANUFACTURING OF BIOGAS

- With design thinking approach

(A review paper)

[1]Dr.Y.Aboobucker Parvez B.E.,M.E.,Ph.D, Assistant professor, Dept of Mechanical Engineering, SNS College of Technology, Coimbatore.

[2]S.Harsavardini, Student, Dept of Agricultural Engineering, SNS College of Technology, Coimbatore.

ABSTRACT

This article examines the reputation of biogas education in different ways. It can be made from scrap paper and its mixture with cow dung. It can be made from food scraps. It can also be made from natural waste streams or industrial methods. The ability to grow sweet sorghum with unique row spacing (20, 50, 75 cm) in small-scale plots with three varieties is also used for biogas production. exclusive types of small-scale and large-scale production are mentioned.

Keywords- Cow dung, Food scraps, Natural waste stream,Small-scale production,Large-scale production

INTRODUCTION

Biogas is a renewable fuel consisting of microorganisms and microorganisms in the absence of oxygen. It is made using the anaerobic digestive system. It burns with negligible smoke. Biogas is a mixture of gases, mainly methane, carbon dioxide and hydrogen sulfide, generated from uncooked substances with agricultural waste, fertilizers, municipal waste, plant tissue, wastewater, green waste, wastewater and food waste. Biogas no longer leaves any residue as it is not a product of the whole scum. A discussion of multiple biogas development methods is provided in this paper.

DESIGN

THINKING APPROACH

In the realm of biogas production, we embark on a journey guided by the principles of design thinking—an approach that encourages us to empathize, define, ideate, prototype, and test our way to innovative solutions. Our journey begins with empathy as we delve into the diverse landscape of biogas production methods. We listen to the hum of anaerobic digesters, the whispers of microbial communities, and the aspirations of sustainable energy enthusiasts worldwide. Through empathizing with the challenges and aspirations of biogas stakeholders, we move on to the define phase, wherein we crystallize the complex landscape into clear problem statements.

In the ideate phase, we unleash the creative force of our research, weaving together insights from an extensive review of existing literature on biogas production methods. This ideation process is the culmination of our collective knowledge, fusing ancient practices with cutting-edge technologies. We explore uncharted territories and envision novel approaches to harnessing the potential of waste streams for energy generation.

With a wealth of ideas in hand, we proceed to the prototype and test phase. Here, we construct theoretical models and scenarios, simulating the outcomes of various biogas production techniques. We scrutinize the strengths and weaknesses of each approach, much like a blacksmith fine-tuning a blade. Our prototypes are not forged from steel but from data, and our testing grounds span the pages of numerous research papers. Through this iterative process, we aim to refine our understanding and contribute to the evolution of biogas production methods.

In the spirit of design thinking, we embrace the challenge of unraveling the complexities of biogas production with open minds and creative hearts. Our goal is not just to review what exists but to envision what could be—a sustainable, innovative, and environmentally conscious future fueled by biogas. This journey is one of empathy, definition, ideation, and experimentation—a journey that invites us to rethink, redesign, and revolutionize biogas production for a cleaner and brighter world.

TYPES OF BIO GAS PRODUCTION

The study investigated the biogas potential of waste paper (PW-A) and its mixture with cow manure (PW:CD) in the ratio 1:1. The effects confirmed that the PW had a cumulative gas yield of 6.23 ± 0.07 dm3/kg of sludge with a flash coefficient on day 2. This mixture multiplied the cumulative gas yield by 9,340.11dm3/kg.Slurry, with the onset of gas flammability on day 6 and sustained throughout the storage period.(1)

The article presents a case study on the possibility of modernizing a biological waste treatment plant. Accumulated events over consecutive years are taken into account, and mass stability assessments of entrances and exits are performed. An estimate of the plant's strength and environmental impact was made, and the plant was found to have significant environmental benefits. However, fabric stability evaluation has shown that the amount of methane produced and the energy produced can be further increased by optimizing plant operations.(2)

The newspaper specializes in biogas production from food waste produced with the help of the Mahendra School of Engineering canteen using an anaerobic digestion process. Parameters were optimized to maximize biogas production and biogas production was decided using a batch 90-day batch thermophilic anaerobic digester assessment. The characteristic oscillation is localized in the methane production load, which may be due to the presence of a methyl abiotic population in the activated sludge. All biogas generated is a mixture of 76% methane and 24% carbon dioxide.(3)

This paper version of the biogas production process can be labeled as a white, gray and black field process, or bottom-up and bottom-up. Biogas models can provide dynamic records of anaerobic digesters, while electric utility modes provide aggregate information on regional biogas potential and greenhouse gas emissions. . Embedding detailed method patterns into electric utility modes can lead to dynamic and volatile biogas usage business models.(4)

Testing indicates that biogas can be produced from natural waste streams or commercial processes. It helps produce electricity, prevents odors and reduces pathogens. However, the number of natural substances available is limited and new substrates and technologies are needed to facilitate the growth of the biogas business. Current developments in molecular biology strategies have provided the research community with a valuable wealth of enhanced information about this complex microbial machine that can help optimize and manage the technique. .(5)

To fully explore the use of biomass in force generation, a number of government organizations and researchers have established programs and studies to promote the use of biofuels. For example, the European Union targets that by 2020, 10% of the electricity market share in the transport sector will come from biofuels (Molino et al., 2018). In addition, by 2022, the United States is expected to supply approximately 36 billion gallons of biofuels per year (Molino et al., 2018). Currently, commercial plant life is applying biogas generation to power technology and biomethane upgrading to feed into the power grid. Biogas production is an uncomplicated and concentrated generation with a low degree of natural conversion to biogas (nearly 5 to 10% by weight), mainly depending on the form of raw materials and operating conditions. onion(6)

This study aimed to determine the effects of manure, rumen and water on biogas production. The study was carried out anaerobically for 60 days and the results showed that variable A (faeces and water) with a ratio of 1:3 and variable B (faeces and rumen) with a ratio of 1:2 produced a good amount of biogas. best. The highest biogas production occurred on average on 23.(7)

This article investigated the effect of delayed mowing of alfalfa on biogas production. The results showed that the ABY of alfalfa would be significantly increased using exchange in harvest control close to delayed cutting. The common increase in DM yield during late bloom is around 50 and 35%, respectively, although the overall maximum decrease in SBY at flowering ranges from 25-30%. The effects of a sharp reduction in SBY were not consistent over the years and were related to the crude protein content of the forage. Alfalfa may be a suitable supplement for disciplined biogas production due to its non-productive properties.(8)

The trial confirmed the suitability of growing sweet sorghum with different row spacing (20, 50, 75 cm) on small-scale plots with 3 varieties (Bovital, Goliath, Sucrosorgho). The effects of row width and cultivar on biomass, methane and biogas production as a function of location became statistically significant. The best biogas production per hectare was observed in the case of row spacing of 25 cm. Goliath became the most productive cultivar in all parameters.(9)

Biogas is an effective means of supplementing or modifying primary power. Ukraine has followed the global trend of replacing fossil electricity sources with renewable sources, incorporating biogas. In particular is the importance of solving sanitary and technological protection issues in the construction of biogas plants and biogas production, in addition to the reasons that prevent you from Ukraine to continue with biogas missions. The authors calculated the production and conversion of biogas using trend model and Excel software.(10)

This study investigates the importance of hydrogen in the microbial food chain. New prototypes of laboratory biogas reactors have been designed and built, traveling with time in the thermophilic and thermophilic communities that produce natural biogas. Molecular organic techniques have been performed to examine altered ecosystems. A systematic review has found that transduction of total natural solids has become an important parameter in fermentation. Increased biogas production has become localized and improved biogas yields have become associated with an increase in hydrogen producers. The rational creation of microbial consortiums that produce more sustainable and efficient biogas is proposed.(11).

This article outlines the factors that influence biogas production in Fiji. It describes the current biogas capacity, decomposition and uses in Fiji. Experiments show that cow + pig manure produces excessive amounts of biogas at medium temperature and cow manure is very good for biogas production at room temperature.(12)

Anaerobic digestion is a widely deployed technology to provide biogas from organic wastewater. For biogas flow > 100 m3/h, the 2-step technique is often used. However, for a biogas flow rate of 3/h, biogas filtration is not in your budget. New anaerobic digestion strategies, including microaerobic digestion, methane-enhanced electrolysis, and internal circulating anaerobic digesters (ICADs) with wastewater heating pumps, can improve production. biogas or reduce the cost of biogas production. Environmental situations, including natural loads, high retention times, hydraulic retention times and surface positions, are beneficial to enhance methane fermentation. New modes of action and standard precious metal dosages can be decided. (13)

Coupled with the rising cost of electricity sources is a growing preference for renewable energy assets. One of the most profitable is biogas production. On this paper is provided the possibility of biomass for biogas production. To date, it is possible to supply biogas and energy from specific and general resources of 156.9 million m3/year. To improve biogas production, monetary support, increased research, work and education are needed.(14)

The purpose of the pictures is to determine and test the concentrations of the individual components of the biogas depending on the crudes used mainly based on plant biomass. Pruning aims to produce biogas by relying on uncooked materials such as silage corn, silage and rye seeds. The total amount of plant biomass entering the fermenter during pruning varies by about 40% w/w, with the remainder being pig manure. The measured values are statistically evaluated and optimized for the next vigorous operation of the biogas plant. The results clearly demonstrated that the biogas generation system was stabilized with the help of the addition of other plant biomass additives such as silage and rye grain and the dilemma nan of hydrogen sulfide formation takes place. Maize silage should form about 80% w/w of the total vegetative biomass used.(15)

This study investigates the possibility of biogas production from tanning wastewater at Al-Amatounj Tannery in Khartoum. Experiments show that biogas production costs are affected by operating temperature, pH and substrate sensitivity. The best biogas yield is 72% CH_4 and 28% CO_2. Biogas was generated from 20 L of tanning wastewater with 100 g of yeast, 0.0215 m3 and generated after three days. The impact of this research work provides useful information and operating parameters, and this promotion is most effective with efficient anaerobic digestion. (16)

The Indonesian government is researching alternative energy from renewable assets, as well as biogas. To promote the era of using biogas, an experiment was conducted with a sludge return machine. The results confirmed that the addition of biodegradable tank sludge accelerated biogas production and methane concentrations. The initial retention time of the biogas production process with the addition of sludge was 20 days, with a cumulative biogas volume of 156.38 liters. The most effective retention time for methane growth increased to 15 days with methane enrichment from 0.8% to 29.41%.(17)

This study investigates biogas production from anaerobic digestion of shrimp pond sediments. The principle of mass stability was used to create mathematical models and decompose organic matter into biogas. The results show that treating shrimp pond bottom sludge by anaerobic digestion can reduce TS, TDS, TSS, TVS, BOD, COD and EC using 89%, 52-60%, 95-4-99%, 80-60%. respectively 89%, 86-95%, 85-95% and 12-22%.(18)

This paper reviews training methods for biogas production. In this article, the use of biogas software was discussed to make them better adapted to the environment and human activities. In addition, issues related to waste treatment and control that caused serious environmental and global concerns have been resolved. Despite the fact that these wastes provide a considerable resource: a large proportion of the waste is biodegradable and can be rationally used in biogas production, which can play an important role in biogas production. role as a solution to the problem of greenhouse fuels, but besides controlling waste will lead to an increase in the greenhouse gas effect in the environment.(19)

Research on optimization of parameters of biogas production process from water hyacinth (Eichhornia crassipes). The maximum amount of biogas was observed with 1 cm of water hyacinth, 40% sensitivity to inoculum, temperature 45°C, neutral pH and manganese chloride (0.2 mM). In 40 days, 44.9 l biogas/kg water hyacinth, 360.09 l/kg total solids and 397.95 l biogas/kg volatile solids were produced. Water hyacinth has proven to be an excellent source of biogas production and can be used as an energy feedstock. (20)

This test aims to determine biogas production from algal waste and examine the impact of particle temperature and time parameters on biogas yield. It seems to have been decided that algal biogas production is directly proportional to temperature and inversely proportional to the lifetime of the particles. The advanced conditions for biogas production from algal waste were decided to be a temperature of 55°C, a particle cycle of 200 m, a residence time of 30 days, and a 1:4 algae-inoculum ratio. The fine biogas yield obtained in these situations becomes 342.59 cm3 CH4 g1 VS with Ulva lactuca. Similar studies are sought to increase biogas production and in particular.(21)

Entire biogas-based energy has grown rapidly, with global capacity increasing from 65 GW in 2010 to 120 GW in 2019. This test provides biogas uses in energy conversion through power generation and fuel generation software. Biogas can be used in diesel engines, gasoline or fuel engines, generators, small turbines and Stirling engines. Enriched biogas or biomethane can be stored in storage tanks or pumped into fuel distribution lines for use as renewable natural gasoline. Biogas can be used immediately for cooking and lighting devices in addition to resistive technology and for the production of Fischer-Tropsch (feet) fuel. Syngas is used in the production of alcohol, jet fuel, diesel and gasoline by the Fischer-Tropsch method.(22)

Renewable energy production is becoming increasingly important in Ukraine due to international climate regulation. The production of agricultural biogas is a means of slowing climate change and the self-sufficiency of growth. However, barriers to production include less focus on agriculture and economies of scale. The paper assessed the potential for agro-biogas production in Ukraine, including its impact on energy self-sufficiency, greenhouse gas emission reductions, and overall average economic performance.(23) This results in biogas production from municipal and agricultural waste. 5 types of agricultural waste were used: 100% corn silage, 25% apple residue – 75% corn silage, 50% apple residue – 50% corn silage, 75% apple residue – 25% residue silage corn and waste urban length ratio. Waste fermentation was conducted for 30 days and measured CH4, CO2, O2 content and converted biogas production. Thermal analysis of the digested biogas was successful, but due to the impurities present in the decomposition gas, it could not be used as a fertilizer in agriculture. (24)

This study aims to use Salvinia moleta as a substrate for biogas production by batch device to reduce the impact of eutrophication in the lake. An immediate inspection is conducted to look for chemical trends of aquatic weeds. The composition of the biogas was analyzed by fuel chromatography. The biogas production potential of S. Molesta becomes fifty 8.6 L.Kg-1 with 318.29 mL.Gram VS-1day-1 produces methane.(25)

This study investigates the effects of specific solids ratio (TS), carbon to nitrogen ratio (C/N, g/g) and layered pretreatment on biogas production from coffee grounds. and coffee nibs, poultry. The results show that adjusting the TS ratio at low stage will accelerate the decomposition process, increase chemical oxygen demand (COD) and biogas production. The pre-treatment identification process helps microorganisms break down the substrate, which lowers COD costs and faster biogas conversion. A ratio of 25% TS and 25 (g/g) C/N with the grading system achieved top biogas yield, with a biogas yield of 10,438.04 mL. The Gompertz technique indicates that it is better to distinguish the TS percentage that can affect biogas production and that biogas production by classification method is better than not using it.(26)

The complexity of microbial societies and metabolic pathways involved in biogas production are poorly understood. Metagenome sequence statistics of biogas generating microbial networks can give an idea of a rational approach to improve biotechnological biogas generation systems. Protected and multiphase processes help uncover the special composition of raw networks for biogas production. The phylogenetic structure of the microbial network can be analyzed using clone library sequencing and metagenome sequence information. (27)

The present study examined the effects of different wastes and arrangements of biogas flowers on gas production. Uncooked materials use protected bird droppings, straw, cabbage, water hyacinth, one-gallon water cylinders, plastic bags, plastic pipes, tap water, bicycle tires, and glue. The parameters measure the time covered by the gas produced, the amount of fuel for 15 days and the color of the heater. Consequences confirm that biogas tunnels using plastic bags become better than using bicycle tubes. Poultry and goat manure have excellent results in gas production.(28)

This paved the way to explore the current and renewable properties of energy such as solar, wind, tidal, biogas, etc. Biogas, among all its distinctive energy properties, can be an easily available option for power generation that can help with energy demand and waste management issues. Biogas energy is harnessed to generate electricity for automobile transport. This article explores the capacity factors that affect biogas production rates and outlines specific scenarios for increasing and optimizing gas production.(29)

The studies aim to develop the theoretical and methodological bases to determine the feasibility of developing plant materials for bioconversion to energy assets and technological substances in order to maximize the yield. use company sports activities. Monographs, statistics, modeling and precise logic techniques were used. The biogas production of specific crops was analyzed, with sugar beet and maize yielding more than 5,500 m3 of biogas per hectare. Biogas upgrade technologies were analyzed, with anaerobic digested biogas systems providing universal performance equivalent to 3,000 liters of diesel over the course of a day. Both economic and mathematical models have been proposed to determine the feasibility of planting plant material to maximize total revenue.(30)

CONCLUSION

In addition, the obvious biocontaminant used to provide biogas will decompose spontaneously, so the firing of the gases produced through the use of this decay and use them as a source of power will cause less damage to the environment than letting them spread around the world. Ecosystem. Finally, the advent of biogas is an absolutely essential element to plant-based life. The uses of biogas are numerous. It is commonly used in rural areas as a cooking gas. It can be used to generate electricity. It can be applied in appliances used for water heating, zone (room) heating, etc. It can upgrade compressed natural fuel for car use. It can move carbon dioxide in the life cycle of the cogeneration plant on site. It is far from being able to conclude by claiming that this method is a good way to conserve the vegetative resources of the environment.

REFERENCES

(1) (2010, January 11). Biogas production from Paper Waste and its combo with Cow dung. Studies Gate, 8.

Https://www.Researchgate.Net/e-book/303541582_Biogas_Production_from_Paper_Waste_and_its_blend_with_Cow_dung

(2) (2016). Biogas from organic Waste - A Case have a look at. Procedia Engineering, 146, 310–317.

Https://www.Sciencedirect.Com/technological know-how/article/pii/S1877705816308529

(three) (2022, January). Production of Biogas by using the usage of meals Waste. Research Gate, 390–394.

Https://www.Researchgate.Net/ebook/357991833_Production_of_Biogas_by_Using_Food_Waste

(4) (2021, April 8). Biogas flora in Renewable energy systems—a systematic evaluation of Modeling tactics of Biogas production. MDPI.

Https://www.Mdpi.Com/2076-3417/eleven/eight/3361

(five) (n.D.). Recent updates on biogas manufacturing - a evaluation. Biofuel studies journal.

Https://doi.Org/10.18331/BRJ2016.Three.2.4

(6) (2019, February). An overview of Biogas production: fundamentals, applications and future research. Research Gate, a hundred and five–one hundred fifteen.

Https://doi.Org/10.32479/ijeep.7375

(7) Putri, Dewi Artanti, Roy R. Saputro, and B. Budiyono. "Biogas manufacturing from Cow Manure." international journal of Renewable strength development 1, no. 2 (July nine, 2012): 61–64.

Http://dx.Doi.Org/10.14710/ijred.1.2.Sixty one-sixty four.

(8) Hakl, J., P. Fuksa, J. Habart, and J. Šantrůček. " The biogas production from lucerne biomass when it comes to term of harvest." Plant, Soil and environment 58, No. 6 (June 18, 2012): 289–94.

Http://dx.Doi.Org/10.17221/98/2012-pse.

(nine) Pazderů, k., J. Hodoval, J. City, J. Pulkrábek, V. Pačuta, and J. Adamčíok. "The influence of sweet sorghum crop stand association on biomass and biogas manufacturing." Plant, Soil and surroundings 60, No. Nine (September 8, 2014): 433–38.

Http://dx.Doi.Org/10.17221/562/2014-pse.

(10) Kucher, Oleg, Taras Hutsol, Szymon Glowacki, Iryna Andreitseva, Anatolii Dibrova, Andrii Muzychenko, Anna Szeląg-Sikora, Agnieszka Szparaga, and Sławomir Kocira. "electricity capacity of Biogas production in Ukraine." Energies 15, no. 5 (February 24, 2022): 1710.

Http://dx.Doi.Org/10.3390/en15051710.

(eleven) Kovács, ok. L., N. Ács, E. Kovács, R. Wirth, G. Rákhely, Orsolya Strang, Zsófia Herbel, and Z. Bagi. "development of Biogas production with the aid of Bioaugmentation." BioMed research global 2013 (2013): 1–7.

Http://dx.Doi.Org/10.1155/2013/482653.

(12) Prasad, Ravita D. "Empirical have a look at on factors Affecting Biogas manufacturing." ISRN Renewable energy 2012 (August 8, 2012): 1–7.

Http://dx.Doi.Org/10.5402/2012/136959.

(13) Nie, Yan Qiu, Yu Xiu Li, Hui He, Wen Jing Zhou, Zhao Hui Pang, and Hui Bing Peng. "manufacturing of high Calorific Biogas from natural Wastewater and Enhancement of Anaerobic Digestion." advanced materials research 550-553 (July 2012): 522–28.

Http://dx.Doi.Org/10.4028/www.Scientific.Net/amr.550-553.522.

(14) Dubrovskis, Vilis, Imants Plūme, Andis Spīdāns, and Indulis Straume. "FACILITY OF BIOGAS manufacturing IN LATVIA." surroundings. Era. Resources. Complaints of the international scientific and sensible convention 1 (June 23, 2007): forty six.

Http://dx.Doi.Org/10.17770/etr2007vol1.1717.

(15) Herout, M., J. Malaťáokay, L. Kučtechnology, and T. Dlabaja. "Biogas composition depending on the sort of plant biomass used." research in Agricultural Engineering fifty seven, No. Four (December 14, 2011): 137–forty three.

Http://dx.Doi.Org/10.17221/41/2010-rae.

(16) Elamin, Aisha Elawad Mohamed, and Gurashi Abdalla Gasmelseed. "Biogas production from Tannery Liquid Waste." european magazine of Engineering studies and technological know-how 3, no. 10 (October 30, 2018): 117–19.

Http://dx.Doi.Org/10.24018/ejers.2018.Three.10.912.

(17) Pertiwiningrum, Ambar, Ratih Kusuma Wardani, Joko Wintoko, Rachmawan Budiarto, Margaretha Arnita Wuri, and Misri Gozan. "How return sludge boom biogas manufacturing from cow manure?" E3S net of meetings 181 (2020): 01006.

Http://dx.Doi.Org/10.1051/e3sconf/202018101006.

(18) Muhibbu-din, Ismail, Ganiyu Adebayo, Segun Odedele, and Oluyomi Olamide Ajibulu. "assessment on Environmental impact of Biogas production." Malaysian journal of applied Sciences 6, no. 2 (October 31, 2021): 93–104.

Http://dx.Doi.Org/10.37231/myjas.2021.6.2.290.)

(19) Muhibbu-din, Ismail, Ganiyu Adebayo, Segun Odedele, and Oluyomi Olamide Ajibulu. "assessment on Environmental impact of Biogas manufacturing." Malaysian magazine of applied Sciences 6, no. 2 (October 31, 2021): 93–104.

Http://dx.Doi.Org/10.37231/myjas.2021.6.2.290.

(20) Rozy, Rozy, Rouf Ahmad Dar, and Urmila Gupta Phutela. "Optimization of biogas manufacturing from water hyacinth (Eichhornia crassipes)." journal of applied and natural technological know-how nine, no. 4 (December 1, 2017): 2062–67.

Http://dx.Doi.Org/10.31018/jans.V9i4.1489.

(21) Koçer, Anıl Tevfik, and Didem Özçimen. "research of the biogas production capability from algal wastes." Waste control & research: The journal for a Sustainable round financial system 36, no. Eleven (September 25, 2018): 1100–1105.

Http://dx.Doi.Org/10.1177/0734242x18798447.

(22) Kabeyi, Moses Jeremiah Barasa, and Oludolapo Akanni Olanrewaju. "Biogas manufacturing and programs in the Sustainable electricity Transition." magazine of electricity 2022 (July 9, 2022): 1–forty three.

Http://dx.Doi.Org/10.1155/2022/8750221.

(23) Wąs, Adam, Piotr Sulewski, Vitaliy Krupin, Nazariy Popadynets, Agata Malak-Rawlikowska, Magdalena Szymańska, Iryna Skorokhod, and Marcin Wysokiński. "The ability of Agricultural Biogas production in Ukraine—effect on GHG Emissions and electricity production." Energies thirteen, no. 21 (November three, 2020): 5755.

Http://dx.Doi.Org/10.3390/en13215755.

(24) Kuźnia, Monika, Anna Magiera, Wojciech Jerzak, Kinga Pielichowska, and Jakub Sikora. "Biogas manufacturing from agricultural and municipal waste." E3S web of conferences 108 (2019): 02010.

Http://dx.Doi.Org/10.1051/e3sconf/201910802010.

(25) Kawaroe, Mujizat, Hefni Effendi, Zidni Ilma Palupi, Neneng Sri Hendra, and Dea Fauzia Lestari. "utilization of Aquatic Weed Salvinia molesta as a raw fabric for Biogas production." Jurnal Pengolahan Hasil Perikanan Indonesia 22, no. 2 (August 25, 2019): 209–17.

Http://dx.Doi.Org/10.17844/jphpi.V22i2.27891.

(26) Sumardiono, Siswo, Bakti Jos, Agata Advensia Eksa Dewanti, Isa Mahendra, and Heri Cahyono. "Biogas manufacturing from coffee Pulp and bird Feathers the use of Liquid- and stable-state Anaerobic Digestions." Energies 14, no. 15 (August 1, 2021): 4664.

Http://dx.Doi.Org/10.3390/en14154664.

(27) Mukti, Roushney Fatima, and Sanjida Sakhawat Sinthee. "Metagenomic method: reworking In-Silico studies for progressed Biogas manufacturing." worldwide magazine of applied Sciences and Biotechnology 7, no. 1 (March 27, 2019): 6–11.

Http://dx.Doi.Org/10.3126/ijasbt.V7i1.23315.

(28) (2021). Sustainable approaches of biogas production the usage of low-fee substances in environment. IOP technology.

Https://doi.Org/10.1088/1742-6596/1933/1/012113

(29) (2022, February 1). Evaluate: factors Affecting Biogas manufacturing. Ijraset journal for studies in carried out technology and Engineering generation.

Https://doi.Org/10.22214/ijraset.2022.40192

(30) Kalinichenko, Antonina, Valerii Havrysh, and Vasyl Perebyynis. "evaluation of Biogas manufacturing and usage potential." Ecological Chemistry and Engineering S 23, no. 3 (September 1, 2016): 387–400.

Http://dx.Doi.Org/10.1515/eces-2016-0027.