Practical overview of Production of Bio-Gas from Napier Grass.

Author – Mr.T.R.Tipayle , Mr.T.A.Lakare, Mr.K.S.Badakh, Mr.O.R.Kale, Mr.R.L.Nibe

Abstract:
This research paper aims to provide a comprehensive and practical overview of the production of Bio-Gas from Napier grass and Cow Slurry as a fermenter. As the demand for renewable energy sources continues to grow, the utilization of biomass for biogas production has gained significant attention. Napier grass, known for its rapid growth and high biomass yield, presents a promising feedstock for Bio-Gas production. This paper discusses the cultivation of Napier grass, the anaerobic digestion process for biogas production, the sodium hydroxide (NaOH) primary treatment procedure is employed in the Napier process to enhance overall yield and the subsequent upgrading to Bio-Gas. Also this study looks at how we can make biogas from Napier grass and cow slurry in a cheaper and more sustainable way. And the highest methane content was reached 62.4%. Various aspects such as feedstock preparation, anaerobic digestion parameters. [1]

1. Introduction:

1.1 Background:

The background of bio- Gas production involves the evolution of renewable and sustainable energy sources in response to environmental concerns and the quest for cleaner fuel alternatives. Bio-Gas, also known as renewable natural gas (RNG), is derived from organic materials such as agricultural waste, municipal solid waste, or other biomass sources. The development of bio-gas production is rooted in the recognition of the detrimental environmental impact of traditional fossil fuels, particularly in terms of greenhouse gas emissions. [2]

As a renewable and low-carbon alternative, bio-gas production aligns with the global shift toward reducing dependency on conventional fossil fuels and mitigating climate change. The process typically involves the anaerobic digestion or thermal gasification of organic materials to produce methane, which is then purified to meet natural gas quality standards.

Governments, industries, and researchers have increasingly focused on advancing bio-gas production technologies to enhance efficiency, reduce costs, and promote its widespread adoption in the transportation and energy sectors. This background underscores the imperative to transition towards more sustainable and environmentally friendly energy solutions, positioning bio-gas as a promising avenue in the broader context of renewable energy development**.** [3]

1.2 Objectives of the research:

The objective of a from organic waste, which would otherwise be released into the atmosphere as methane gas, contributing to greenhouse gas emissions. Utilizing organic waste for Bio-Gas production contributes to a circular economy by recycling and repurposing waste materials. Bio-Gas is being utilized to replace CNG as an automobile fuel (for CNG buses and tractors) and LPG as a cooking fuel. The potential for compressed biogas production from various sources in India is estimated at about 62 million tons per annum and also helps bring down dependency on crude oil imports. Bio CNG also holds great promise for efficient municipal solid waste management and in tackling the problem of polluted urban air due to farm stubbleburning and carbon emissions . [2]

2. Napier Grass Cultivation:

2.1 Characteristics and properties of Napier grass:

Napier grass is a tropical perennial C4 grass with superior biomass yield and quality. It is an important forage crop and a promising feedstock for lignocellulosic biofuel production. However, precise phenotyping and genotyping data to support the molecular breeding of Napier grass are scarce. [4] Napier grass which is scientifically called as “Pennisetum purpureum” is the one which has its origin in grasslands of Africa. [4]

Table 1: Physical and chemical characteristics of feedstocks.

Variety	Super Napier Grass
Height of Grass	10 to 12 Feet
Yield/Acre/Year	200 ton

cellulose	35-39 %
xylene	19-23 %
lignin	15-19 %
Whether Condition	All
Retained on Field	Up to 8 years

2.2 Cultivation:

Though Napier grass is tolerant to drought and can grow well even in the areas which are dry, it is considered to be suitable to grow in the areas where Napier plant grass can also undergo intercropping with the crops like fodder trees, legumes etc. Napier grass also grows very well at an altitude of 1800 m to 2000m above the sea level. Napier grass also performs well in the temperatures varying between 26°C to 42°C there is high rainfall. Napier grass can grow in a large variety of soils. very good yields are obtained from the soils which are fertile with rich content of organic matter and nutrients. For the cultivation of Napier grass, make sure that the soil pH is between 5 and 8. [5] For the plantation of Napier grass, there are two methods used:

1.Conventional method.

2.Thumbkiza method.

2.3 Biomass yield and sustainability:

Napier grass plays a pivotal role in biomass production. Remarkably, it can be harvested up to six times in a single year, making it an abundant and sustainable source of biomass. This feature positions it as a valuable raw material for the production of biofuels, contributing to the renewable energy sector**.** [6] In recent years, Napier grass has stepped into the realm of bioenergy production. With approximately 2 billion hectares of non-arable land suitable for energy crop cultivation, Napier grass is poised to alleviate pressure on food production. Technologies like thermal pyrolytic conversion can transform Napier grass into valuable resources such as charcoal, biogas, and bio-oil. This holds the promise of not only providing energy to African communities but also enriching local soil quality. [6]

3.Anaerobic Digestion Process:

3.1 Basics of anaerobic digestion:

Anaerobic digestion is a biological process where microorganisms break down organic matter in the absence of oxygen, yielding biogas as a metabolic byproduct. This natural phenomenon takes place in various environments such as waterlogged soils, deep water bodies, and the digestive tracts of organisms like termites and large animals. [7] in anaerobic digesters naturally occurring biological processes are exploited in an engineered system to treat and dispose of waste materials stabilize and product destroy pentagons, and generate bio gas as a valuable product.

4. Process design:

[1] Here we have taken fresh napier grass from farm.

[2] We washed the cutted napier grass with water to remove impurities like stones, bedding and forage grass from it.

[3] We kept it for drying for next two days.

[4] We have taken napier grass of 16 kg for anaerobic digestion.

[5] Then we performed its size reduction using cutter and reduced the size of Napier grass from 6 feet height to 1.3 cm height with diameter of 1.2 cm having weight 2 gram.

[6] After this we prepared solution of 20 L 1N NaOH in a bucket. Here we add 400 grams of NaOH pallet in 10 L of water and allow it to sterilize properly.

[7] We kept our Napier grass submerged under 1N NaOH solution for next 24 hours.

[8] After completion of 24 hours, we take out all Napier grass and separate liquid and solid fraction from it

[9] As after pouring the solution in NaOH solution its pH was increased so we washed its solid particles with water and check pH till it was coming in range of 6.9-7.4.

[10] After this we have added 5.33 kg of cow dung into it which will act as bacterial solution for it. The ratio of addition is 1: 3.

[11] After this we put the mixture of Napier grass and cow dung in digester until 90% volume.

[12] Fermentation time for anaerobic digestion is 16 days.

5. Result and Discussion:

5.1 Biogas Yield:

The average biogas yield from Napier grass was found.

Variation in biogas production was observed over the digestion period, with peak production occurring between days 8 and 16 of digestion. The methane content of the biogas was measured at an average of 62.4%, indicating a high-quality biogas suitable for energy production.

5.2 Comparison to Other Feedstocks:

When compared to other common feedstocks like corn silage and wheat straw, Napier grass showed competitive biogas yields.

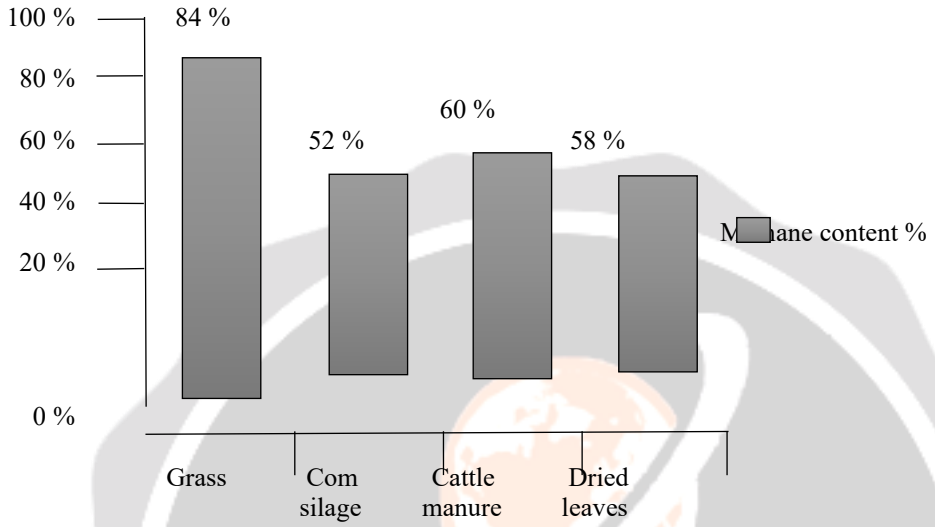

Fig: % Methane Content of Different Feeds

6. Conclusion:

Biogas is a renewable energy made mostly of methane and carbon dioxide. It's great for things like transportation, making power, and cooking. If we keep important factors in the right range, we can make more biogas. In this study, the focus was on assessing the production of biogas and methane from treated Napier grass and cow farm slurry. This was accomplished through the use of an anaerobic batch digester operating at atmospheric temperature conditions. The batch digestion test spanned a duration of 16 days, which was deemed sufficient for the complete digestion of all the substrates under investigation. Notably, the methane content reached a level of 62.4% during these experiments, indicating a significant yield of this valuable energy resource.

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