Idea: a mixture of rice husks and livestock manure for household-scale biogas

Judul : "Utilizing SekoGas: Rice Husk and Animal Manure for Household Biogas Production – A Sustainable Energy Solution"

SekoGas: GAS FILTH husk

Background: look for statistical data whether it is rice harvest or something else in Central Java (can search in BPS) =>https://www.bps.go.id/id/publication/2021/06/14/b5801872a261dcb4ecbfdcbf/evaluasi-statistik-harga-produsen-gabah-2020.html

Urgency: husk waste which is usually burned => causes air pollution, is rarely used and thrown away straight away, if used => does not litter on the side of the road or creates air pollution.

Rice straw is one of the most abundant lignocellulosic wastes in the world => **Lignocellulosic waste** is a type of organic waste that is rich in fiber and consists of main components such as cellulose, hemicellulose and lignin.

Using animal dung to optimize methane gas can only be husks but the treatment is difficult if only original husks => then add cow dung which contains various bacteria and microorganisms, including: *Clostridium*, *Bacteroides*, *Bifidobacterium*, *Enterobacteriaceae* (for example *E. coli*), And *Ruminococcus*.

Basic Solid State Anaerobic Digestion (SS-AD) Method SS-AD is an anaerobic fermentation process (without oxygen) that breaks down solid organic materials through the activity of microorganisms to produce biogas, especially methane (CH_4) and carbon dioxide (CO_2). SS-AD works with materials that have a high solids content (more than 15%).

Advantages of SS-AD

- **Higher Solids Content**: SS-AD can handle organic waste with higher solids content (such as rice husks), thereby reducing the need for water.
- **Space and Energy Efficiency**: Due to the higher solids content, the SS-AD process is more efficient in terms of space required than conventional AD systems. This is suitable for areas with limited land.
- **Less Waste Water**: Compared to liquid AD, SS-AD produces less wastewater that needs to be treated, making it more environmentally friendly.
- **Agricultural Waste Processing Potential**: This method is very effective for processing agricultural waste such as rice husks, which are difficult to manage in liquid form.

Biogas consists of methane (CH4, about 45-75% by volume), carbon dioxide (CO2, 25-55%), and other compounds including hydrogen sulfide (H2S), water, and several other gaseous compounds

The procedure has four interrelated stages, namely hydrolysis, acidogenesis, acetogenesis and methanogenesis

Digesters are usually tube-shaped and are used as a place for the anaerobic fermentation process to occur. Digester types can be divided into 2 when viewed from the way they are filled, namely batch feeding (one filling) and continuous feeding (continuous filling).

We use 2 plastic bins for the digester/container (https://youtu.be/jbIgoSRwU44?si=jpGXMpMXug2ZltmU) with continuous feeding type (continuous filling).

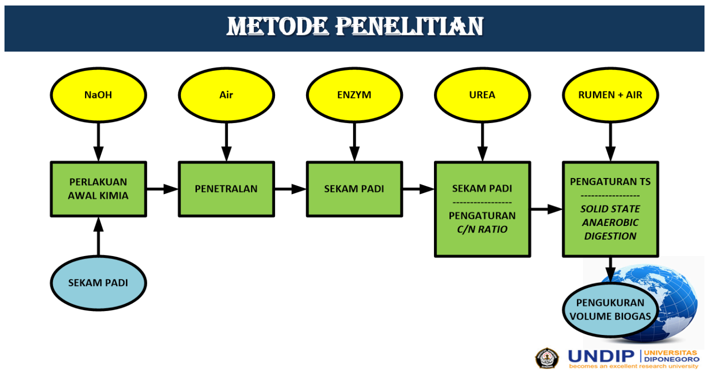
The calorific value of 1 m3 of biogas is equivalent to 0.6-0.8 L of kerosene. To produce 1 kwh of electricity, 0.62-1 m3 of biogas is needed, which is equivalent to 0.52 L of diesel oil.

Materials used: rice husks, livestock manure (cows, goats, etc.), 2 20L plastic barrels, manometer.
(1) digester which is used as a place for digestion of biogas material and as a home for bacteria, both acid-forming bacteria and methane gas-forming bacteria, (2) gas container which can move using a balloon, (3) inlet hole which functions as a place to enter waste material livestock manure, (4) outlet holes as a place to discharge waste that has been used.
The average pH value obtained within 30 days ranged from pH 6.2 to pH 8. The average temperature observed was 23-36 degrees C. This pH condition affects the growth of anaerobic microbes in producing biogas, especially methane.

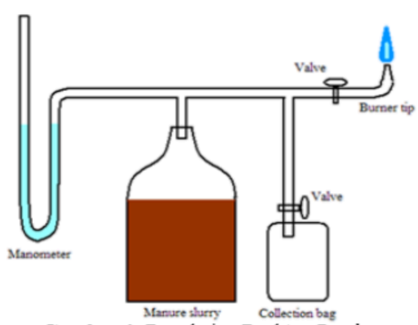
This research uses a biogas digester with a volume of 20 L with a ratio of livestock manure and rice husks of 50: 50 (v/v). 5 liters of each treatment to obtain a total mixture volume of 10 liters. (20L remaining so it doesn't overload and doesn't explode). Periodic checking for gas leaks for 7 consecutive days is carried out using a manometer.

DETAIL FOCUS PROJECT

1. Focusing on making biogas energy storage equipment as a substitute for LPG gas energy which focuses on the household scale using rice husk waste and animal waste into biogas energy using the SS AD technique with barrel materials, the necessary waste, additional chemicals (urea, NaOH, Rumen fluid, and H2O water). The addition of animal waste is intended to increase the methane gas that comes out of the biogas.



2. Used biogas waste can still be made into organic fertilizer, it doesn't cause a lot of water waste because it uses the SS AD method. **Solid State Anaerobic Digestion (SS-AD)** can produce solid residues that have a lower water content compared to residues from **Liquid Anaerobic Digestion (L-AD)**. This provides several advantages, especially in terms of easier management of residues and their use as organic fertilizer.
3. A rough description of the prototype



Gambar 1. Rangkaian Reaktor *Batch*

4. Pretreatment of lignocellulosic raw materials aims to facilitate the conversion of biopolymers contained in cellulose. Pretreatment (with NaOH) can increase the total methane yield.
5. **Estimated Time:**
   Starting to Form Gas: Inside **2-3 weeks** after the first charge.
   Optimal Production: Usually occurs approx **4 weeks** once the process begins, when the microorganisms are fully active and the anaerobic fermentation process is stable.
   Sistem batch feeding (filling once), gas usually starts to form inside **2-3 weeks** after initial charging.

6. Advantages: 1. raw material from a combination system of husks, rice, animal waste 2. Does not cause waste because the output other than gas, namely solid husks, can be used as plant fertilizer 3. Has a shelf life of up to 3 months

SUMMARY

1. Project Title

"Utilizing SekoGas: Rice Husk and Animal Manure for Household Biogas Production – A Sustainable Energy Solution"

SekoGas: GAS FILTH husk

2. Background

- **Agricultural Statistics**: Referring to data from BPS, the background includes information regarding the amount of rice production in Central Java, as well as the impact of rice husk waste if it is not managed properly.
- **Environmental Issues**: Emphasis on pollution resulting from burning rice husks and the potential for this waste to be used as a renewable energy source.
- **Characteristics of Lignocellulosic Waste**: Describes rice straw as a fiber-rich lignocellulosic waste, with high potential for processing into biogas.

3. Project Urgency

- Reducing air pollution from burning agricultural waste.
- Providing sustainable solutions for organic waste management.
- Utilizing waste that is often thrown away and not utilized.

4. Project Objectives

- Build a simple biogas system that uses a mixture of rice husks and livestock manure.
- Produces biogas which can be used as an alternative energy source for households.

5. Methodology

Metode Solid State Anaerobic Digestion (SS-AD)

- Anaerobic fermentation process without oxygen to produce biogas from solid organic material.
- Explanation of the stages involved: hydrolysis, acidogenesis, acetogenesis, and methanogenesis.

Digester Design and Use

- Description of the type of digester (batch feeding vs. continuous feeding) and the selection of a continuous feeding system using 2 plastic barrels with a capacity of 20 L.
- The process of manufacturing and operating a digester.

6. Materials Used

- **Main Ingredients**: Rice husks, livestock manure (cows, goats, etc.).
- **Equipment**: Two 20 L plastic barrels, manometer, gas reservoir.
- **Digester Components**: Inlet to enter waste, outlet to remove treated waste.

7. Parameters and Measurements

- **pH and Temperature**: Monitor pH (between 6.2-8) and temperature (between 23-36 °C) to ensure optimal conditions for the growth of anaerobic microorganisms.
- **Mix Ratio**: Using a ratio of livestock manure and rice husks of 50:50 (v/v), with a total volume of 10 liters in a 20 L digester.

8. Monitoring and Evaluation

- Check for gas leaks periodically for 7 days using a manometer.
- Analysis of biogas production results, including gas volume and composition (methane, carbon dioxide, etc.).

9. Project Benefits

- Produce renewable energy for household needs.
- Reducing agricultural waste and animal waste which can pollute the environment.
- Provide examples of good practices in managing organic waste at the household level.

10. Conclusion

- This project is expected to demonstrate the potential of a mixture of rice husks and livestock manure in producing biogas, as well as contributing to better and more sustainable waste management.

Reference

- Includes data from BPS and scientific literature related to biogas production, use of lignocellulosic waste, and microbiology in anaerobic processes.

1. Tools Used

a. Digester Biogas

- **Function**: Anaerobic fermentation place that converts organic waste into biogas.
- **Description**: The digester can be in the form of a tube or barrel made of corrosion-resistant material. In this project, two plastic barrels with a capacity of 20 L each were used.
- **Charging Method**: Digester using method *continuous feeding*, where waste is introduced continuously.

b. Manometer

- **Function**: A tool for measuring gas pressure in the digester.
- **Description**: Used to monitor gas leaks and ensure that the pressure in the digester remains safe and stable. It also helps in monitoring biogas production.

c. Gas Container

- **Function**: Holds biogas produced from the fermentation process.
- **Description**: Can be a balloon or flexible container that can expand according to the volume of gas produced. This reservoir allows measurement of the volume of gas produced.

d. Inlet dan Outlet

- **Function**:
    - **Inlet**: Place to put animal waste and rice husks into the digester.
    - **Outlet**: A place to remove residual waste after the fermentation process is complete.
- **Description**: Designed to facilitate the process of filling and removing waste without disturbing the fermentation process.

e. Temperature and pH Monitoring System

- **Function**: Measuring the temperature and pH in the digester to ensure optimal conditions for microorganisms.
- **Description**: Can use a thermometer and pH meter to monitor environmental conditions in the digester.

2. Techniques Used

a. Solid State Anaerobic Digestion (SS-AD)

- **Description**: Anaerobic fermentation technique that uses solid organic materials with high solids content (more than 15%). This process does not require a lot of water, so it is more efficient and environmentally friendly.
- **Process Stages**:
    1. **Hydrolysis**: The breakdown of organic materials into simpler compounds by enzymes.
    2. **Asidogenesis**: The process by which microorganisms convert hydrolysis products into acids, hydrogen, and other compounds.
    3. **Asetogenesis**: Microorganisms convert acid into acetate, hydrogen, and carbon dioxide.
    4. **Methanogenesis**: Microorganisms produce methane and carbon dioxide from acetate and hydrogen.

b. Filling and Production of Materials

- **Teknik Continuous Feeding**: Waste material is introduced gradually into the digester. This method allows continuous waste management and stable biogas production.

c. Monitoring and Analysis

- **Gas Leak Measurement**: Using a manometer to detect gas leaks periodically.
- **Temperature and pH Monitoring**: Monitor temperature and pH to ensure that fermentation conditions remain optimal for microbial growth.

d. Checking Gas Volume

- **Method of Using a Gas Container**: The resulting gas is collected and its volume measured for further analysis and evaluation of system efficiency.

Reference link

https://e-journal.unipma.ac.id/index.php/cheesa/article/view/7406/pdf

COMPARISON OF BIOGAS QUALITY FROM VARIOUS TYPES OF ANIMAL FEES PRODUCED WITH PORTABLE DIGESTERS

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