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DESIGN OF HOUSEHOLD-SCALE BIODIGESTER FROM COW MANAGEMENT

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Abstract
Biogas is one solution to overcome community difficulties due to rising fuel prices and the scarcity of LPG gas, this technology can be immediately applied, especially for cattle breeders. Utilizing cow dung that is processed anaerobically in a digester which will produce methane gas as an alternative energy. In planning this household-scale biogas device, there are several components designed including a digester with a volume capacity of 400L with a filling capacity of 2/3 of the digester volume, the material used is HDPE plastic (High Density Polyethylene) and a holding capacity of 147 L which produces a flash time. fire for 20.01 minutes for 15 days of the fermentation process. Where the lowest pressure is obtained on the 3rd day with a pressure of 104.668,73 N/m2, and the maximum pressure is on the 12th day with a maximum pressure of 107.201,85 N/m2i. simulation using solidwork software results in the digester construction which is planned to be used because it has a fairly good level of security.

Keywords: *Biogas, Digester, Pressure, Simulation.*

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Introduction

The increase in the price of fuel oil (BBM) and the tendency for the scarcity of kerosene has made the use of alternative energy sources start to be taken into account. One alternative energy source that has a great opportunity to be developed for its utilization in Indonesia is biogas energy. This gas comes from various kinds of organic waste such as biomass waste, animal manure which can be used as energy through the process of anaerobic digestion. (Mayasari, 2010).

The most widely used petroleum energy in everyday life is gasoline and diesel, while for household needs people prefer to use kerosene. However, because of the kerosene to LPG conversion program, the price of kerosene in the market is high and its availability is very scarce, so that many people have switched to using LPG gas to meet their energy needs. But the existence of the program also does not solve the problem of fuel in society. Its distribution has not been evenly distributed to all regions in Indonesia which has caused a shortage of LPG gas in several regions. In a situation like this, the search, development and dissemination of environmentally friendly non-fuel energy technology is very important, especially aimed at poor families as the group most affected by the increase in fuel prices (Lazuardy, 2008). As stated by several energy experts and the Deputy Minister of Energy and Human Resources (ESDM) that there is a need for new breakthroughs in the form of alternative energy so that they can help the lack of energy supply (BBM) in Indonesia. One of the technologies that suit this situation is biogas technology (Kementrian energi dan sumber daya mineral, 2012: 5) .

Thus the design of a biodigester is one of the solutions to overcome people's difficulties due to rising fuel prices, this technology can be immediately applied, especially for cattle breeders. This tool can produce biogas by mixing cow dung and water and then storing it in a closed place (anaerobic). This livestock manure will first be converted into gas by methanogenic bacteria which will then produce gas with a fairly high methane gas content. In households biogas can be used as fuel for cooking using a modified ordinary gas stove or by making your own biogas stove..

In the planning this biogas device will be made on a household scale with a 400L digester volume. However, it is hoped that it can be used as a reference for use in society.

Research Method

Biodigester design process, there are several steps that can be carried out. In this case the aim is for the biodigester device so that the process is structured and planned.

- Identification of problems
- Literature review
- Observation
- Data collection
- Design of bio digester design
- Simulation analysis
- Test result

Biodigester scheme

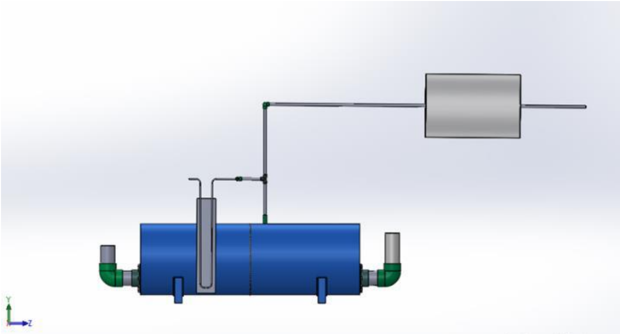

Figure 1. Schematic of the biodigester device

Parts of the biodigester apparatus.
1. Reactor tank (digester)
2. Inlet
3. outlet
4. water faucet
5. gas holder
6. pipe
7. manometer

Simulation Analysis

simulation analysis using software, including::
1. Methane Pressure
2. Material Strength

Material

The materials used in this study are as follows:
1. Plastic HDPE
2. Software

Tools

The equipment used in this study are as follows:
1. Laptops
2. As well as other supporting tools

Results and Discussion

Tool Design

The results of the tool design are preceded by observations looking for references on the internet and direct interviews. After making observations, the next stage is designing the design. Design using Solidwork software. The initial process of making design drawings, preceded by determining the size of the digester tool.

Type of biogas unit, all reactors are above ground level, the reactor is placed vertically with a capacity of 400L placed above the floor surface. The initial feed in the form of a mixture of dirt and water is put into the biogas reactor as much as 66.7% of the volume of the reactor tank, so that there is space for gas formation from the reactor tank of 33.3%.

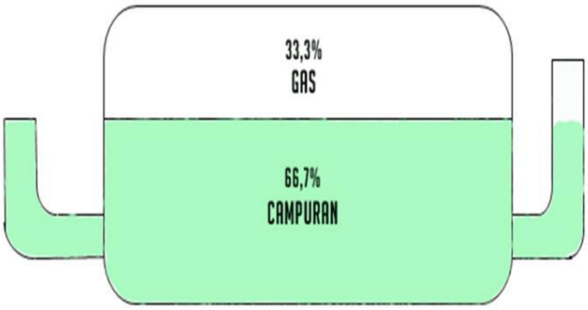

Figure 2. Reactor loading

Biodigester component

1. Digester

The digester plays the main role as a biogas fermentation tool so that in this design it must have a fairly strong material strength resistance.

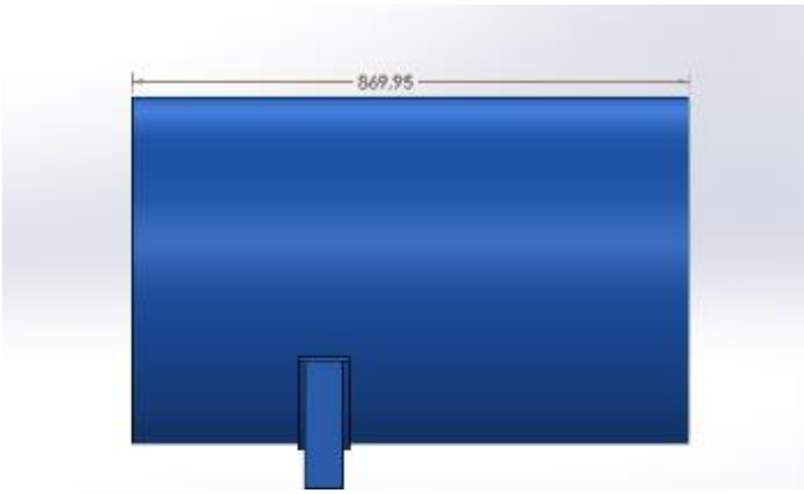

Figure 3. Frame length

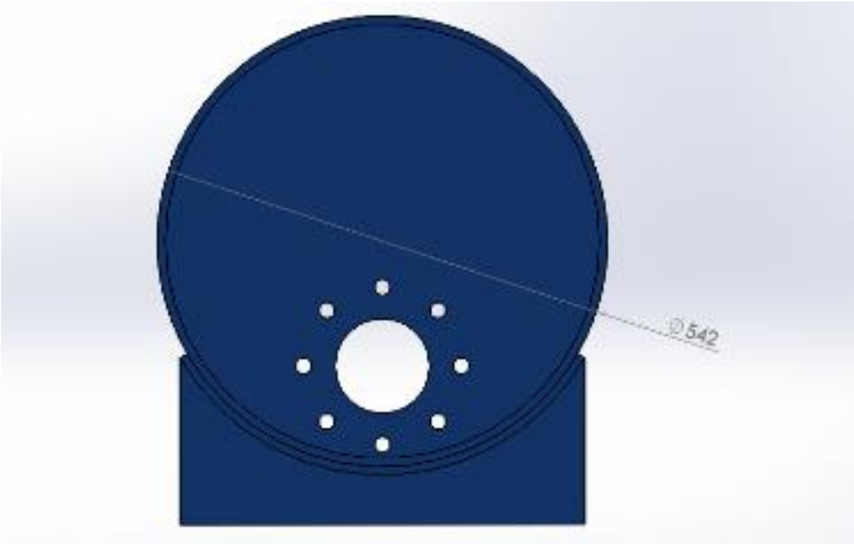

Figure 4. Tank diameter

In this design the digester is designed with a digester length of 869 mm and a diameter of 542 mm where the volume of the digester is:
digester Volume =πr^2 t
digester Volume =3,14 x 27,1 cm x 27,1 cm x 86,99 cm
digester Volume = 200,3 L

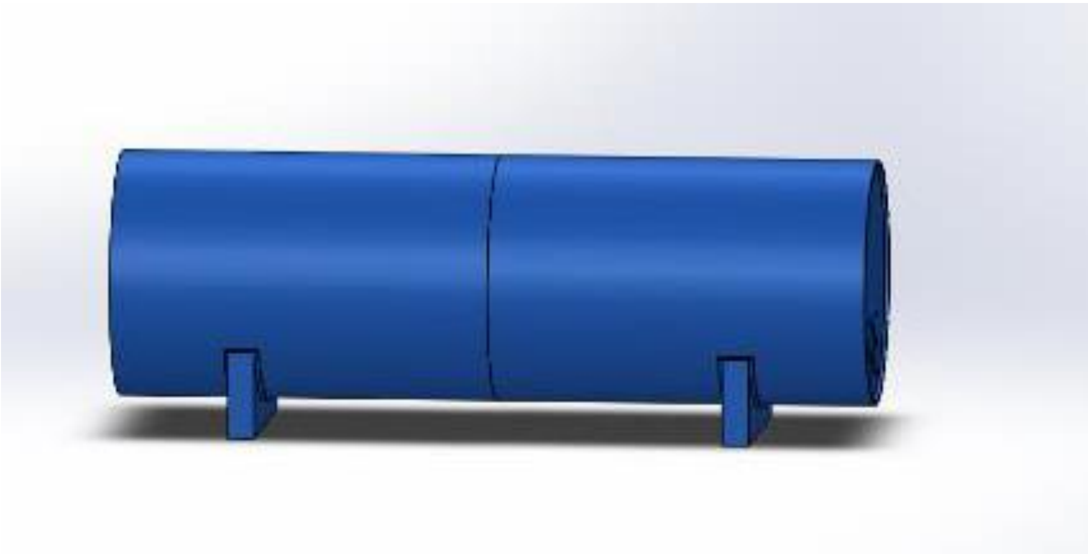

Figure 5. Assembly results

The picture above is the result of a digester design, the software used is solidworks. The size made refers to the size of 2 200L plastic drums which are combined into one, where the results of the length and diameter of the tube are measured directly in the field.

2. Inlet
The inlet is used to enter the slurry (a mixture of manure and water) into the main reactor. The goal is to maximize biogas production, and avoid the formation of sediment in the inlet. The material used for the inlet pipe is PVC (polyvinyl chloride).

Figure 6. Inlets

3. Outlet

The outlet functions to remove sludge that has undergone a fermentation process in the digester chamber. This channel works on the principle of hydrostatic pressure equilibrium.

Figure 7. Outlets

Biogas pressure

In this study, the results of pressure data obtained 5 variations of pressure from a span of 15 days taken every 3 days. To calculate the pressure on the biogas, it can be calculated using the following hydrostatic pressure formula:

Known :

ρ_{air} = 1000 kg/m3

gravitational (g) = 9,81 m/s2

different water level (Δh) = 0,60 m

Pgauge...?

Pgauge = ρair x g x Δh.

= 1000 kg/m3 x 9,81 m/s2 x 0,60 m

= 5886 Pa

Because the pressure used is in the form of absolute pressure, it is changed to:
Pabs = Patm + Pgauge
= 101.325 Pa + 5886 Pa
= 107.211 Pa x (1 $atm/101.325\ Pa$)
= 1,058 atm
= 107.201,85 N/m2

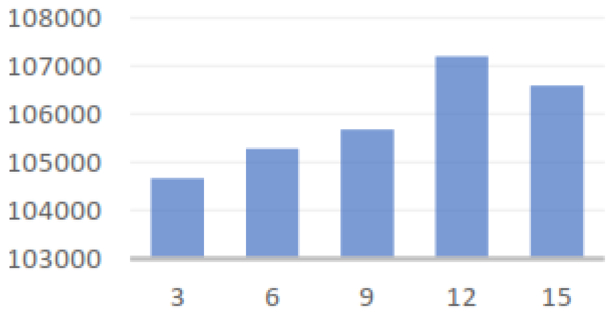

Figure 8. Biogas pressure graph

From the pressure data above it can be concluded that the digester pressure is increasing from day to day, where the lowest pressure is obtained on the 3rd day with a pressure of 15.18 psi, and the maximum pressure is on the 12th day with a maximum pressure of 15.54 psi and then fell on the 15th day with a pressure of 15.47 psi.

Construction Simulation Testing Using Software
In designing a machine construction, it is necessary to test the frame or test the construction first using a software system. In this case the software used is SolidWorks software. Which in the test is carried out by carrying out a pressure analysis which aims to be able or not the construction accepts the planned load. The results of the test can be seen from the steps below:

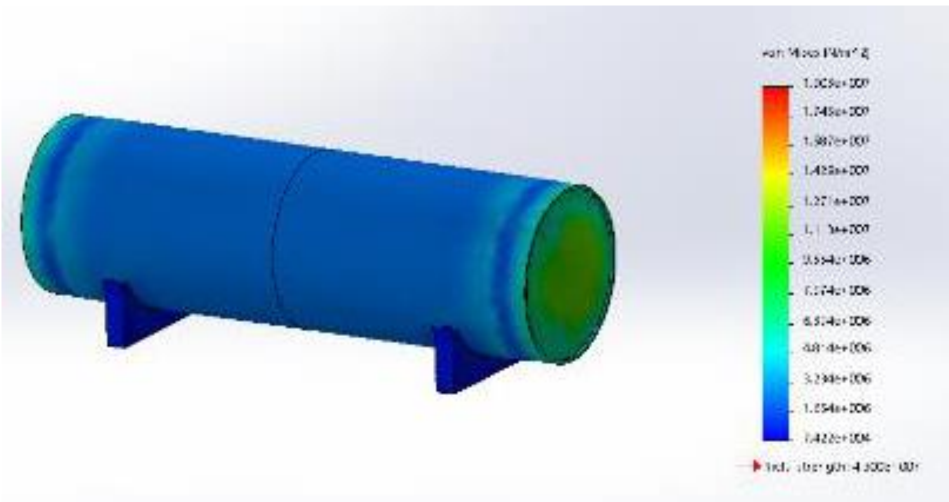

Figure 9. Stress analysis

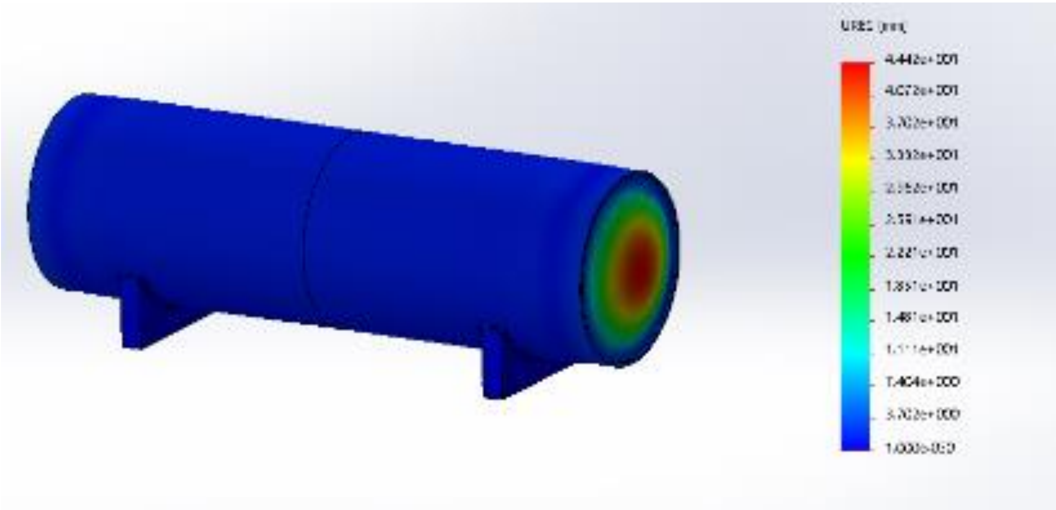

Figure 10. Deformation values

The results of the factor of safety (safety factor) with HDPE (Highdensity polyethylene) plastic material get a value of 2.2, with a pressure of 107,201.85 N/m2. The following is a picture of the results of the safety factor.

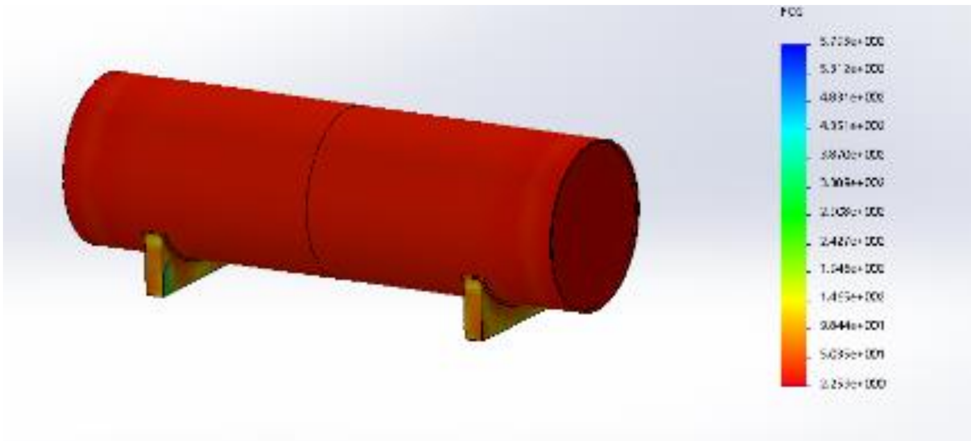

Figure 11. FoS

Conclusion

- Utilizing cow dung which is processed anaerobically in a digester which will produce methane gas as an alternative energy. In planning this household-scale biogas device, several components were designed, including a digester with a volume capacity of 400L with a filling capacity of 2/3 of the volume of the digester and a storage capacity of 147 L which resulted in a flame time of 20.01 minutes for 15 days of the fermentation process. Where the lowest pressure was obtained on the 3rd day with a pressure of 15.18 psi, and the maximum pressure was on the 12th day with a maximum pressure of 15.54 psi.
- In the testing phase carried out such as stress analysis, displacement, and also the factor of safety using solidwork software, the results obtained from the planned digester construction can be used because it has a fairly good level of safety.

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