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ISMO Applications in Maintenance Planning for Biogas-Producing Organic Waste Machines

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Abstract
The use of alternative energy sources is a solution to the limited fossil fuel supply. This renewable energy must become new energy such as solar power, wind power, biogas and others. Biogas is another source of electricity in the form of flammable gas produced during the decomposition of organisms by anaerobic organisms or organisms that can survive in confined space conditions. Organic waste biogas production equipment is a tool that supports biogas production by various decomposition processes. In order for the biogas generator to always work properly and be ready for use, there must be a maintenance plan for the device.
When planning the maintenance of machinery producing biogas from organic waste, the ISMO method should be followed in the following steps, such as defining maintenance tasks and scheduling maintenance. Machine maintenance is a process to maintain and maintain the machine for a long time. Its function is to ensure the normal operation of the machine and good operation during use, the life of the machine is long, and the machine does not need to be repaired quickly, which can reduce the maintenance cost as much as possible. . The results of the study using this method show that a biogas machine with 200 liters of organic waste capacity requires 9 inspections, 6 minor repairs and 2 medium repairs.

Keywords*: Alternative energy; biogas, maintenance; organic waste; ISMO*

1. Introduction

The rapid development of science and technology has provided great benefits to the progress of human civilization, and science and technology have provided many conveniences and comforts on human life. The application of science and technology to human life has developed in many ways, but it should be accepted that behind these developments there are also disadvantages, namely the effect on energy. Energy demand is increasing and in this case oil is running out, so new construction is required to meet the needs of other energy sources.

The use of alternative energy sources is a solution to the limited fossil fuel supply. This energy conversion includes solar power, wind power, biogas etc. energy produced from natural sources such as Availability of natural resources is inexhaustible and unsustainable if properly managed. Among these energy sources, biogas energy is useful and beneficial. This is because the raw material for biogas comes from waste or sewage or organic matter. Biogas is gas or electricity produced by bacteria (anaerobic organisms) during the decomposition of organic materials such as plant, fruit, animal waste, human waste in a closed environment. The biogas processing process includes: mixing the manure or waste, doing it in a vacuum (decomposition process), separating the gas from the digester and the next step is to use the gas or store it in pipes. Of course, this process uses a lot of equipment that requires regular maintenance for smooth operation and long life. Based on this explanation, it is necessary to plan the maintenance of the systems for organic waste biogas production using the ISMO method.

Machine maintenance is the maintenance and repair function of long-term machines. Its task is to ensure the normal and good operation of the machine during use and maintenance work, so that the equipment is not repaired prematurely and the maintenance cost is minimized.

2. Research Methods

A. Biogas

Biogas is a gas mixture of methane (CH_4), carbon dioxide (CO_2) and other gases obtained from the decomposition of organic matter (such as animal waste, human excrement and plants) by methanogenic bacteria. To produce biogas, the organic matter needed is collected in a biodigester. The process of decomposing organic matter occurs anaerobically

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(without oxygen). Biogas is formed on day 4-5 after the biodigester is fully filled and reaches its peak on day 20-25. Most of the biogas produced consists of 50-70% methane (CH_4), 30-40% carbon dioxide (CO_2) and other gases in small quantities (Fitria, B, 2009). The constituent components of biogas are as follows (Sudarto. 1997):

Table 1. Compositions of biogas

No	Gas Name	Chemical Formula	Total
1	Hidrogen Sulfida	H_2S	a little
2	Oksigen	O_2	0.1%
3	Karbon monoksida	CO	0.1%
4	Hidrogen	H_2	1%-2%
5	Nitrogen	N_2	3%-5%
6	Karbon monoksida	CO_2	27%-45%
7	Metana	CH_4	54%-70%

The energy contained in biogas depends on the methane (CH4) concentration. The higher the methane content, the higher the energy content (cal value) in the biogas, conversely, the lower the methane content, the lower the calorific value (Chisti, Y, 2007).

Factors affecting biogas production include: raw material, transport material, time and temperature required to achieve decomposition (Polprasert, 1996).

biogas is used for cooking, lighting, pump, boiler, etc. can be used for many purposes. Below are pictures of methane gas used in various applications.

B. Maintenance

Maintenance (maintenance) is the maintenance or maintenance of equipment, overcoming damage and returning the equipment to its original condition as much as possible so that it can be stored and dies in the long term as planned. harm can be prevented (Clifton, R., 1974).

Planning must have a basic control and maintenance need, namely thinking, thinking and executing. In this case, the treatment process works similarly to (Garg, H P., 1976):

- Use or work on the device.
- Use cleanup tools.
- Used spare parts or accessories.
- Use of equipment.
- How to Dispose of Waste

Maintenance is generally classified as follows:

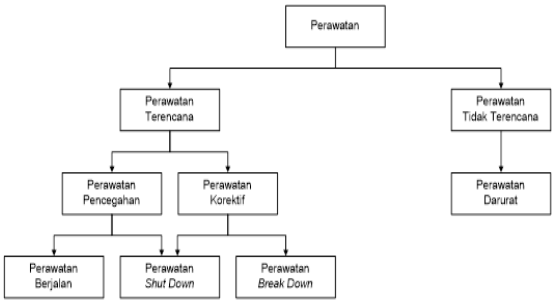

Figure 1. Maintenance Classification

In the maintenance plan, the equipment is repaired in the rotation of the time interval or on a so-called regular scheduled basis to prevent further damage. The repair time can be determined according to the load of the equipment involved and the repair complexity (Garg, H P., 1976). Easy maintenance of all equipment is shown in the table below:

Table 2. Equipment of Repair Complexity

No.	*Type of Production*	*Average Repair Complexity of Equipment*
1	*Rolling Mils (Steel)*	15
2	*Turbine (Steam and Hydro)*	14
3	*Boiler*	12
4	*Steam Turbine for Ships*	11.5
5	*Avitation Engines, Heavy Diesel Engine, Heavy Machine Tool*	11
6	*Automobile, Heavy Tractors, Ship, Aircraft*	10
7	*Tractor*	9.5
8	*Railway Wagon (Good and Passenger)*	9
9	*Machine Tool (Medium)*	9
10	*Ball or Roller Bearing Motor Cycles*	8.5
11	*Heavy Electrical Machines, Electric Trains, Precision Instruments*	8.5
12	*Cycles Tractor Spare Part, Machine for Chemicals,Industrial Paper Wood Pulp*	8
13	*Compressor, Hydraulic Machine, Light Machine Tools*	8
14	*Tool and Cutters*	7.5
15	*Textile, Food Industries Latter, Fire Protection Equipment*	7.5
16	*Gas Appararatus*	7
17	*Low Voltage Appararatus*	7
18	*Weighing Instruments*	7
19	*Electrical Instruments*	6
20	*Earth Moving Machinery Shower, Bulldozers, ect.*	6
21	*Watches and Light Instrument*	5.5

The planned maintenance method is a form of scheduled maintenance implementation. Therefore, treatment cycles are gaining importance. The distribution of maintenance in the repair plan will be divided into 4 groups (Garg, H P., 1976):

- Inspections (I)
- Small Repair (S)
- Medium Repair (M)
- Overhaul (O)

C. Biogas Production Machine

In planning the maintenance of the machine that produces organic waste biogas,, there are many planning methods such as data research, design design, definition of maintenance activities and maintenance planning. The maintenance time of the machine or equipment is very important to keep the machine working properly. When planning the maintenance of this biogas generator, there are many tasks presented in the maintenance tasks table below.

Figure 2. Flow chart of maintenance plan for organic waste biogas generator

The analysis will tell you which landfill biogas producers need to produce. Then group each task, starting with inspection, minor repairs, medium repairs, major repairs. You can look at the difficulty table when deciding on a maintenance plan. In this plan, there is a repair time that needs to be completed within a certain amount of time for the machine to function well.

3. Results and Discussion

A. ISMO Method

Maintenance activities for ISMO systems are generally divided into two parts: simple maintenance and maintenance cycles. According to the facility maintenance labor intensity in Table 2, the maintenance labor intensity is 7 when planning the maintenance of the organic waste biogas generator. afternoon. According to the equipment maintenance cycle table, the maintenance cycle of biogas organic waste generator is defined as follows.

Table 3. Repair Cycle of Maintenance Planning for Biogas Organic Waste Machines

Repair Complexity	*Repair Cycle*				Tipe	t (Bulan)	T (Tahun)
	Siklus	*M*	*S*	*I*		3 Giliran kerja/hari	3 Giliran kerja/hari
7	*O-I_1-S_1-I_2-S_2-I_3-M_1-I_4-S_3-I_5-S_4-I_6-M_2-I_7-S_5-I_8-S_6-I_9-O*	2	6	9	Unit	3	4,5

From the table above, it is seen that the maintenance plan of organic waste biogas generators is made every 3 months according to the level of maintenance such as inspection, minor maintenance and repair environment. At the same time, the maintenance plan of the organic waste biogas generator will be revised after 4.5 years.

The inspection activities within the scope of the Organic Waste Biogas Production Machinery Maintenance Program are as follows:

1. Drum choppers
   a. Clean up any dirt or dust
   b. Check the condition of the chopper
   c Check for water leaks
2. Motors
   a. Section Removes dust or dirt from the engine
   b. Check the tightness of the retaining nuts and bolts of the motor mounting table and adjust if the nuts and bolts are loose
   c. Check if the cable is damaged
   d. Lubricate the bearings
3. Frame
   a. Clean the dirt or dust that sticks.
   b. Check the condition of the frame for corrosion.
   c. Lubricate the wheels
4. Chopper Knife
   a. Clean the dirt or crust attached to the chopper knife.
   b. Check the sharpness of the chopper.
   c. Check the chopper bolts and if there is looseness then set it.
5. Digesters
   a. Clean the dust or dirt that sticks to the digester.
   b. Check for leaks with soapy water.
6. Piping
   a. Removal of dust or dirt.
   b. Check the pipes for leaks with soapy water.
7. Compressor. Section
   a. Removal of dust or dirt.
   b. Check inlet and outlet pressure.

Small repair activities in the planning of maintenance of organic waste biogas producing machines include:

1. Drum choppers.
   a. Perform all steps required during inspection. rain.
   b. Check the lower grinder seal.
   c. Lubricate the support bearin

2. Knife Chopper.
   a. Perform all steps required during inspection.
   b. Sharpen your chopper blades.
3. Digester.
   a. Perform all steps required during inspection.
   b. Tighten the outlet cap.
4. Compressor.
   a. Perform all steps required during inspection.
   b. Add oil to the compressor.

Medium repair activities in the planning of maintenance of organic waste biogas producing machines include:

1. Drum choppers.
   a. Do whatever needs to be done for minor repairs.
   b. If the shaft seal is damaged, replace the bearing shaft seal.
   c. Painting the chipped paint surface.
   d. Replace damaged blade mounting bolts.
2. Motors.
   a. Do whatever needs to be done for minor repairs.
   b. Replace damaged engine mounting bolts.
   c. Use a voltmeter to check the voltage of the motor.
3. Frame.
   a. Perform all necessary work for minor repairs.
   b. Sleeping on the surface.
   c. Repair or weld the joints of damaged frames.
4. Knife chopper.
   a. Do whatever needs to be done for minor repairs.
   b. Replace damaged blade mounting bolts.
5. Digester.
   a. Do everything you do in Child Care.
   b. Replace the outlet cover gasket.
   c. Chipped surface painting.
6. Piping
   a. Do whatever needs to be done for minor repairs.
   b. Fix the pipe with glass glue.
7. Compressor.
   a. Do whatever needs to be done for minor repairs.
   b. Check the voltage of the compressor.

Overhoul activities in planning maintenance of biogas producing machines for organic waste include:

1. Drum choppers.
   a. Do whatever needs to be done in the media.
   b. Replace damaged shredder drums with new ones.
2. Driving.
   a. Do whatever needs to be done in the media.
   b. Replace with new motor.
3. Frame.
   a. Do all the necessary work for media editing.
   b. replace with new frame.
4. Kitchen knife.
   a. Do all the necessary work for media editing.
   b. Replace with new teeth.
5. Digester.
   a. Performs all operations performed medium repair.
   b. Dismantling and repair of digesters.
   c. If the stomach is damaged beyond repair, replace it with a new one.
6. Piping.
   a. Do all the necessary work for minor repairs.

b. If the pipe is damaged, replace it with a new one.

7. Compressor.
   a. Do all the necessary work for media editing.
   b. Check the voltage of the compressor.
   c. Compressor disassembly and repair.
   d. If the compressor is damaged, replace it with a new one.

4. Conclusion

As a result of the discussions, the following decisions were taken: The maintenance work of the 200 L capacity organic waste biogas generator using the ISMO method requires 9 revisions, 6 minor repairs and 2 medium repairs. According to the maintenance schedule, this machine can be completed between 2022 and 2027.

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