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MAKING COMPOST USING ORGANIC SOLID WASTE

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Abstrak. This research using the vegetables garbage, baggase, and goat dirt. The research quickened with addition of EM-4 bacterium. The variation of research is, mixture between vegetables garbage and goat dirt (variable A), vegetables garbage and baggase (variable B), baggase and goat dirt (variable C),and the last mixture betwen vegetables garbage, baggase and goat dirt. All the variable added by 10 ml of EM-4 bacterium. Research conducted by aerobic method. Conclusion obtained from this research is the mixture of vegetables garbage and goat dirt (variable A) more easily becoming compost than other variable. Require to be underlined, addition of baggase into variable B, C, and D cause the mixture more difficult become compost. Compost maturity seen from C/N ratio. C/N ratio of compost variable A is 17.45, this is according to value of compost quality at SNI 19-7030-2004. Usually compost experience of the maturation in 30 day, but in mixture with baggase the time of maturation is longer..

Keywords: baggase; compost; C/N ratio; goat dirt; vegetable garbage

I. INTRODUCTION

Solid waste from market waste is produced in quite large quantities. The waste is in the form of vegetable waste that is only piled up in the dump and waiting for scavengers to pick it up or dumped in the landfill if the pile is high. Piling up for too long can cause pollution, namely the nesting of pests and the emergence of unwanted odors.

Sugarcane bagasse is a waste material that is usually disposed of by open dumping without further management so that it will cause environmental disturbances and unpleasant odors.

Based on the above, it is necessary to apply a technology to overcome solid waste, namely by using solid waste recycling technology into high-value compost products.

Composting is considered a sustainable technology because it aims for environmental conservation, human safety, and economic value. The use of compost helps environmental conservation by reducing the use of chemical fertilizers that can cause land degradation. Composting also indirectly helps human safety by preventing the disposal of organic waste.

The purpose of this study was to determine the C, N content, and C/N ratio of mature compost and to determine the best composition of the compost material mixture in accordance with SNI-7030-2004.

The composting process is the process of decomposing organic matter into compost through aerobic biological reactions of microorganisms under controlled conditions. Composting itself is the process of decomposing compounds contained in organic waste (such as straw, leaves, household waste, and so on) with a special treatment. Almost all materials that have ever lived, plants or animals will rot in a compost pile (Outterbridge, 1991).

Compost as a result of composting and is one of the organic fertilizers that has important functions, especially in the field of agriculture, including: Organic fertilizer contains macro and micro nutrients. Organic fertilizer can improve soil structure. Increase soil absorption of water and nutrients, increase the binding capacity of sandy soil. Improve drainage and air management in the soil. Help the weathering process in the soil. Plants that use organic fertilizers are more resistant to disease.

The composting process takes place by maintaining the balance of nutrient content, water content, pH, temperature and optimal aeration through watering and turning. In the early stages of the composting process, the compost temperature will reach 65-70 oC so that pathogenic organisms, such as bacteria, viruses and parasites, plant disease germs and weed seeds in the composted waste will die. And in these conditions, harmful gases and pungent odors will not appear. The composting process generally ends after 6 to 7 weeks which is marked by the achievement of the lowest constant temperature and material stability. Factors that affect composting include: humidity, oxygen concentration, temperature, C/N ratio, acidity level (pH), material size. Microorganisms can work with humidity of around 40-60%. These conditions need to be maintained so that microorganisms work optimally. The oxygen requirement in making compost is between 10-18%. The optimum temperature required by microorganisms to break

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down materials is 35-55 ° C. The optimum C/N ratio for the composting process is between 25-25. The best acidity level for the composting process is at a neutral pH condition, which is between 6-8. The recommended material size for aerobic composting ranges from 1-7.5 cm.

II. RESEARCH METHODS

The materials needed in the composting process include: vegetable waste, sugarcane pulp, goat manure, and EM-4. Before composting is carried out, a preliminary test is carried out to determine the characteristics of vegetable waste, sugarcane pulp, and goat manure, which include C, N values, C/N ratio, water content, temperature, and pH. After the characteristics of vegetable waste, sugarcane pulp, and goat manure are obtained, the composition of the basic materials can be arranged as Table 1.

Table 1. , The composition of the basic materials

Variations	Comparison of compost base materials			EM-4 (10 ml)
	Vegetable waste	Bagasse	Goat manure	
A	+	-	+	+
B	+	+	-	+
C	-	+	+	-
D	+	+	+	+

In the study, the amount of material for each variation was 2 kg. Composting was carried out aerobically using a box made of wood. In the composting process, temperature measurements are carried out every day and C and N levels are measured on the 20th and 30th days. Turning is carried out once a week and watering is carried out if necessary.

III. RESULTS AND DISCUSSION

Characteristics of Composted Materials

A preliminary test was conducted on vegetable waste, bagasse, and goat manure. The results are as follows:

Table 2. Characteristics of compost materials (dry basis)

Table 3. Initial content of each variation (dry basis)

Description: A: vegetable waste + goat manure + 10 ml EM-4

B: vegetable waste + bagasse + 10 ml EM-4

C: bagasse + goat manure + 10 ml EM-4

D: vegetable waste + bagasse + goat manure + 10 ml EM-4 Source: laboratory analysis results, 2008

Temperature

The temperature of the compost for 30 days is as follows:

From the temperature measurement graph, each compost variation undergoes three stages of the composting process. In the first stage, namely the warming stage (mesophilic stage), microorganisms are present in the compost material quickly and the temperature increases. Mesophilic microorganisms live at temperatures of 10-45 oC and are tasked with reducing the particle size of organic materials so that the surface area of the material increases and accelerates the composting process. In the second stage, namely the thermophilic stage, thermophilic microorganisms are present in the compost pile. Thermophilic microorganisms live at temperatures of 45-60 oC and are tasked with consuming carbohydrates and proteins so that the compost material can be degraded quickly. These microorganisms are Actinomycetes and thermophilic fungi. Some of the Actinomycetes are able to break down cellulose and hemicellulose. Then the decomposition process begins to slow down and the peak temperature is reached. After the peak temperature has passed, the pile reaches stability, where the material is more easily decomposed. The third stage is the cooling and maturation stage. At this stage, the number of thermophilic microorganisms decreases because the food for these microorganisms is also reduced, this causes mesophilic organisms to start being active again. The mesophilic organisms will decompose the remaining cellulose and hemicellulose from the previous process into simpler sugars, but their ability is not as good as thermophilic organisms. The decomposed material decreases in quantity and the heat released is relatively small. In this study, changes in the temperature of compost variations A, B, C, D have followed the stages of heating, peak temperature, cooling and maturation. At the beginning of composting, the temperature of the four variations rose rapidly and reached peak temperature. The peak temperatures achieved for each variation were 35.67 oC, 39.33 oC, 38.00 oC, 37.00 oC. The peak temperature in variation B occurred on the fourth day, while in variations A, C, and D occurred on the fifth day. This is because variation B has the highest C/N ratio, which is 36.14. Nitrogen is needed by microorganisms as a food source for the formation of body cells and carbon as a source of energy for microorganisms to reproduce well and be able to produce higher heat. The peak temperature of all compost variations never reached the temperature at which thermophilic microorganisms grow and develop, because the pile conditions were on a laboratory scale so that the pile could not isolate heat sufficiently. This resulted in the sululose in the bagasse not being able to decompose, so that the resulting compost was small. The higher the volume of the pile, the greater the heat insulation and the easier the pile becomes hot, so that the temperature at which thermophilic bacteria can grow will be reached. With the growth of thermophilic bacteria, the variation of the pile using bagasse will have a faster maturation time. In addition, with the addition of EM-4, the activity of microorganisms will be faster in decomposing compost materials, so that the pile will go down.

The entire compost pile then undergoes a cooling phase and a maturation phase which is marked by a decrease

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in temperature from peak temperature to stability. Compost maturity occurs at a temperature of 26-27 oC on the 30th day. This temperature is the same as the soil temperature and has met the requirements for mature compost.

Characteristics of Mature Compost

After maturing on the 30th day, a final laboratory test is carried out to determine the characteristics of mature compost.

Table 4. Chemical content of mature compost

Description: A: vegetable waste + goat manure + 10 ml EM-4

B: vegetable waste + sugarcane pulp + 10 ml EM-4

C: sugarcane pulp + goat manure + 10 ml EM-4

D: vegetable waste + sugarcane pulp + goat manure + 10 ml EM-4 Source: laboratory analysis results, 2008

Table 5. Characteristics according to SNI-19-7030-2004

Based on the table above, it can be seen that the organic C content of compost variation A does not meet the organic C range in SNI 19-7030-2004. The organic C content of compost variation A is still very large and far from the maximum SNI content. This is due to the imperfect decomposition process. The condition of the compost pile variation A is on a laboratory scale so that the pile cannot isolate heat sufficiently. This results in the organic C content in each compost material not being able to be decomposed perfectly. While the organic C content of compost variations B, C, and D meets the organic C range in SNI. This is because the initial organic C content of compost variations B, C, and D is already quite low, namely 16.90; 28.04; and 29.03 respectively.

The total N content of all compost variations has met the SNI requirements (minimum 0.4%). The total N value of compost variation A is the largest of the total N of other compost variations. This is due to the decomposition process by microorganisms that produce ammonia and nitrogen trapped in the compost pile because the pores of the compost pile are very small so that the ammonia and nitrogen released into the air are in small amounts. While other compost variations have larger compost pile pores.

The C/N ratio of compost variation A is in the range of the C/N ratio required by SNI 19-7030-2004. While compost variations B, C, and D are not in the range required by SNI. Compost variation A meets the requirements with a C/N ratio of 17.45, this is due to the large initial total N content and the addition of a mixture of ingredients, namely vegetable waste and goat manure. Vegetable waste is easily decomposed while goat manure provides P as a substance needed for the growth and development of microorganisms. Compost variations B, C, D do not meet SNI requirements with C/N ratios of 21.72; 20.77; 20.93 respectively. This is because compost variations B, C, D contain bagasse as a composting material. Bagasse cannot be decomposed because the temperature of the compost pile never reaches 45oC, because at this temperature thermophilic organisms can decompose cellulose and hemicellulose contained in bagasse. If the temperature does not reach 45oC, the bagasse does not decompose so that the organic C content and C/N ratio are still quite high. The C/N ratio of compost variation B (21.72) is greater than that of variations C and D (20.77 and 20.93). This is because the ingredients of compost variation B are vegetable waste and bagasse, and do not contain goat manure. While the ingredients of compost variations C and D contain goat manure.

Goat manure is a provider of P elements for microorganisms, so that microorganisms in compost variations C and D can grow and develop well.

C/N ratio

The change in the C/N ratio of each variation is as follows:

Figure 3. Graph of C/N ratio of compost vs. time

From the graph it can be seen that the C/N ratio of each variation has decreased. This is because the material undergoes decomposition. Organic C in the material is a food source for microorganisms so that its amount decreases. In addition, organic C also decomposes into CO2 into the air. Total N in the material increases due to the decomposition process of compost material by microorganisms which produce ammonia and nitrogen, so that the total N content of the compost increases. With the decrease in organic C content and the increase in total N content, the C/N ratio decreases.

Analysis of Physical Content of Mature Compost

The physical condition of mature compost can be seen directly on the last day of composting, which is day

30. Analysis of the physical condition of mature compost consists of:

Final weight of compost

The weight of the composted material has shrunk which means that the compost has matured. This shrinkage can be seen in the following table:

Table 6. Initial weight of compost material and final weight

Description: A: vegetable waste + goat manure + 10 ml EM-4

B: vegetable waste + sugarcane pulp + 10 ml EM-4

C: sugarcane pulp + goat manure + 10 ml EM-4

D: vegetable waste + sugarcane pulp + goat manure + 10 ml EM-4 Source: laboratory analysis results, 2008

The compost produced is compost that passes the 1.18 mm sieve, while what is left behind is the remaining material that is not composted, for example sugarcane pulp, roots from vegetable waste, and undecomposed goat manure. The weight of the lost material is the gases resulting from decomposition by microbes that are released into the air, for example ammonia and water vapor, causing the final weight of the material to decrease.

Smell, color, and final form of compost

Mature compost smells like soil, because the material it contains resembles soil and is blackish brown in color, which is formed due to the influence of stable organic materials. Meanwhile, the final form no longer resembles its original form because it has been destroyed due to natural decomposition by microorganisms living in the compost. This is in accordance with the SNI 19-7030-2004 standard.

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IV. CONCLUSION

Bagasse is an organic material that is difficult to compost. The C/N ratio of mature compost variations A, B, C, and D are as follows: 17.45; 21.72; 20.77; 20.93. The best compost material for the composting process is vegetable waste + goat manure with the addition of 10 ml of EM-4 (compost variation A). The characteristics of compost variation A have met the SNI 19-7030-2004 standard with a C/N ratio of 17.45, water content of 49.71, and pH 7 with a maturity time of 30 days.

REFERENCES

[1] Agassiz & Hog Producers, 1996. " Large Scale Utilization and Composting of Yard Waste". www.edis.ifas.ufl.edu. Anonimous. 2006. "Windrow Composting". www.univpm.msw.co.id.

Anoimous 2006." Composting". www.ppc.health.nsw.gov.au Anonimous 2005. "Kompos Dari Sampah". www.brdp.or.id.

Djuarnani, Nan. 2005. "Cara Cepat Membuat Kompos". PT. Agromedia Pustaka: Jakarta Indriani, Yovita Hety . 2003 . "Membuat Kompos Secara Kilat" . Penebar Swadaya : Jakarta..

Tchobanoglous, George . 1991 . "Wastewater Engineering Treatment Disposal Reuse ". 3th ed. McGraw-Hill Book Co : Singapore.

. 1993 . "Integrated Solid Waste Management". McGraw-Hill Book Co : Singapore.