JOURNAL OF CHEMICAL PROCESS ENGINEERING
p-ISSN : 2527-4457
e-ISSN : 2655-2957

Vol. 9 No. 3 (Sepecial Issue 2024)

Research Paper

Water Level and NPK Test of Bokashi Compost Fertilizer Results of Industrial Waste Processing Practical Work at the Mineral and Environmental Testing Laboratory

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Artikel Histori : Submitted 20 October 2024, **Revised** 1 November 2024, **Accepted** 20 December 2024, **Online** 31 December 2024
https://doi.org/10.33096/jcpe.v9i3.1536

ABSTRACT: *Compost is one of the products resulting from the Industrial Waste Processing practicum in the form of solid waste. This compost goes through a composting process and becomes one of the organic fertilizers containing macro and micronutrients. Compost is produced through the biological decomposition process of organic material, which is controlled and results in humus. Moisture content is one of the key factors in the composting process, and it is essential for determining the maturity and quality of compost. Moisture content refers to the amount of water in a material or object, such as soil (also known as soil moisture), agricultural materials and products, rocks, etc. Additionally, compost fertilizer contains nutrients such as nitrogen (N), phosphorus (P), potassium (K), calcium (Ca), magnesium (Mg), and other elements. Based on testing, the sample rice husk: TSP 3:2:2 moisture content was 40.74%, and for another rice hull: TSP 3:2:2 sample, it was 43.14%. rice hull: TSP 3:2:2 had 0.74% for nitrogen content testing, and the second sample had 0.76%. Phosphorus content testing for rice husk: TSP 3:2:2 was 0.28%, while the second sample had 0.18%. rice husk: TSP 3:2:2 had 0.53% for potassium content testing, and the second sample had 0.509%. From these test results, it can be concluded that both samples meet the standards of SNI 19-7030-2004 for compost specifications from domestic organic waste. This research is expected to provide information on the quality of the bokashi fertilizer and be a reference in developing more optimal waste processing methods.*

Keywords*: Compost; Water Content; Nitrogen; Phosphorus; Potassium*

1. INTRODUCTION

The increase in industrial activity in various sectors has resulted in the emergence of various types of solid, liquid, and gas waste [1] [2]. Waste not processed correctly can hurt the environment, such as soil, water, and air pollution. Therefore, industrial waste processing is an essential focus in efforts to maintain ecosystem balance and realize sustainable development [3][4][5]. In this context, processing industrial waste into valuable products, such as compost, is an effective solution [6].

Compost is one of the products used in the Industrial Waste Processing practicum at the ATI Makassar Polytechnic. Compost is produced from the decomposition process (weathering) of organic waste biologically into humus [7][8][9]. In the compost maturation process, the water contained in the water plays an important role. The water content is one of the essential components in composting engineering because the availability of water content affects the decomposition of organic material [9][10]. Water content is significant for the maturity and quality of compost. Water content is the amount of water in an object or material, such as soil (also known as soil moisture), agricultural materials and products, rocks, etc.

Compost fertilizer is made from organic materials, which are the main ingredient. This compost fertilizer is rich in nutrients that are very important for plants. Organic fertilizer made from waste will produce nutrients, which are very important for the transportation of photosynthesis in the form of shoots or young leaves [11][12]. Adding bioactivators can accelerate the composting process and improve compost products

Published by
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[13][14][15]. The nutrients in compost fertilizer include nitrogen (N), phosphorus (P), potassium (K), calcium (Ca), magnesium (Mg), and sulfur (S) [16][17]. The microelements include chlorine (Cl), iron (Fe), manganese (Mn), copper (Cu), zinc (Zn), boron (B), and molybdenum (Mo). Because compost fertilizer offers many benefits for plant growth, it is now a very popular fertilizer [11][18].

Bokashi compost is a type of organic fertilizer made through a fermentation process with the help of effective microorganisms (EM) [19][20]. Bokashi is faster to make than conventional compost, making it an efficient alternative to processing organic waste. It also has good nutrient content, such as nitrogen (N), phosphorus (P), and potassium (K), which play an essential role in supporting plant growth [21][22]. Compost fertilizers are sourced from natural ingredients and processed into high-quality fertilizers, and they greatly help plant growth. NPK fertilizer refers to the content of nitrogen (N), phosphorus (P), and potassium (K), which are essential macronutrients for plants. Nitrogen plays a role in the formation of leaves and stems, phosphorus functions for root development, and the formation of flowers and fruits. At the same time, potassium helps increase plant resistance to disease and strengthens plant structure [23]. Balanced NPK content in fertilizer will significantly affect plant productivity.

The water content and NPK content in fertilizer significantly affect the effectiveness of fertilizer in increasing soil fertility [24][25][26]. The right water content will affect the storage life of fertilizer, while the NPK content determines the extent to which fertilizer can provide the nutrients plants need. Therefore, testing the water content and NPK composition is important in evaluating fertilizer quality. This study aims to test the water content, NPK content, and component ratio in bokashi compost fertilizer from industrial waste processing practicums at the Mineral and Environmental Testing Laboratory with SNI Compost. The results of this study are expected to provide information on the quality of bokashi fertilizer produced and be a reference in developing more optimal waste processing methods in the future.

2. RESEARCH METHODOLOGY

2.1 Materials

Bokashi compost, filter paper, and latex were used as materials. This study used a drying oven, spectrophotometer, petri dish, beaker, Erlenmeyer flask, stirring rod, spatula, analytical balance, volume pipette, bulb, dropper pipette, and asbestos gauze.

Figure 1. Tools and Materials

2.2 Procedures

This research was conducted at the Mineral and Environmental Testing Laboratory, Department of Mineral Chemical Engineering, ATI Makassar Polytechnic from March to August 2024. It was experimental, comparing the values of water content, Nitrogen content, Phosphorus (P), and Potassium (K) content in compost with two types of compost compositions produced from Industrial Waste Processing Practicum with SNI standards for Compost from domestic organic waste.

This type of research is experimental and compares the results of the water content and NPK of bokashi compost with those of SNI Compost. The research was carried out by measuring the air content using the Gravimetry method. The Gravimetry method is a quantitative analysis technique that measures the mass of a substance to determine specific components in a sample [27][28][29]. In this method, the components to be measured are converted into a stable and weighable form, such as sediment or dried products. The stages carried out with this Gravimetry method are the Gravimetry Method. The first method is sample preparation. Take a sample of Bokashi compost fertilizer that is homogenized to be representative. Next, the initial weighing sample. The next method is sample drying. The sample is processed using an oven at a temperature of 105°C for 24 hours to evaporate the air content. The next method is weighing dry residue. The next step is calculation of water content. Calculation of water content can be seen in the following equation.

$$\text{Water Content (\%)} = \frac{(Initial\ mass\ of\ sample - Mass\ of\ dry\ residue)}{Initial\ mass\ of\ sample} \times 100\% \quad \text{.....(1)}$$

Next is the Nitrogen (N) Test, based on the Total Nitrogen Test Method SNI 2308: 2010. Phosphorus (P) testing based on the Total Phosphorus Test Method as P2O5 SNI 2308:2010. Determination of carbon content (C) based on the Total Organic Carbon Test Method SNI 06-6989.28-2005. Indonesian National Standard (SNI) 19-7030-2004 “Specifications for compost from domestic organic waste” was prepared to regulate the quality of compost products to protect consumers and prevent environmental pollution (National Standardization Agency, 2004) [30][31]. The research stages can be seen in Figure 2 and the compost quality standards can be seen in Table 1.

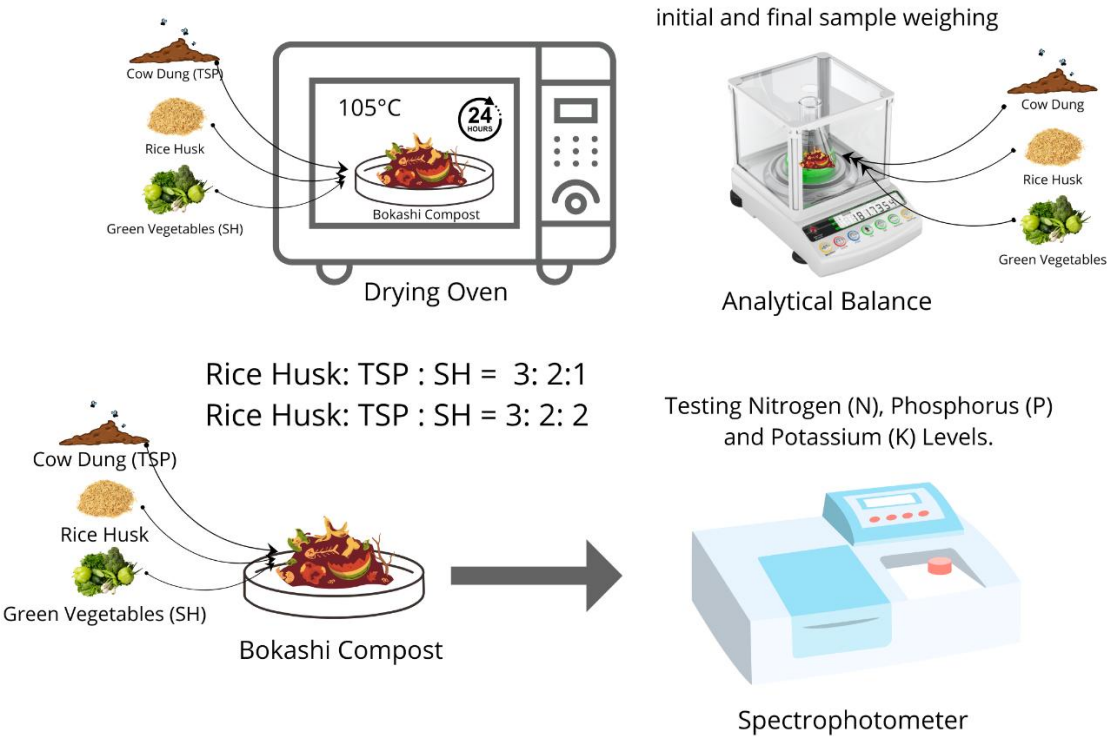


Figure 2. Water, Nitrogen (N), Phosphorus (P) and Potassium (K) Content Testing Process

Table 1. Compost Material Quality Standards

No	Parameter	Unit	Minimum	Maximum
1	Moisture Content	%	-	50
2	Nitrogen	%	0,4	-
3	Phosphorus (P2O5)	%	0,1	-
4	Potassium (K2O)	%	0,2	-

3. RESULT AND DISCUSSION

The Mineral and Environmental Testing Laboratory produces two types of bokashi compost: compost with a ratio of Rice Husk: TSP (cow dung): SH (green vegetables) 3: 2: 1 and compost with a ratio of Rice Husk: TSP (cow dung): SH (green vegetables) 3: 2: 2. Both samples were then tested for water content and Nitrogen, Phosphorus, and Potassium. The study results can be seen in Table 2

Table 2. Experiment Result

No	Parameter	SNI Standard	Result	
			Rice Husk: TSP: SH 3: 2: 1	Rice Husk: TSP: SH 3: 2: 2
1	Moisture Content	<50%	40,74%	43,14%
2	Nitrogen	>0,40%	0,74%	0,76%
3	Phosphorus (P2O5)	>0,10%	0,28%	0,18%
4	Potassium (K2O)	>0,2%	0,53%	0,509%

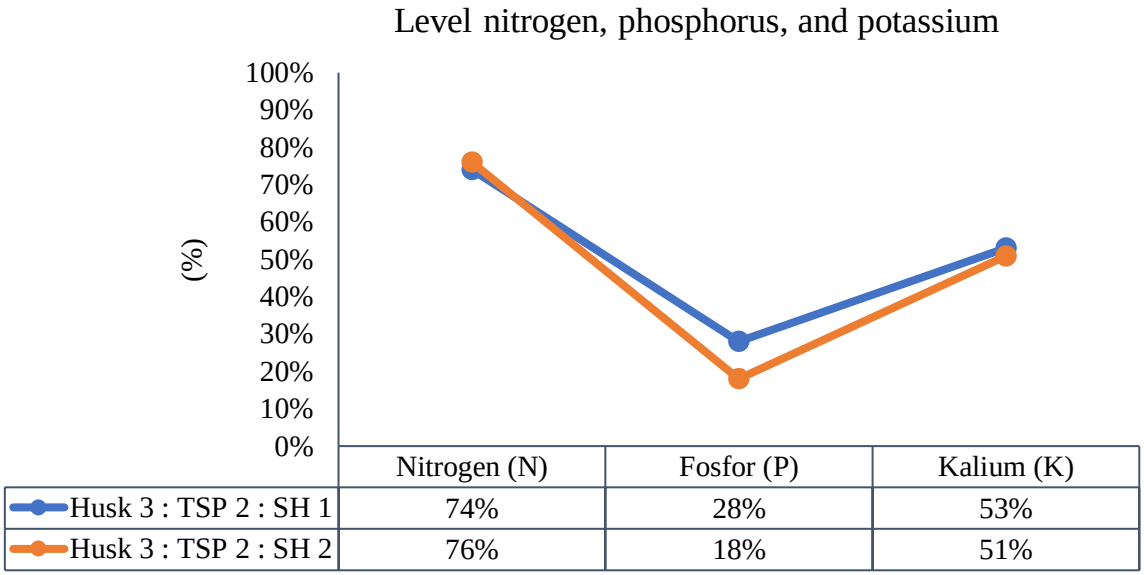
Based on the test results, the water content of compost with a ratio of Rice Husk: TSP: SH 3:2:1 obtained a water content of 40.74%, and compost fertilizer with a ratio of Rice Husk: TSP: SH 3:2:2 obtained a water content of 43.14%. These test results are still below the maximum limit set by SNI, which is a maximum of 50% [30][31]. Based on this, both samples have met the existing SNI standards. One of the important components in the composting process is water content. The water content of compost is very important for the maturity and quality of compost because decomposing microorganisms play an important role in the decomposition process of organic compost materials. The right water content helps microorganisms in the decomposition process, which affects the quality of compost and plant growth. Water content that is too low or too high can inhibit the activity of microorganisms responsible for the decomposition of organic matter[30][32]. In addition, suboptimal water content can cause incomplete decomposition, resulting in low-quality compost. Using compost with inappropriate water content can reduce the availability of nutrients for plants so that plant growth becomes suboptimal. In addition to water content, this compost is also tested for nitrogen (N), phosphorus (P), and potassium (K) levels.

Plant growth requires Nitrogen for growth or the process of forming vegetative parts such as roots, stems, and leaves . The nitrogen content required by microorganisms to maintain and form body cells is 0.74% for Rice Husk: TSP: SH 3: 2: 1 and 0.76% for Rice Husk: TSP: SH 3: 2: 2, according to the results of testing bokashi compost fertilizer (Table 2 and Figure 2).

The SNI standard for nitrogen content in compost fertilizer is a minimum of 0.40%. This shows that the nitrogen content contained in both compost fertilizers meets the SNI standard. Compost's standardized nitrogen (N) content is very important to support optimal plant growth [33][34]. Inappropriate nitrogen content in compost can harm plant growth and cause stunted plant growth, yellowing leaves (chlorosis), and decreased protein production, so photosynthesis is not optimal. However, excess nitrogen content can also cause excessive vegetative growth by forming dense leaves but inhibits flowering and fruiting. In addition, excess nitrogen can cause poisoning in plants and increase disease susceptibility. Therefore, the Nitrogen content must follow the standard. Based on several studies, quality compost usually has a nitrogen content of 1% to 3% in total nitrogen. Compost with this nitrogen content can provide sufficient nutrients to support plant growth without causing toxic effects.

The phosphorus (P) content in bokashi compost fertilizer is an important factor for soil fertility because organic materials depend on nutrient intake to help increase soil nutrient levels [35][36]. This component plays an important role in plant chemical physiology and photosynthesis processes. In addition, it is needed at plant growth points, tissue development, and cell division. The right phosphorus (P) level in compost is essential for optimal plant growth. Inappropriate levels of phosphorus in compost can negatively impact plant growth. For example, phosphorus deficiency can cause stunted plant growth, purple or dark leaves, and underdeveloped root systems, resulting in suboptimal nutrient and water absorption. Excess phosphorus can also interfere with the absorption of other nutrients, such as zinc (Zn) and iron (Fe), which can cause plant micronutrient deficiencies [35][36]. In addition, excess phosphorus can cause plants to experience premature aging, resulting in a shorter lifespan compared to normal plants. Therefore, maintaining standard phosphorus levels in compost is essential to ensure optimal plant growth and yield.

The results of the bokashi compost fertilizer test showed that the phosphorus (P) content was 0.28% for Rice Husk:TSP: SH 3:2:1 and 0.18% for Rice Husk:TSP: SH 3:2:2, respectively (Table 2 and Figure 2). Based on the SNI standard for phosphorus content in compost, which is a minimum of 0.10%, both samples meet the standard. However, based on the results of several studies, quality compost usually has a total phosphorus content of around 0.3% to 1.0%. Compost with this nitrogen content can provide sufficient nutrients to support plant growth without causing toxic effects. This shows that the phosphorus content in the research results is still lacking even though it has met the SNI standard.



	Nitrogen (N)	Fosfor (P)	Kalium (K)
Husk 3 : TSP 2 : SH 1	74%	28%	53%
Husk 3 : TSP 2 : SH 2	76%	18%	51%

Figure 3. Results of testing the Nitrogen, Phosphorus, and Potassium content of Bokashi Compost Fertilizer

Potassium (K) is responsible for photosynthesis and the formation of cellulose and protein, as well as increasing plant resistance by strengthening plant stems [37][38]. In addition to helping the formation of carbohydrates and proteins, potassium in compost increases plant resistance to drought stress. The right potassium (K) level in compost is essential for plant growth and yield. Inadequate levels of potassium in compost can negatively impact plant growth. Potassium deficiency can result in stunted plant growth, yellowing or burning of leaves at the edges, and decreased quality and quantity of yields. Potassium plays a role in plants' stomata regulation and water transport; its deficiency can interfere with photosynthesis and metabolism. However, excess potassium can also interfere with the absorption of other nutrients, such as magnesium (Mg) and calcium (Ca), which can lead to deficiencies in these nutrients in plants. The potassium (K) level for Rice Husk: TSP: SH 3: 2: 1 is 0.53%, and Rice Husk: TSP: SH 3: 2: 2 is 0.509%, according to the results of testing bokashi compost fertilizer, which meets the SNI standard for a minimum potassium

content of 0.20% (Figure 2). The availability of potassium nutrients is very important for plants because it affects flowering and fruit formation [37][38].

4. CONCLUSION

The results of the study conducted on the samples of Rice Husk:TSP: SH 3:2:2 and Rice Husk:TSP: SH 3:2:2 can be concluded that both bokashi compost fertilizers from the Industrial Waste Processing practicum at the Mineral and Environmental Testing Laboratory meet the SNI standards for testing water content, nitrogen content (N), phosphorus content (P), and potassium content (K). This shows that the quality of compost based on SNI is sufficient to support plant growth. Nitrogen, phosphorus, and potassium in compost positively impact vegetative and generative development, as well as plant resistance to environmental stress. High-quality fertilizers are crucial in ensuring healthy plant growth and optimal harvest yields.

ACKNOWLEDGEMENT

Thank you to the Department of Mineral Chemical Engineering Study, Polytechnic of ATI Makassar, for providing facilities during the research.

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