Utilization of Biopori Infiltration Holes as a medium for composting in Purwoyoso Village Semarang City

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Abstract. Population growth is directly proportional to the amount of waste produced. Facts on the ground show that almost 70% of the waste generated by households is organic waste. Organic waste is waste that comes from the remains of living things that easily decomposes naturally without human intervention to decompose and be processed again into compost. Utilization of biopore infiltration holes is used as a medium for composting organic waste. Compost sample testing methods to determine compost specifications include C-Organic testing using the Walkley & Black method; The N-Total test used the Wet Destruction + Indophenol method; Phosphate test using the wet destruction method + Ascorbic Acid; Testing for Potassium with the Wet Destruction+AAS method; pH measurement with a pH meter; testing the water content through a Moisture Analyzer and measuring the C/N ratio with a Gravimetric tool. The results obtained showed that only the water content and pH met the compost specifications based on SNI19-7030-2004. Other parameters indicate that the value of C-Organic, low Phosphate and C/N ratio that is too high indicates the composting process is too fast. So that potassium is of low value.

1 Introduction

Population growth and settlement growth are interrelated things that affect the current form of Semarang City development. Increasing population growth has an effect on activities that generate waste. The population in the city of Semarang is currently recorded at 1,835,083 people [1]. Facts on the ground show that almost 70% of the waste generated by households is organic waste [2]. Organic waste is waste that comes from the remains of living things that easily decomposes naturally without human intervention to decompose. In addition, organic waste can be reprocessed into something useful [3]. In general, household waste decomposes quickly, such as leftover vegetables, leftover spices, leftover food/drinks, and others [4].

According to the Ministry of Environment and Forestry, the increase in population is directly proportional to the amount of waste it produces. Roughly calculated, with Indonesia's population of more than 250 million people, if each person produces 0.7 kg of waste/day, the national waste pile will reach 175 thousand tons/day or can be equated with 64 million tons/year [5]. The increase in the amount of waste production in Semarang City is currently increasing compared to during the pandemic, which reached 1,110 tons per day [6].
Garbage is a problem that is never finished to be solved. Garbage that is not managed properly will have a negative impact not only on the environment but also on human health. And the opposite happens if waste can be managed properly will bring benefits to humans and the environment. The benefits of properly managed organic waste can be used as additional animal feed, biogas, electricity and organic fertilizer or compost.

Biopores are spaces or pores in the soil formed by soil fauna, such as worms and termites. In addition, the formation of these pores is also due to plant roots in the soil [7]. Biopore infiltration hole technology is the use of pipes that are installed in the ground by utilizing the activities of small organisms and microorganisms to decompose organic waste in the holes. The advantages of using biopore infiltration hole technology include (i) increasing the absorption of water in the soil, (ii) preventing flooding and improving the quality of groundwater, (iii) decomposing organic waste into compost, (iv) overcoming problems that arise due to standing water, (v) Utilizing the activities of fauna and plant root systems [8].

Purwoyoso Village, located in Ngaliyan District, Semarang City, with a population of 15,616 consisting of 14 RWs, has a community formed in Proklim Purwokeling RW 10. Proklim Purwokeling has benefits in controlling climate change at the site level. In this case, the aim is to reduce the accumulation of organic waste through composting in the biopore infiltration pit. Composting is a way of obtaining fine organic matter that has gone through a perfect decomposition process. Technically, composting is reducing the C/N ratio of organic matter so that it is the same as the C/N ratio of soil. The C/N ratio is the result of the comparison between the carbohydrate material and the nitrogen contained in a material. Compost contains minerals that are essential for plants [9].

Based on the description of the problems above, it is important to have research related to the use of biopore infiltration holes to reduce the negative impact of not managing organic waste into compost or organic fertilizer in Proklim Purwokeling, Purwoyoso Village, Ngaliyan District, Semarang City. The quality of the compost formed in the biopore infiltration pit was analyzed and compared with the specifications for compost through the Indonesian National Standard (SNI) 19-7030-2004 concerning specifications for compost from domestic organic waste.

2 Materials and Methods

2.1 Research Location

This research was limited to Proklim Purwokeling RW 10, Purwoyoso Village, Ngaliyan District, Semarang City. The location of the geographic coordinates of the research location at 6°59'36.7"S 110°21'21.1"E The research station is in the densely populated Bukit Persada Indah Housing Complex (BPI). Purwoyoso Village has an area of 99.152 ha. The research station is included in the administration of the Ngaliyan District which is topographically located at an altitude of 67.3 meters above sea level with an amount of rainfall ranging from + 2,413 mm/year. This research station represents the city of Semarang with a mid-land topography between the highlands and the coastal area. Purwoyoso Village was chosen as the research station because it has topographical characteristics in the form of slopes with a slope level of 15-25%, the soil type is gray alluvial association, engineering geology is sandstone with high-medium bearing capacity. The geological movement is in the form of low ground movement and is included in the zone of low ground movement and is classified as a buffer zone [10].
2.2 Tools and Materials Research

A set of research tools and materials used includes equipment in the field and research in the laboratory as well as detailed research material components shown in Table.1:

Table 1. Tools and Materials

<table>
<thead>
<tr>
<th>No.</th>
<th>Name</th>
<th>Function Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Biopore drill</td>
<td>Used to make holes in the ground where pipes for biopore will be installed</td>
</tr>
<tr>
<td>2</td>
<td>Shovel</td>
<td>Used to dredge the drilled soil and also to collect organic waste and compost produced by biopore</td>
</tr>
<tr>
<td>3</td>
<td>Hoe</td>
<td>Used to level the ground around the place of manufacture of biopore</td>
</tr>
<tr>
<td>4</td>
<td>Ruler</td>
<td>Rulers and rulers are used to measure the tools needed to make the biopore, measuring the distance between the points of making the biopore.</td>
</tr>
<tr>
<td>5</td>
<td>Bucket</td>
<td>Used to accommodate soil and compost during experimental research on making biopore.</td>
</tr>
<tr>
<td>6</td>
<td>Punching Iron</td>
<td>Used to perforate/make pipe pores for biopore</td>
</tr>
<tr>
<td>7</td>
<td>Dipper</td>
<td>Used to perforate/make pipe pores for biopore</td>
</tr>
<tr>
<td>8</td>
<td>Scales</td>
<td>Used to weigh compost biomass and other materials during the research.</td>
</tr>
<tr>
<td>9</td>
<td>Stationery</td>
<td>Used to record, evaluate and compile research reports</td>
</tr>
<tr>
<td>10</td>
<td>Saw</td>
<td>Used to cut pipes, wood and all supports during the research process</td>
</tr>
<tr>
<td>11</td>
<td>Scissors</td>
<td>Used to cut equipment and materials during the research process</td>
</tr>
<tr>
<td>12</td>
<td>Camera</td>
<td>Used to document everything related to the research process</td>
</tr>
</tbody>
</table>
Materials

1. **Biopori Infiltration Hole cap with a diameter of 16/22 cm**
   As a biopore cover that is planted at the top of the soil hole

2. **PVC pipe and biopori infiltration hole casing with a diameter of 10 cm**
   As a biopore pipe that is planted in a hole in the ground

3. **Organic trash**
   As a biopore pipe that is planted in a hole in the ground

2.3 Compost Quality Measurement

The experimental process of applying biopore infiltration hole technology to compost formation is clearly illustrated in the illustration below:

![Illustration of Experimental Research](https://doi.org/10.1051/e3sconf/202344803029)

After going through a long decomposition process in the BIOPORI INFILTRATION HOLE, organic waste will turn into perfect compost. During this process the organic waste that has been put into the BIOPORI INFILTRATION HOLE is then observed for the percentage of decomposition which is carried out every week. The compost is then analyzed for its quality which includes the physical condition and the nutrients it contains. Compost quality testing was carried out at the Soil Mechanics Laboratory, Department of Environmental Engineering, Faculty of Engineering, Diponegoro University.
3 Results and Discussion

In testing the compost sample for the sample location in Purwoyoso Village, Ngaliyan District, Semarang City, each parameter uses a different method. C-Organic testing using the Walkley & Black method; The N-Total test used the Wet Destruction + Indophenol method; Phosphate test using the wet destruction method + Ascorbic Acid; Testing for Potassium with the Wet Destruction+AAS method; pH measurement with a pH meter; testing the water content through a Moisture Analyzer and measuring the C/N ratio with a Gravimetric tool.

![Compost Parameters](image)

**Fig 3.** Compost content analysis test results

Based on Figure 3, it shows that the compost content at the sampling location in Purwoyoso Village on the C-Organic parameter is 7.97%; N-Total of 0.079%; Phosphate of 0.04%, Potassium of 0.008% with a pH value of 7.1; the water content contained was 38.94% with a C/N ratio of 100.89.

Moisture content is the amount of water content contained in waste and compost. According to the Indonesian National Standard (SNI) 19-7030-2004 concerning the specifications for compost from domestic organic waste, it is explained that the water content allowed in compost is a maximum of 50%, while the water content in the test sample was 38.94%. These results indicate that the water content in the compost formed in the biopori infiltration pit is in accordance with the compost specifications according to SNI.

pH or power of hydrogen or commonly called the degree of acidity in the compost content according to compost quality standards, the minimum value is 6.80 and the maximum is 7.49. Based on the test results, it shows that the compost content formed in the biopore infiltration hole is worth 7.1, so it is sufficient.

The C/N ratio is the ratio of carbon to nitrogen content in the compost content. The range of C/N ratio values that meet compost quality standards is 10-20. In testing the compost sample at Proklim Purwokeling, Purwoyoso Village, it showed a result of 10.00.89. Carbon is used as a source of energy and nitrogen as a source of nutrition for the formation of body cells of microorganisms during the composting process. The higher the C/N ratio, the lower the potassium content in the compost. Potassium is a compound produced by microbial metabolism, where microbes use free potassium ions in fertilizer raw materials to meet metabolic needs. High C/N ratio values can occur because the compost in the biopore infiltration hole is tested too quickly.
Potassium produced in the compost in the biopori infiltration pit is 0.008%, whereas according to compost specification standards the minimum potassium content should be 0.20%. C-Organic (organic matter) is the percentage of soil fertility, which has the benefit of being a source of nutrients for plants, thereby increasing crop productivity. In accordance with SNI, the minimum organic matter content in compost is 27% and a maximum of 58%. While the test results show a value of 7.97%, it is classified as a low organic matter value.

Phosphate from the test results obtained results of 0.04%, this shows a low value compared to the minimum standard of 0.10%.

**4 Conclusion**

The conclusion from the use of biopore infiltration holes in the formation of compost from the several parameters tested shows that the results of the water content and pH are in accordance with the SNI specifications for compost from organic matter. However, other parameters, namely C/N Ratio, Phosphate, Potassium, C-Organic, N-Total, do not meet the compost specifications. This can happen because the composting process takes longer and the depth of the biopore infiltration holes must be added so that compost can be formed according to SNI specifications.

**References**

1. Central Bureau of Statistics for the City of Semarang (bps.go.id). accessed on 10 April (2023)

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