

Design and SWOT Analysis of Compost Shredder Machine at Waste Processing Sites - Reduce, Reuse, Recycle (TPS-3R)

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Keywords:

Waste management

Abstract: *Reduce, Reuse, Recycle Waste Management Site, abbreviated as TPS-3R according to Government Regulation No. 27 of 2020, is a place where collection, sorting, reuse, and recycling activities are carried out on a regional scale. This TPS-3R design has a size of 20 x 10 meters. Following the regulations stipulated that the TPS-3R must have an area of more than 200 m². TPS-3R has separate rooms to process the waste that enters the TPS. Seen here is a room that contains a milling machine or chopping machine and organic waste sifter machine. The innovation provided by TPS-3R is the presence of an organic waste shredder and a compost shredder machine. Both of these machines function to speed up composting and can produce large amounts of compost in a short time. The waste shredder is the most appropriate technology for processing organic waste using a diesel engine with a capacity of 500-700 kg/hour. With the compost shredder machine in TPS-3R, it is hoped to speed up the processing time for sifting the compost material. Accurate cost planning calculates the volume of work, the prices of various materials, and work on a building or project based on actual data.*

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1. INTRODUCTION

Waste is a leftover material from human activities that is no longer useful; therefore, it must be appropriately managed (Suryawan et al., 2022). Without proper management, waste can cause losses because it will cause flooding, increase climate warming, cause unpleasant odors, disturb beauty, worsen environmental sanitation and increase the threat of various diseases (Yudhistirani et al., 2016). Waste is currently a problem that is often a trending topic in almost all developing countries. By processing waste, such as sorting waste, recycling waste, and utilizing it, we hope to reduce problems in our society. However, if you look at the condition of the waste in the environment, currently, the waste is still in a mixed type condition, which means that the waste has not been sorted, so it becomes a problem when it is recycled (Almanda, Deni Haris & Samsinar, 2018). Data from the Ministry of Environment and Forestry in 2021 shows that in 2020 the West Jakarta area will produce 700 thousand waste per year (Kementerian Lingkungan Hidup dan Kehutanan, 2021). In general, the composition of West Jakarta waste is 75.53% organic and 24.47% inorganic. For organic waste, the waste that is considered economically potential consists of 2 (two) types of waste that can be used as raw material for compost. The ingredients are food waste 69.76% and wood/twigs 5.78% (Kementerian Lingkungan Hidup dan Kehutanan, 2021).

Many people do not understand the cleanliness of the environment, so people quickly dispose of waste which is very dangerous for the environment (Kaur et al., 2018; Kedzierski et al., 2020). Such as daily activities such as bathing, washing, and various other activities that are currently considered trivial but produce residual waste that can harm humans and the environment. Of the many human activities, it turns out that the most dangerous is household waste (Hasibuan, 2016). An idea emerged to overcome the current waste problem by designing the TPS-3R technology and its supporting facilities (Marliani, 2015).

The Reduce, Reuse, Recycle Waste Management Site, abbreviated as TPS-3R according to Government Regulation No. 27 of 2020, is a place where collection, sorting, reuse, and recycling activities are

carried out on a regional scale. The TPS-3R technology used for this research is a waste processing system with an innovation of a Waste chopping machine and a compost shredder machine that is more effective and efficient. Processing organic waste in compost is used to fertilize ornamental plants and herbs planted in the land around TPS-3R for sale. In addition, to improve the quality of composting results, composting technology will be applied. Furthermore, the processing results in gas will be used to supply energy for residents around TPS-3R. The purpose of the design in this activity is to design a waste treatment system with an innovative waste crusher and compost shredder machine that is more effective and efficient in the TPS-3R area.

2. METHOD

The design of this research is a literature review. The literature review is a method used to collect data or sources related to a particular topic obtained from various sources such as journals, the internet, theses, and other libraries. In data extraction, which is used in reviewing articles or literature, the researcher extracts all research results in articles following the researcher's goals, namely using a counting machine in the TPS-3R area. Then, the findings from each original report were combined into a modified thematic synthesis by the authors. In the first step, all texts, figures, or figures presented as results and related to the synthesis objective were extracted from the original articles and made in tabulated form.

This study also uses the SWOT technique of strengths, weaknesses, opportunities, and threats. A SWOT analysis organizes the main strengths, weaknesses, opportunities, and threats into an organized list and is usually presented in a simple grid bar. Strengths and weaknesses are of internal origin and location. Opportunities and threats are external things that affect the business or things that happen outside.

3. RESULT AND DISCUSSION

This TPS-3R design has a size of 20 x 10 meters. Following the regulations stipulated that the TPS-3R must have an area of more than 200 m². The following is a front view, side view, top view, or layout of the designed TPS-3R (Figure 1-3).

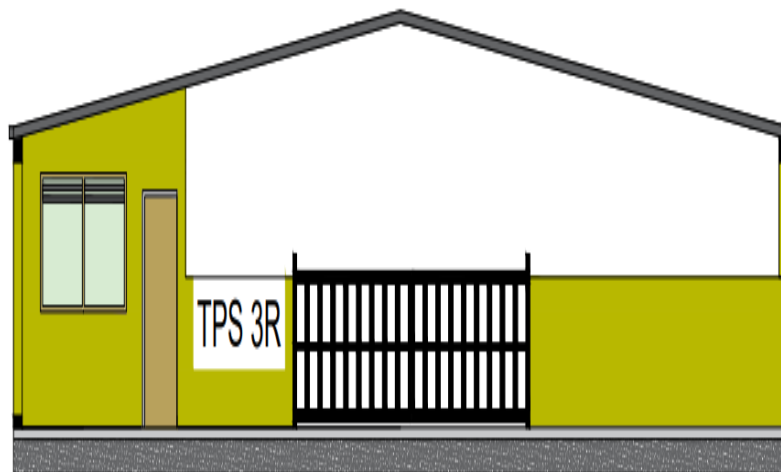


Figure 1. Front View of TPS-3R.

It can be seen in the overhead view or layout of the TPS-3R above if TPS-3R has separate rooms to process the waste that enters the TPS. For example, a room contains a milling machine or chopping machine and an organic waste sifter machine. After both machines process the organic waste, the sieve results will be put into a bamboo aerator to speed up the composting process. The bamboo aerator is made to pile organic waste on a triangular bamboo construction so that air can flow between the cavities. The bamboo aerator has 2.5 m, 0.6 meters wide, and 0.5 meters high. A sufficient amount of air to all parts of the compost heap is required to supply oxygen to the organisms and remove the

carbon dioxide produced (Ayilara et al., 2020; Caba et al., 2019; Oshins et al., 2022). The anaerobic process will produce compounds that smell bad, such as: organic acids (acetic acid, butyric acid, valeric acid, putrescine), ammonia, and H₂S (Garrett et al., 2021; Septiariva & Suryawan, 2021). Compost areas are carried out in three ways: naturally or from piles, passive and active (M et al., 2021). Oxygen needs in the composting process can be supplied in several ways: stirring, turning and giving air actively or passively (Michel et al., 2022). Active provision of air is carried out by providing aeration using an air blower supplied to all parts of the compost (Ottani et al., 2022). At the same time, passive air delivery is based on airflow movement due to bamboo construction. The heat arising from the decomposition process of the material will cause convection flow; hot air will go up, then cold air will enter through the bottom cold air will provide an oxygen supply.



Figure 2. Side View of TPS-3R

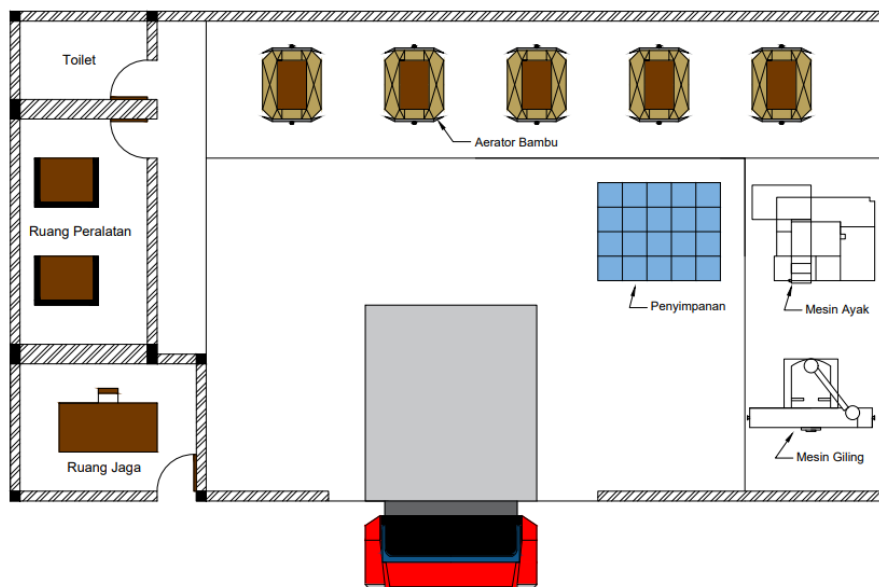


Figure 3. Top View or Layout of TPS-3R

In addition to the room containing the machine, there is also a storage room for storing organic waste chopped and sifted according to size. There is also a space in the middle of the building used to sort inorganic waste to the waste bank and the landfill. The innovation provided by TPS-3R is the presence

of an organic waste shredder and a compost shredder machine. Both of these machines function to speed up composting and can produce large amounts of compost in a short time. Turning organic waste into compost will reduce the waste sent to the landfill. In addition to organic waste, inorganic waste that enters the TPS-3R is also sorted to be sent to the waste bank (Raharjo et al., 2018). This TPS-3R only focuses on processing organic waste into compost and selecting inorganic waste manually. In addition, the existence of TPS-3R can open up new job opportunities for the local community (Kholil & Amaningsih Jumhur, 2018). In addition to the technology provided, this TPS-3R also includes counseling for local communities to apply reuse and reduce in their respective homes. Reuse and reduce aims to reuse items that can still be used and reduced.

The waste shredder is the most appropriate technology for processing organic waste using a diesel engine with a capacity of 46.2 kg/hour - 120.0 kg/hour (Sai & District, 2018). Furthermore, the chopping machine with a size of 112 x 75 x 115 cm is very suitable to be applied in TPS-3R, which is expected to increase the selling value of organic waste that has been chopped using this machine in the form of compost. This organic waste is compost used to fertilize ornamental plants planted on the land around TPS-3R for sale.

This compost shredder machine focuses on time efficiency and cost savings to support a sustainable TPS-3R. In this design, a compost processing machine is made, namely a compost shredder machine with 400-500 kg/hour capacity. The compost shredder machine in TPS-3R hopes to speed up the processing time for sifting the compost material. The SWOT analysis results for this technique can be seen in Figure 4.

<p style="text-align: center;">Strength</p> <ol style="list-style-type: none"> 1. Waste chopper machine that functions to chop large organic waste. 2. A compost sifter machine can be used to facilitate the sifting of waste without manually doing it. 3. The results of processing organic waste in compost can be used as fertilizer that can be sold. 4. The compost sifting process is faster, and the quality is better. 	<p style="text-align: center;">Weakness</p> <ol style="list-style-type: none"> 1. <i>Lack of public awareness in participating in sorting waste from the start.</i> 2. <i>Waste shredder is not effective in processing inorganic waste.</i>
<p style="text-align: center;">Opportunities</p> <ol style="list-style-type: none"> 1. There are regulations related to 3R-based waste management and waste retribution. 2. The majority of the waste produced by the community is organic waste. 3. Assist efforts to preserve the environment. 	<p style="text-align: center;">Threat</p> <ol style="list-style-type: none"> 1. High population growth. 2. Lack of commitment from the surrounding community to support the waste management process.

Figure 4. SWOT Analysis in TPS-3R

The TPS-3R technology is designed as a sustainable aspect because of the waste shredder and compost sifter. These machines have their respective functions, such as an organic waste chopper which aims to facilitate the manufacture of compost which can then be used as plant fertilizer. With this machine, organic waste cutting is no longer done manually but to save time and produce more compost. As for the compost shredder machine itself, it functions to sift compost to the desired size. These machines are equally helpful to simplify and save energy from the workers. The inorganic waste must pass the

sorting stage first, and then the inorganic waste can be sold or sent to the waste bank for further management. Of course, these things have sustainable environmental, social, and economic growth.

The existence of TPS-3R in the community positively impacts the poor. Many people around the TPS-3R location do not have jobs that can provide job opportunities for them, namely sorting out waste and used goods from their homes which can be sold to TPS-3R, and some people who do not have jobs can become Waste collectors as a side job. Thus, the presence of TPS-3R has an impact. The following is a SWOT analysis of the design of the TPS-3R technology innovation.

The innovative design has several advantages over other technological innovations in TPS-3R, including

1. Have a Waste chopper machine with a large knife to make it easier to process sizeable organic waste and reduce the risk of jamming the machine.
2. Has a compost shredder machine to facilitate manual sifting of waste.
3. The results from processing organic and inorganic waste are of higher quality and can improve the compost quality that can be sold around TPS-3R.

Accurate cost planning calculates the volume of work, the prices of various materials, and work on a building or project based on actual data. Planning activities are carried out by first studying the plan drawings and specifications. The material requirements will be used later (Lantang et al., 2014). In carrying out planning activities, a planner must understand the construction process thoroughly, including the types and needs of tools, because these factors can affect construction costs (Lantang et al., 2014). The budget for the same building will vary in each region due to differences in material prices and labor wages. For example, the materials and labor costs in Manado are different from the prices of materials and labor costs in Surabaya, Bandung, Jakarta, Balikpapan, and Padang (Lantang et al., 2014).

4. CONCLUSION

The waste shredder is the most appropriate technology for processing organic waste using a diesel engine with a capacity of 500-700 kg/hour. With the compost shredder machine in TPS-3R, it is hoped to speed up the processing time for sifting the compost material. In addition, accurate cost planning calculates the volume of work, the prices of various materials, and work on a building or project based on actual data.

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