ORGANIC TOILET (TORGANIC), SOLUTION FOR UTILIZING WASTE INTO ORGANIC FERTILIZER IN THE SHUJI LAKE TOURISM AREA

Martha, Aznury[1*] Ahmad Zikri[1] , Anerasari Meidinariasty[1]
Darma Prabudi[2], Hengki Rosadi[3] , Renato G. Reyes[4]

[1]Department of Chemical Engineering, Politeknik Negeri Sriwijaya, Palembang, Indonesia
[2]Department of Civil Engineering, Politeknik Negeri Sriwijaya, Palembang, Indonesia
[3]Pertamina EF 2, Prabumulih, Indonesia
[4]Central Luzon State University, Philippines
martha_aznury@polsri.ac.id

Abstract. Research road map for collaboration with Pertamina EF 2 Prabumulih partners by utilizing organic waste from organic toilets into organic fertilizer for Sriwijaya State Polytechnic through a Research Master Plan (RMP), one of which is focused on technology and utilization of organic waste. Reducing the use of chemicals is an important step where this research is the answer to reducing the use of chemical fertilizers to fertilize the soil but causing the death of microorganisms. Researchers carried out organic fertilizer production by building organic (torganic) toilets, a solution for utilizing waste into organic fertilizer in the Shuji Lake tourist area. This research used a starter made from coconut water, sugar or molasses and starter seeds for 3 weeks. The use of microorganisms to decompose where the microbes release enzymes as catalysts is more efficient at temperatures of 30-40 ^{o}C. Next, Fermentation of human excreta from organic toilets, rice husk, and dried leaves. After, mix all with stater and material in fermentation for 70 days. The results will be decomposition fertilizer which value of 2.92 % Nitrogen, 1.23 % Potasium, and 1.59 % Phosphorus.

Keywords: Human Excreta, Toilet Organic, Fertilizer, Fermentation

1. Introduction

Lake Shuji is located in Lembak Village, Lembak Muara Enim District, South Sumatra, about 70 kilometers (km) from Palembang City, South Sumatra. Lake Shuji, with an area of 60 x 400 m2, is in the middle of a rubber plantation owned by residents. The name Shuji was taken because this location during the war of independence was the location of a public kitchen for Japanese troops which was only 1 km from the Japanese army airport.

The increasingly well-known existence of Shuji Lake and the large number of visitors has attracted the attention of Pertamina in Prabumulih City. Through Corporate Social Responsibility (CSR) funds, the Pertamina Company wishes to help develop Lake Shuji. One of the problems is how the water of Lake Shuji is not polluted by human waste. Meanwhile, toilets are really needed for visitors to Shuji Lake.

N. L. Husni et al. (eds.), *Proceedings of the 7th FIRST 2023 International Conference on Global Innovations (FIRST-ESCSI 2023)*, Advances in Engineering Research 232,
https://doi.org/10.2991/978-94-6463-386-3_30

Toilet construction must be built with the concept of turning human waste into organic fertilizer. With this problem the team from Politeknik Negeri Sriwijaya (Polsri) designed an organic toilet (Torganic) and make organic fertilizer.

Politeknik Negeri Sriwijaya through the Center for Research and Community Service (P3M Polsri) with several research and service activities together with Pertamina ROKAN HULU IV carried out the construction of an organic (Torganic) toilet and make organic fertilizer at Shuji Lake.The formulation of the problem of this research is: What is the effect of fertilizing organic fertilizer from organic toilet waste on food crops on plantations in the Lake Shuji tourist village?. The aim of objective research is to determine the effect of fertilizing organic fertilizer from organic toilet waste on food crops on plantations in the Lake Shuji tourist village.

2. Organic fertlizer

The area of swamp land in Indonesia is around 34.12 million Ha and South Sumatra is 3.08 million Ha. Swamp land has great potential as a resource for farming food crops, vegetables and fruit[1]. Swamp land areas can be used as agricultural land by developing development potential. The land in Lembak Village has a swamp structure, so it is a challenge to use it as agricultural land. The problem with swamp land is nutrient deficiency, so one of the efforts that can be made is through land management by planting food crops. Plants that have been planted need fertilizer. Organic fertilizer is fertilizer derived from organic materials, such as dry leafts, and rice dusks, which are then applied to plants. pH, the elements N, P, and K are elements needed by plants. LOF is a fertilizer produced through a fermentation process with a microbial starter. Making microbial starter is done by fermenting organic materials which are added with rice husks, dry leaves, human waste and water for 3 weeks. Application of fertilizer can improve the chemical, physical and biological properties of the soil, as well as the taste of the plant itself. One of the manufacturing techniques is using fertilization techniques. Bokashi is an environmentally friendly fertilization technology to reduce the use of inorganic fertilizers and is expected to increase alkaline elements in the soil. Bokashi resulting from fermentation of cow dung, goat dung and rice husks contains 1.22% N, P, K, Na, Ca and Mg; 0.53%; 1.71%; 5.64%; 0.62%; 2.01% [2]

3. Design an Organic (TORGANIC) Toilet

This organic design functions as a toilet and the waste can also be used as organic fertilizer which will be used by the residents of Lake Shuji, in Lembak Village.

Fig 3 and 4. Result of organic fertilezer and handover of organic toilets

4. Method

4.1 Tools and materials

The tools used in this research are glass bottles (Pyrex), glassware (Pyrex), pycnometer (Pyrex), magnetic stirrer, hotplate (Heindolph), orbital shaker (Wincom HY-4C), analytical balance (Memmert), and, oven (Memmert). The materials used in this study were rice husk distilled water, phosphate buffer pH 7, methanol, ecoenzyme

4.2 Work procedures

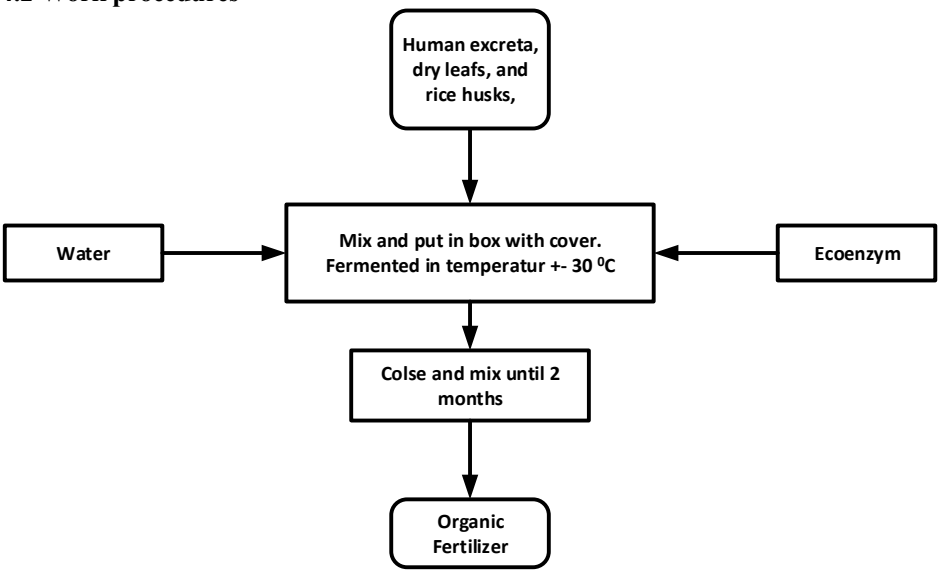

Fig 5. Mechanism of The Fermentation Process of Human Excreta into Fertilizer

5. Results And Discussions

In this research, the process of making organic fertilizer was carried out using anaerobic fermentation processing. Anaerobic fermentation processing has more potential for handling human waste and dry leaves and rice husks have high organic material characteristics [3]. In this research, the fermentation process was carried out by varying the time and fermentation in the process of making organic fertilizer. The following are the results of the analysis of the initial content of organic fertilizer before the anaerobic fermentation processing process is carried out, which can be seen in Figure 6

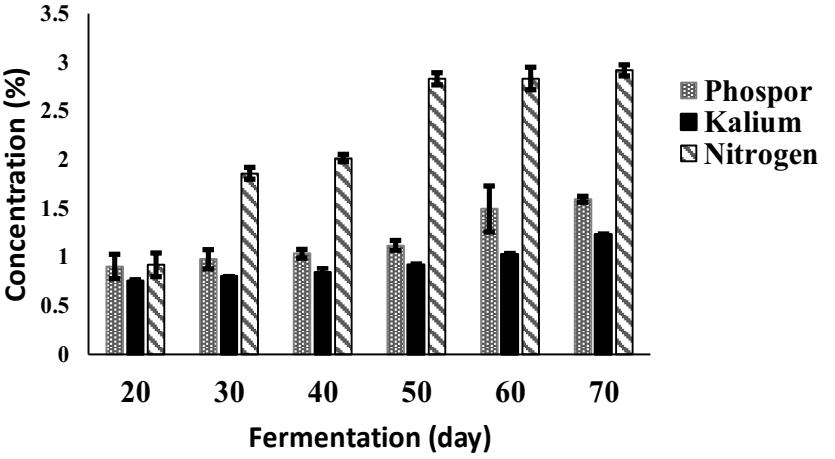

Fig 6. Effect of Fermentation Time in % concentration of Nitrogen Phosphorus and Kalium

5.1Nitrogen content

Nitrogen (N) is an essential macro nutrient that is needed for plant growth. Nitrogen in liquid organic fertilizer functions to construct proteins that function in plant metabolism which in turn stimulates cell division and elongation [4]. From Figure 6 it can be seen that the nitrogen content after the anaerobic fermentation process was carried out ranged between 1-2.92 % from 10-70 days fermentation. The results of the analysis in this research show that the nitrogen levels obtained in this research still exceed the organic fertilizer standards set based on Minister of Agriculture Regulation No.28/Permentan/OT.140/2/2009 where the required standard is < 2% . Providing excess nitrogen will result in very rapid vegetative growth, the color of the leaves will become dark green, and they will be more fertile, which will cause the plants to be susceptible to pests and disease. From Figure 6 it can also be seen that the lowest nitrogen content is in sample 1, where sample 1 is a sample that only contains output from the fermentation digester. Nitrogen levels will increase as the time of the fermentation[5]

5.2 Phosphorus content

The element Phosphorus (P) in plants functions in the formation of flowers, fruit and seeds and accelerates fruit ripening. Providing adequate amounts of P elements can improve seed quality including germination potential and seed vigor . The results of the analysis of phosphorus levels after processing using anaerobic fermentation can be seen in Figure 6. From Figure 6, the phosphorus levels for samples ranged from 0.76-1.59%, from 10-70 days fermentation.

Phosphorus levels in organic fertilizer in this study have met the quality standard requirements for organic fertilizer based on Minister of Agriculture Regulation No.28/Permentan/OT.140/2/2009, namely <2%. The phosphorus content value is very small. Based on Junus (1998), biogas output only has a phosphorus content value of 0.02%.. Element P is also a very important substance but is always in a deficient state. Element P is very important as a source of energy (ATP). Therefore, P deficiency can inhibit plant growth and metabolic reactions. To increase the P content in fertilizer, during the process of making organic fertilizer, materials rich in P can be added, such as bone meal [4]

5.3 Potassium content

Potassium (K) plays a role in the formation of proteins and carbohydrates, hardening the woody parts of plants, increasing plant resistance to disease, and improving the quality of seeds and fruit [6] The results of the analysis of potassium levels after processing using anaerobic fermentation can be seen in Figure 6.

From Figure 6, the potassium levels for samples with 10-70 days fermentation ranged from 0.71-1.23%. The potassium levels obtained in this research also meet the standards set based on Minister of Agriculture Regulation No.28/Permentan/OT.140/2/2009, namely < 2%. The potassium element is really needed by plants because plants that lack the K element will experience symptoms. dryness of leaf tips, especially old leaves. The dry tip will spread further to the base of the leaf. Sometimes it looks like the plant is not getting enough water. Lack of element K in fruit plants affects the sweet taste of the fruit

6. Conclusion

The long-term goal is to develop this production so that the land in the Shuji Lake tourist area becomes fertile and the business for development adds economic value to the community. Optimizing organic fertilizer production by utilizing raw materials from natural waste will add economic value. This organic fertilizer will add to the agricultural industry by utilizing waste to return to the green industry. The development of the results of this research will certainly have an influence on Pertamina Rokan Hulu IV partners who support research innovation so that research will run smoothly.

7. Acknowledgement

To the Politeknik Negeri Sriwijaya who have helped in funding collaboration research in 2023, as well as Pertamina EF2 Prambumulih

References

[1] I. Peningkatan and P. Sumberdaya, "LAPORAN TAHUNAN BBSDLP 2020," 2020.

[2] S. A. A. El-hamied, "Effect of multi-ingredient of Bokashi on productivity of mandarin trees and soil properties under saline water irrigation," vol. 7, no. 11, pp. 79–87, 2014.

[3] J. Spångberg, P. Tidåker, and H. Jönsson, "Environmental impact of recycling nutrients in human excreta to agriculture compared with enhanced wastewater treatment," *Sci. Total Environ.*, vol. 493, no. 2014, pp. 209–219, 2014, doi: 10.1016/j.scitotenv.2014.05.123.

[4] F. Häfner, O. R. Monzon Diaz, S. Tietjen, C. Schröder, and A. Krause, "Recycling fertilizers from human excreta exhibit high nitrogen fertilizer value and result in low uptake of pharmaceutical compounds," *Front. Environ. Sci.*, vol. 10, no. January, pp. 1–21, 2023, doi: 10.3389/fenvs.2022.1038175.

[5] M. E. Kelova, S. Eich-Greatorex, and T. Krogstad, "Human excreta as a resource in agriculture – Evaluating the fertilizer potential of different composting and fermentation-derived products," *Resour. Conserv. Recycl.*, vol. 175, no. June, p. 105748, 2021, doi: 10.1016/j.resconrec.2021.105748.

[6] L. Krounbi, A. Enders, H. van Es, D. Woolf, B. van Herzen, and J. Lehmann, "Biological and thermochemical conversion of human solid waste to soil amendments," *Waste Manag.*, vol. 89, pp. 366–378, 2019, doi: 10.1016/j.wasman.2019.04.010.