

Identification of Waste Processing Methods in Bersinar Waste Bank Bandung, West Java

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Abstract

The bersinar waste bank is one of the waste management units in Bandung. The bersinar waste bank is a solution to reduce waste generation at the sarimukti TPA, Bandung. Waste managed by the bersinar waste bank is in the form of organic and inorganic waste. This study aims to identify the methods of processing waste and processing products at the bersinar waste bank in Bandung. This research is a qualitative research. The stages of this research are problem identification, literature review, determination of research aims and objectives, data collection, data analysis and interpretation, and reporting. This research data collection is divided into two, namely primary data (observation) and secondary data obtained from books or scientific journals (literature review). The results of the identification of waste processing methods at the bersinar waste bank can be concluded that the bersinar waste bank uses physical, biological and thermal methods. The first method to reduce waste is to process organic waste using maggot technology as a decomposer of organic waste into compost. the second method is the use of a bottle press to produce a cube of bottle waste. The third method is processing used baby diaper waste using a hydrothermal reactor machine and processing it into fiber to produce pockbrick.

Keywords

Waste Management, Organic, Inorganic, Waste Bank

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1. INTRODUCTION

One of the obstacles faced by developing countries in the world is waste problems (Bhuiyan, 2010; Caniato et al., 2015; Davies, 2005; Ezeah and Roberts, 2014; Howell, 2017; Louise Bjerkli, 2013; Nzeadibe and Anyadike, 2012; Warslawsky, 2015). In Indonesia, the issue of waste has become a serious concern of the government in the past ten years (Pasang et al., 2007; Zurbrugg et al., 2012). This can be seen from the various efforts made by the government to reduce the figure of waste production, which is estimated to increase from year to year. Basically solid waste is something that is attached to the community. Solid waste is also a serious threat to society, because throwing solid waste carelessly can cause environmental pollution. This is stated in law number 18 of 2008 concerning waste management (Undang-Undang, 2008). The increasing volume of the garbage was not balance with the waste management program. Still many communities manage their garbage traditionally and do not consider the impact on the environment (Ejaz and Janjua, 2012).

For those who throw waste indiscriminately that will

damage the environment and cause human health problems, they will be given a sanction in the form of imprisonment for three months or a maximum fine of 50 million rupiah. Solid waste can be broadly divided into two types, namely organic waste in the form of leaves and food waste and inorganic waste in the form of plastic waste. Organic waste is the largest composition of waste generation every day. This can trigger environmental problems, one of which is flooding (Subandriyo et al., 2012). Most waste bank programs are easy to find in South East Asia Countries. An example is in Thailand, family members of waste banks could get funeral assistance as an incentive of the program (Challcharoenwattana and Pharino, 2015). Waste bank program raised awareness of the importance of recycling (Alias et al., 2019).

West Java Province is one of the Provinces that often experiences flooding when it rains. Bandung is one of the areas in West Java that has the highest level of flooding. Floods in West Java Province are caused by two factors, namely the lack of proper waste management and the overflow of the citarum river due to the accumulation of waste in the citarum river (Sekarningrum, 2017). Therefore, it is necessary to manage waste starting from sorting the types

of waste. The cause of the waste separation has not been carried out properly, including the lack of public awareness to care about the environment and manage waste (Kurniaty et al., 2016).

To reduce the growth in the amount of waste, especially in urban areas, it is necessary to manage household waste. Waste management can be done by establishing a waste bank. The waste bank is a waste management innovation that has benefits for the environment, economy, and social empowerment. The establishment of a waste bank is a real manifestation of citizens in social activities where in these activities the community plays a role in reducing waste in their environment (Pratama and Ihsan, 2017; Shahreza et al., 2020). Waste bank began to develop in various Cities in Indonesia such as in Bantul (2008), Malang (2011), Surabaya (2010), Gresik (2012), Cilacap (2012), Barat (2012) and growing to almost every City and Regency in Indonesia. It was a good effort, especially in managing waste problems. Waste bank teaches people to sort the waste, raising public awareness to process waste wisely in order to reduce waste going into landfill (Asteria and Heruman, 2016; Wulandari et al., 2017).

Integrating the waste bank program into municipal solid waste management is predicted decrease greenhouse gas emissions (Raharjo et al., 2016). The integration is not limited to environmental approaches, but also social and economic approaches (Satori et al., 2018).

The implementation of waste banks in Indonesia has shown very positive results. From year to year, waste banks continue to grow and develop throughout Indonesia. As of July 2020, the number of waste banks in Indonesia has reached 11,330, consisting of 11,088 unit waste banks and 242 main waste banks (Usis, 2021).

There are many studies or research on waste banks, such as the optimization of the kanci bersinar waste bank which is located in Bandongan District, Magelang Regency. The waste bank was created with a nutrition garden program in the waste bank environment and created a waste bank management application. Through the efforts to optimize the waste bank that has been carried out, it can increase public awareness about the role of the waste bank (Maimunah et al., 2020).

Beside in Magelang, Kepanjen District will have three main outputs from waste bank. The first output is getting the fertilizer for agriculture. It helps the farmer to fill their desires in farm activity. The second output is getting foodstuff and the last program is paying the electricity. The third output from these scenarios will give the contribution for community life and government in Kepanjen District (Purba et al., 2014).

The implementation of the central waste bank program in Paropo Village, Panakukang District, Makassar City has been going well and has its own advantages for its customers. The forms of the waste bank program in the waste bank are: (1) Borrowing business unit. (2) Sembako business unit,

namely the community can exchange waste for basic necessities while keeping the environment clean from waste. (3) Business capital loans, namely with waste, the community can also borrow capital from a waste bank with a note that the return is divided in two from the results of the business and it can also be from the sale of waste (Rosmita, 2020).

The bersinar waste bank, which is part of the Yayasan Solusi Bersinar Indonesia, is a private company engaged in waste processing. Bersinar waste bank was established in 2014 as one of the unit waste banks located in Baleendah District, Bandung. The bersinar waste bank received 70 types of waste consisting of organic waste, inorganic waste and other residues. In addition, the bersinar waste bank has several waste processing methods such as processing waste with a press, processing organic waste with BSF flies (maggot) and processing used baby diapers with a hydrothermal reactor machine. The purpose of this study is to identify waste processing methods at the bersinar waste bank and to identify waste processed products at the bersinar waste bank.

2. EXPERIMENTAL SECTION

This research is a qualitative research. The stages of this research are problem identification, literature search, determining the aims and objectives of the research, data collection, data analysis and interpretation, reporting (Creswell, 2002). The research was supposed to be carried out for a month but was constrained by the covid 19 pandemic, so the research was carried out for 2 months, namely at the bersinar garbage bank located at Bojongsoang Canal Street No. 174A, Baleendah District, Bandung, West Java. The research method consists of 3 stages, namely literature study, data collection, and data analysis stage. The data collection of this research is divided into 2, namely primary data obtained directly in the field by interviewing participants at the bersinar waste bank and secondary data obtained from books or scientific journals (literature review) as additional research information. The analysis or interpretation stage of the data in this study was in the form of text and images obtained from direct field observation (Creswell, 2002).

3. RESULTS AND DISCUSSION

3.1 The Existing Condition of The Bersinar Waste Bank

All bersinar waste banks are main waste banks owned by the Yayasan Solusi Bersinar Indonesia, which are located at Bojongsoang Canal Street No. 174A, Baleendah District, Bandung, West Java, with a land area of ± 3 hectares (Figure 1) (Kusumawati et al., 2019).

Currently, the bersinar waste bank already has more than 1200 active customers. Bersinar waste bank has implemented a special industrial waste processing program, namely responsible waste management and extended producer responsibility. The bersinar waste bank implemented

Table 1. The Amount of Waste that is Processed at The Bersinar Waste Bank

Month	Number of Customers (Person)	Amount of Waste Processed (Kg)
April		28,229.8
May	1200	26,927.8
June		48,866.5
	Total	104,024.1

**Figure 1.** Bersinar Waste Bank

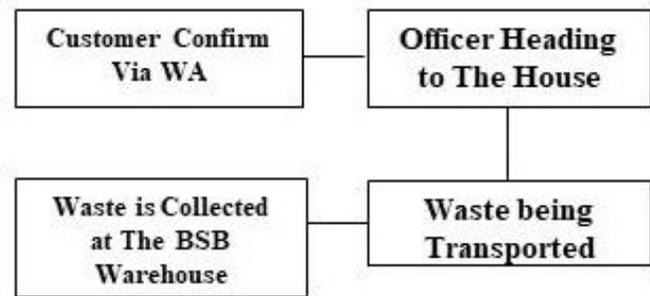
a new paradigm in terms of waste management, namely by reducing waste that is integrated from upstream to downstream. This is in accordance with the law of the Republic of Indonesia No. 18 of 2008 concerning waste management. Waste management at the bersinar waste bank is currently considered the most effective because waste management starts from the source first, namely by sorting waste according to its type, namely organic, inorganic, and residual waste, each of which requires different actions.

The bersinar waste bank already has several waste processing installations, including processing plastic bottle waste presses, processing maggots and processing used baby diapers. In mid-2021, the bersinar waste bank has \pm 1200 customers. Every month, \pm 50 tons of waste that enters the bersinar trash bank consists of organic waste (rotten vegetables and fruit) and inorganic waste (plastic bottles, used baby diapers). From April to June 2021, the bersinar waste bank is able to process \pm 104 tons of waste consisting of organic and inorganic waste. The following Table 1 is the amount of waste generated at the bersinar waste bank:

The waste bank has also implemented the house waste management system, which is picking up trash from residents' homes that have been confirmed in advance and according to the intended route. The flow of waste collection can be seen in Figure 2.

3.2 Waste Management

Waste management is a complicated process because it involves technology and many aspects need to be involved.

**Figure 2.** Waste Collection Flow

The technologies involved in waste management are waste generation control, handling, storage, collection, transfer, transportation, processing and disposal of waste. All these aspects need to work together in order to implement good waste management. According to [Damanhuri \(2008\)](#) before law 18 of 2008 was issued, urban waste management policies (issued by the Ministry of Public Works) in Indonesia positioned that urban waste management was a system consisting of 5 subsystem components, namely: regulations/laws, institutions and organizations, operational technical, financing, and community participation.

Waste processing technology is generally divided into 3 categories, namely technology based on physical, biological and thermal processing. Waste processing technologies based on physical processes include: compacting, shredding, pulping, granulating, roll crushing, refused derived fuel (RDF). Biological process based waste processing technologies include: composting, anaerobic digestion (AD), landfill gas recovery (LFG). Thermal processing based waste processing technologies include: incineration, pyrolysis, and gasification ([dan Pelatihan, 2018](#)). Some of the waste processing methods that are part of the program at bersinar waste bank are: plastic bottle press waste processing, maggot processing, used baby diaper treatment.

3.2.1 Plastic Bottle Press Waste Processing

The bersinar waste bank is one of the waste recycling industries that uses the plastic bottle press method. Plastic waste to be recycled is first collected at the bersinar waste bank warehouse. Then the plastic bottle trash is cleaned of dirt attached to the waste. Furthermore, the waste is sorted

according to the color and type of bottle (for example, blue and white) and then pressed until solid using a hydraulic press and then sold. The flow of waste processing can be seen in Figure 3.

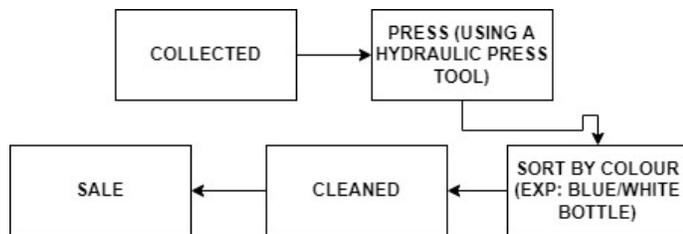


Figure 3. Plastic Bottle Press Waste Processing Flow

The bersinar waste bank presses 12 sacks of plastic bottle waste every day. The results of the press show that 6-7 balls/cubes of plastic bottle waste have been pressed (Figure 4). Every week, the waste will be sent to PT. Langgeng Jaya Plastindo and PT. Hadtex by using trucks.



Figure 4. Plastic Bottle Hydraulic Press Tool

According to research Putra and Wahid (2021) this press machine is able to reduce the volume of plastic waste which originally took up quite a lot of land, namely 4 m² with a total weight of 221 kg. The use of this machine, which is capable of processing each press, is able to press up to 50 kg with a dimension of 1 m², which means that from 221 kg it only becomes 4 times of pressing. Utilization of plastic waste so that it can be processed further by reducing the mass of the plastic waste.

3.2.2 Maggot Processing

Maggot is one of the organisms that can break down into the organic waste. Maggot will breed into flies called black

soldier flies (BSF) (Figure 5). BSF flies are insects that can be used as animal feed because they contain high protein and friendly environmentally. BSF will reproduce by laying eggs and forming a prepuppa that resembles a cocoon which will turn into a maggot. Maggot will decompose until organic becomes compost (Monita et al., 2017).



Figure 5. Maggot

The bersinar waste bank conducts maggot cultivation using a special room for maggot breeding. The area of maggot cultivation in the bersinar waste bank is about 42 m². In the decomposition of organic waste into compost, maggot requires organic waste as food to grow. The process of decomposing organic matter into compost carried out by maggot lasts for 25 days until the compost is ready for harvest. Maggot has the ability to decompose organic waste 2 to 5 times its body weight for 24 hours. One kilogram of maggot can consume 2 to 5 kg of organic waste per day (Nugraha et al., 2018).

BSF is a fly (*Diptera*) which belongs to the stratiomyidae family. This fly can be found in tropical and subtropical areas (46°-42° South Latitude). The life cycle (see Figure 6) consists of five phases namely egg, larva, prepupa, pupa and adult which lasts about 38-41 days. Adult female flies will lay eggs about five to eight days after exiting the pupa and generally can lay up to 500 eggs per head. The eggs will hatch into larvae in approximately 4.5 days (± 105 hours).

The numbers listed in the schematic indicate the length of time for BSF development in each stage of its metamorphosis in days. BSF larvae have a high growth rate and optimal feed conversion and can make good use of various types of materials as food sources including organic materials that are considered useless such as household waste in general, and kitchen waste, vegetable waste, fruit waste, waste food

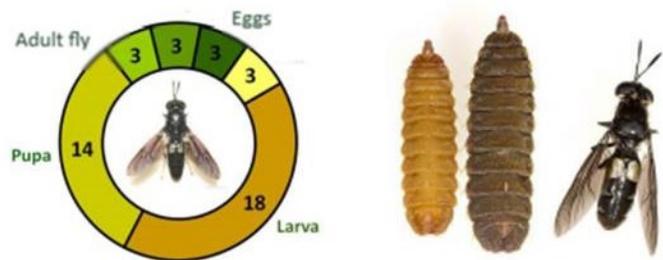


Figure 6. Maggot Cycle

processing, and livestock waste in particular. BSF larvae can consume food rapidly ranging from 25 mg to 500 mg of fresh material per larva in one day and can reach a length of ± 27 mm, a width of about 6 mm and a weight of up to 220 mg at the end of the larval stage (± 14 days) (Mutia et al.).

Within two to four days, the eggs will hatch into larvae and develop within 22-24 days with an average of 18 days (Wardhana, 2016). Judging from its size, the newly hatched larvae from the eggs are approximately 2 mm in size, then grow to 5 mm. After molting, the larvae develop and grow larger with a body length of 20-25 mm, then enter the prepupa stage. Female larvae that are in the media longer will have a heavier weight than male larvae. Naturally, the prepupa will leave the feed medium to a dry place, then make a tunnel to avoid predators (Wardhana, 2016). The average female pupa weight is 13% heavier than the male pupae weight (Wardhana, 2016). After 14 days, the pupa develops into an adult fly (imago). Two or three days later the adult flies are ready to mate (Wardhana, 2016).

How to cultivate maggot is fairly easy. In maggot cultivation, what is needed is a BSF fly cage which functions as a place for BSF to mate and produce eggs until hatching. The cage is covered with wire or gauze and placed in a place exposed to sunlight. For laying eggs for female BSF flies, it is necessary to prepare cardboard, wood, or boards that have gaps. Put the eggs in the hatching media in the form of a box or small container. The eggs will hatch in 3-4 days. Finally, prepare a shelf or biopond for the maggot enlargement. Maggot processing at the bersinar waste bank is currently quite good, but there is one problem that arises, namely the supply of organic waste that is still lacking. Finally, the workers took the initiative to look for additional inorganic waste in several markets near the bersinar waste bank such as baleendah market, tonggeng market and tugu baleendah sunday market.

3.2.3 Used Baby Diaper Treatment

The bersinar waste bank cooperates with PT. Guna Olah Waste (GOL) in terms of processing used baby diapers using an environmentally friendly hydrothermal engine or without the combustion method, the used diapers are the first processed into fiber and plastic. Then, the fiber is

processed into pokbricks, planting media and materials for making opaque paper. Figure 7 is the result of processed baby diaper waste in the form of fiber.



Figure 7. Fiber used Baby Diapers

The waste of used baby diapers collected in the bersinar waste bank must be in a clean condition with no dirt (faeces) on the diapers. The hydrothermal reactor is a technology used by the bersinar waste bank in processing used baby diapers into pokbricks, planting media and materials for making opaque paper (see Figure 8).



Figure 8. Hydrothermal Reactor

The bersinar waste bank collaborates with octopus (a mobile application for garbage collection) in terms of collecting used baby diaper waste by recruiting conservationists (people who take baby diapers to people's homes) to help distribute used baby diapers from people's homes to the drop box (a temporary collection place for used baby diapers). One drop box that is quite well managed is in the terminal ledeng area, Cidadap District, Bandung City (see

Figure 9).



Figure 9. Drop Box Ledeng Terminal

After being collected at the drop box, every day (working hours) the officer will pick up the waste of used baby diapers with a max capacity. 300 kg/day/drop box to be sent to the used baby diaper processing unit inside the bersinar waste bank. For more details can be seen in Figure 10.

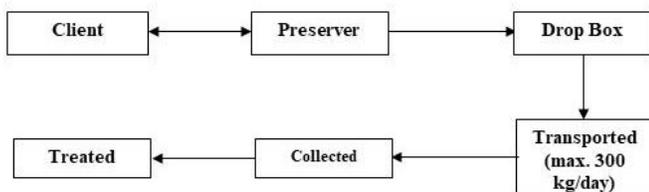


Figure 10. Waste Transport Scheme

Arriving at the bersinar waste bank, the officers will put the baby's used diapers into the hydrothermal reactor machine which has been turned on first at 200°C. The waste of used baby diapers to be inserted is mixed with \pm 40 liters of water and processed in a hydrothermal reactor tube by boiling. The boiling process takes 1.5-2 hours.



Figure 11. The Final Result of The Hydrothermal Reactor Engine

After boiling, the officer will open the hydrothermal reactor tube to separate the used baby diaper fiber from the used baby diaper waste water. This process cannot be

seen by the general public because the hydrothermal reactor engine is still in the testing phase (Figure 11). Then later the fiber will be mixed with cement to make bricks (Figure 12).



Figure 12. Pokbrick

Based on research Pasaribu et al. (2020) related to the use of baby diaper waste as a mixed material for making paving blocks, the resulting compressive strength is good, which is at least 35 MPa. What is obtained is paving block based on SNI 03-0691-1996. The use of baby diaper waste as a mixture of paving blocks has no effect on water absorption and does not meet quality standards.

4. CONCLUSIONS

Based on the results of the identification of the waste processing methods at the bersinar waste bank, it can be concluded that the bersinar waste bank uses physical, biological and thermal methods. The biological treatment method used is waste processing using maggot in the decomposition of organic waste, the thermal treatment method is the use of hydrothermal reactor technology in processing baby diaper waste and the physical waste processing method is the use of a bottle press tool in the formation of a plastic bottle waste cube to reduce the volume of waste plastic. The processed products found in the bersinar waste bank are biologically compost fertilizer, thermally bricks from baby diapers or pokbricks, and physically are cube press bottles and economic value is also obtained from selling fresh maggot to farmers around the waste bank location.

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