ASTONJADRO: CEAESJ

pISSN 2302-4240
eISSN 2655-2086

Volume 11, Issue 2, June 2022, pp.405-417
DOI: http://dx.doi.org/10.32832/astonjadro.v11i2

DETERMINATION OF CARBON EMISSIONS WITH A GREEN MANUFACTURING APPROACH

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ABSTRACT

A green manufacturing approach on bakso aci will contribute to UMKM in finding out the origins of environmental waste. This research aims to identify the origins and type of environmental waste in the production process of bakso aci Sekar at UMKM Sekar Group Bogor. The method used for this research is a calculation with mass balance and the emission with the calculator carbon footprint. The data collection process is conducted by observation and interview with the related person in UMKM Sekar Group Bogor. The waste identification results show that environmental waste was found in the production of bakso aci sekar. The results show that environmental waste generated is CO_2 emission with a total of 0.17874 tons/month, water with a total of 10.5 Liters/month, material with a total of 0.482 Kg/month, and waste with a total of 0.5184 Kg/month. Identifying environmental waste with a green manufacturing approach will provide information for UMKM Sekar Group Bogor to discover the origins of environmental waste in their production process.

Keyword: green manufacturing; emission; UMKM, meatball; material.

Received:	Revised:	Accepted:	Available online:
2022-02-01	2022-05-10	2022-05-11	2022-05-15

INTRODUCTION

Growth in the manufacturing or service industry sector is currently overgrowing. This growth has an impact on market competition in the industrial world. Competition occurs on a national and international scale. The industry competition requires various companies, both manufacturing and service companies, to increase their productivity. The productivity of each company is the driving wheel for running a company (Nurseto, 2012). The higher the level of productivity carried out by a company, the company shows good performance in managing its production (Priscilia, 2017). Furthermore, related to the growth of the industrial sector, at the national level, growth in the industrial sector of the Indonesian MSME scale has achieved a significant increase. The development of the industrial sector is evidenced by the emergence of various MSMEs (Micro-Middle Class) currently in Indonesia (Halim, 2020; Tanael et al., 2021). Referring to data from the Central Statistics Agency (BPS) in 2019, the number of MSME actors in Indonesia reached 4.1 million (BPS, 2019). Growth in the industrial area opens up opportunities for MSME actors to always provide ideas and innovations in realizing developments in their business (Tanael et al., 2021).

In addition to the problems of competition and productivity in the industrial world, environmental problems are currently also one of the biggest challenges. The industry continuously develops production systems but has a significant negative impact on environmental quality (Widodo, 2017; Rimantho and Ardinia, 2020). The problem of global warming is increasing day by day (Riphah, 2015; Haines and Reichman, 2008). Furthermore, environmental pollution in the form of water, soil, and air will affect human health, the loss of biodiversity and the economic sector will also be affected by the environmental damage caused. Systems in industrial areas are slowly evolving to upgrade in awareness of the environmental risks posed. Industrial competition activities that are efficient move from being potentially harmful to the environment to being potentially optimal (Anas et al., 2008). An industrial system can be called an environmentally friendly industry if it can minimize or even eliminate the results of green waste on the production floor (Indrasti & Fauzi, 2009; Rimantho and Athiyah, 2019.). Aspects that need to be considered in green waste management include energy, water, materials, waste, transportation, emissions, and biodiversity (Deif, 2011; Kaczmarek et al. 2021).

This environmentally friendly industrial system can be applied on various industrial scales, large, small, and medium, such as the research results by Dyah Ika et al. (2013) at the Batik Puspa Kencana UKM lead a sustainable batik industry. Syarief et al. (2018), in the potential application of clean production in the Diponegoro bread industry, provides the results of a source of environmental wastage on the production line of the bread industry. In Jaka Darma et al. (2018), it is stated that identifying environmental waste using a mass balance can improve the production process in terms of processing raw materials, working atmosphere, and industrial cleanliness. It can be seen that the application of an environmentally friendly industrial system can be applied anywhere, including meatball aci products. Regarding meatball aci, meatball aci is the latest traditional culinary business (Erica et al., 2021) developing among the community. Bakso Aci provides a new sensation in the culinary world and is one of the newest business innovation ideas. The rise of the meatball aci culinary business has significantly impacted business competition, especially the aci meatball culinary.

One of the business players for the meatball aci product is the Sekar Group Bogor SMEs. MSME Sekar Group Bogor has a meatball product called Bakso Aci Sekar (BOCIKAR). The UMKM produces various aci meatball fillings such as chicken, corned beef, mozzarella cheese, and beef sausage meatballs, which make the meatball aci Sekar (BOCIKAR) product. The existence of demand for products from consumers requires SMEs Sekar Group Bogor to carry out the production process to meet consumer demand. However, the Sekar Group Bogor SMEs are still very simple and traditional in its production activities. The simple and traditional nature of the production process triggers environmental waste activities in energy use and raw material processing. This has an impact on increasing the amount of energy and waste from the production of Bakso Aci Sekar (BOCIKAR). So far, there has been no research on waste (environmental waste) in SMEs processing aci meatballs. So based on the description of the problem, the purpose of this study is to analyze the source of waste generation (environmental waste) and the types of waste in the production of aci sekar meatballs in the Sekar Group UMKM, Bogor.

RESEARCH METHODS

The research method used in this study is a green manufacturing approach. Furthermore, this research also uses primary data in the form of interviews, direct observations in the field, and data processing and analysis. The stages of this research were carried out by observing and identifying the production process of meatballs (BOCIKAR), the use of raw materials, tools and production machines used, energy, and water, as well as calculating the input-output process using a mass balance. To calculate the CO2 emissions generated in the output process, a carbon footprint calculator application (https://www.carbonfootprint.com/calculator.aspx) is used which is accessed online on a browser by entering data on electrical energy use in kWh units and LPG gas usage in liters.

RESULT AND DISCUSSION

The process of identifying waste in the production of meatballs (BOCIKAR) is divided into 4 components due to the different processing processes for each component in one meatball product (BOCIKAR). The four components include the meatball component, the filling for the meatball variant, the meatball seasoning, and the meatball topping.

The mass balance calculation process is carried out on the meatball component. The flow chart of the production process is shown in Figure 1. Mass Balance of the Components of meatballs. In order to conduct of the calculation of the mass balance of the material flow of the component, it was carried out through several stages of the process. The results of generating sources and environmental wastage in the form of CO2 emissions of 0.04049 tons/month from the use of electricity and LPG gas, the remaining 10.5 liters/month of water use which comes from the water left over from washing and boiling aci meatballs, 0.3 Kg/month of material wasted from the remaining meatball dough that is not brittle and destroyed in the cooking process, and the resulting waste is 0.0384 Kg/month from the rest of the waste plastic wrapping the raw materials used.

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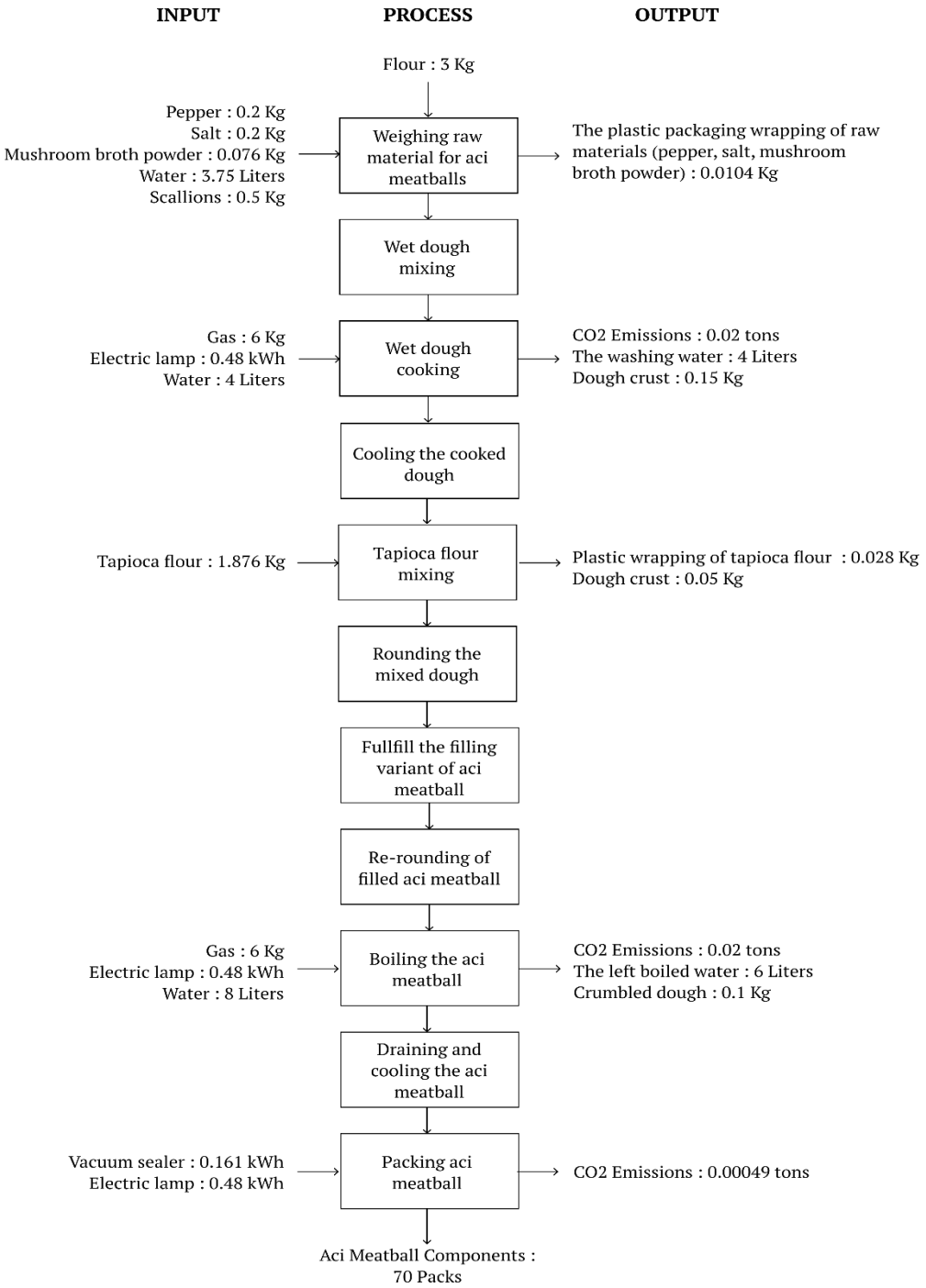

Figure 1. Mass Balance of Meatball Components

Meatball Variant Stuffing Components

The mass balance calculation process is carried out on the components of the meatball variant stuffing. Calculation of material flow is done by dividing into four different variants due to

differences in processing. The four variant fillings are chicken, corned beef, mozzarella cheese, and beef sausage meatballs.

a. Corned beef

The results of the environmental waste of the Mass Balance on the corned beef variant can be seen in Figure 2.

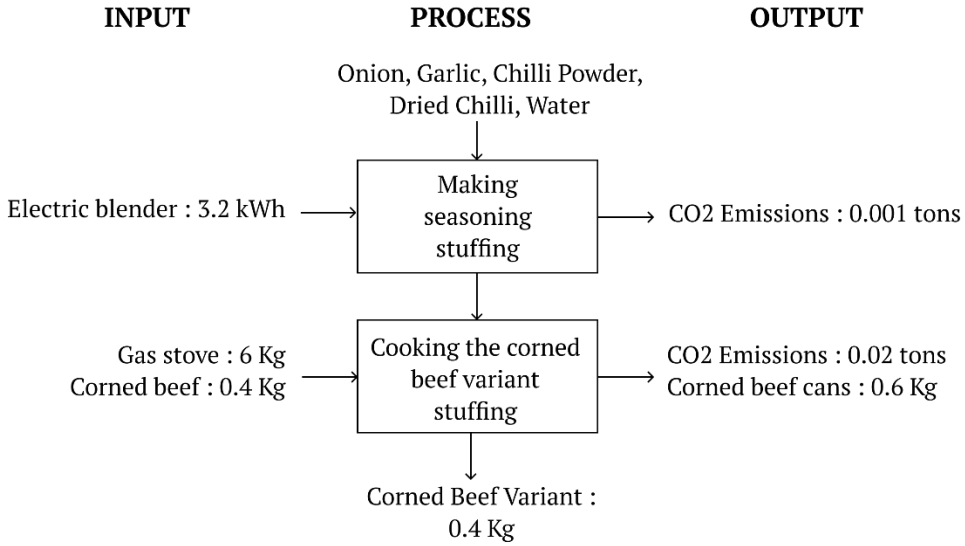

Figure 2. Mass Balance with Corned Variants

In the corned beef variant, the source of the generator and the resulting environmental waste are found. The results of generating sources and environmental waste are in the form of CO2 emissions of 0.04 tons/month from the use of electricity and LPG gas and 0.6 kg/month of waste from used corned beef cans.

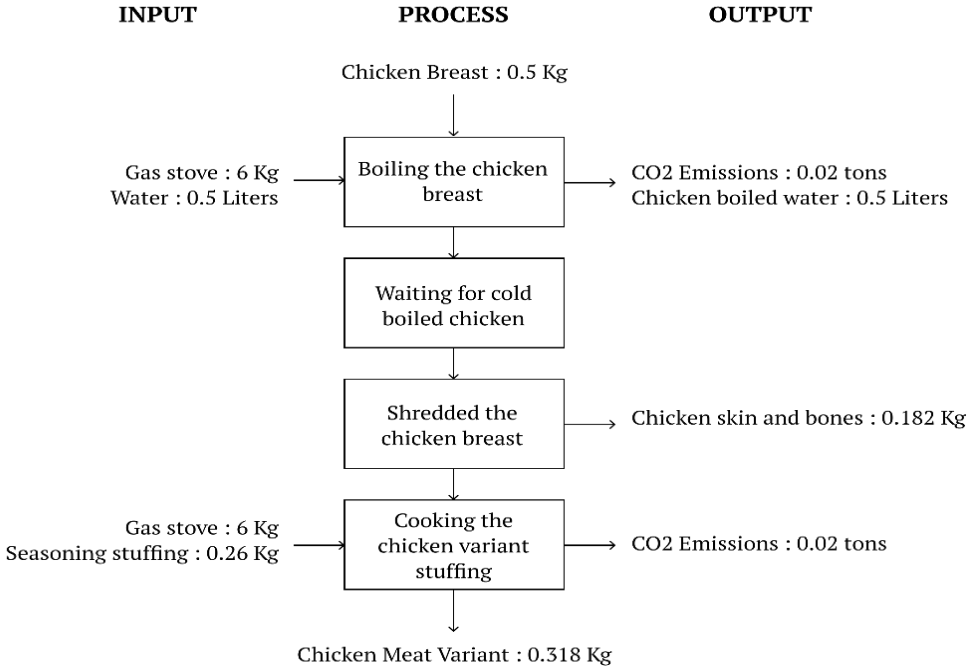

Figure 3. Mass Balance of Chicken Meat Stuffing

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b. Chicken meat

The results of environmental waste in the chicken variant stuffing can be seen in Figure 3. Mass Balance of Chicken Variant Stuffing. In the component of the chicken variant, the source of the generator and the resulting environmental waste are found. The results of generating sources and environmental waste are CO2 emissions of 0.04 tons/month from LPG gas, 0.5 liters/month of chicken boiled water, and 0.182 kg/month of chicken skin and bones.

c. Mozzarella Cheese

The results of environmental waste in the mozzarella cheese variant can be seen in Figure 4. Mass Balance for the Mozzarella Cheese Stuffing.

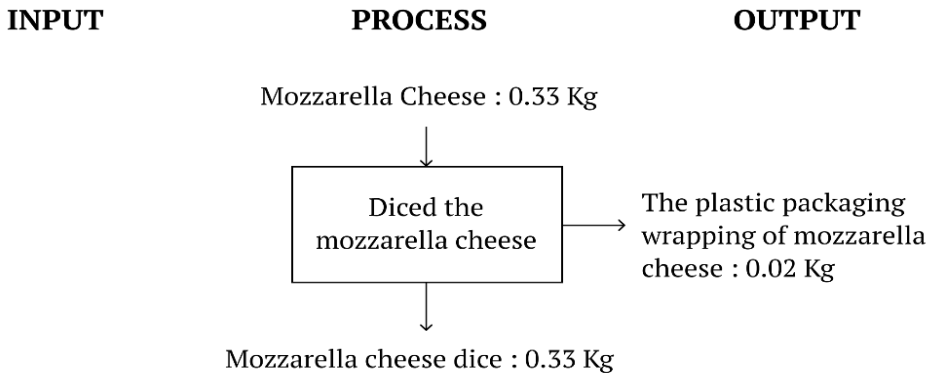


Figure 4. Mozzarella Cheese Stuffing Mass Balance

In the filling component of the mozzarella cheese variant, the source of the generator and the resulting environmental waste are found. The result of generating sources and environmental waste in the form of plastic waste wrapping mozzarella cheese is 0.02 Kg/month.

d. Beef Sausage Meatballs

The results of environmental waste in the meatball variant can be seen in Figure 5. Mass Balance for the Beef Sausage Meatball Variant.

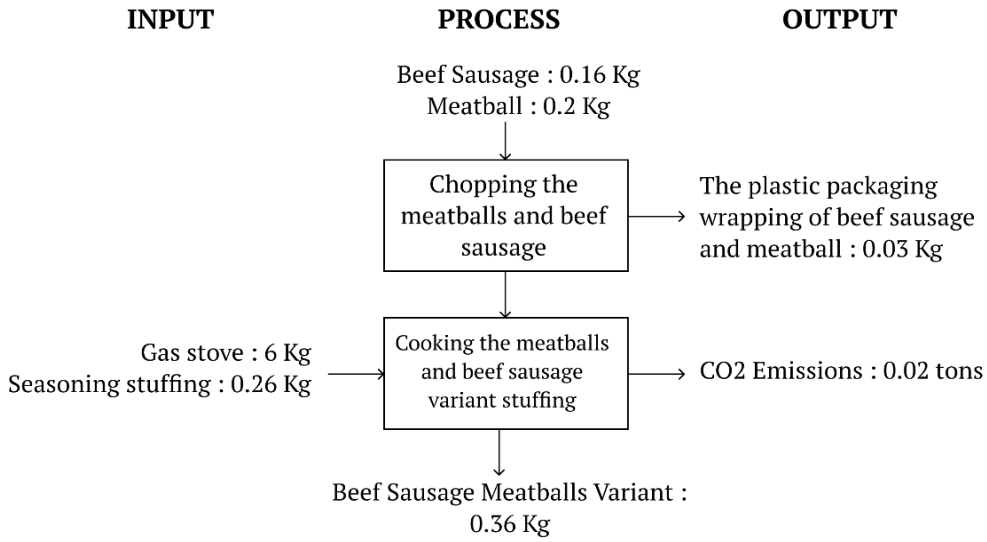


Figure 5. Mass Balance of Beef Sausage Meatball Variants

In the filling component of the meatball and beef sausage variants found the source of the generator and the resulting environmental waste. The results of generating sources and environmental waste

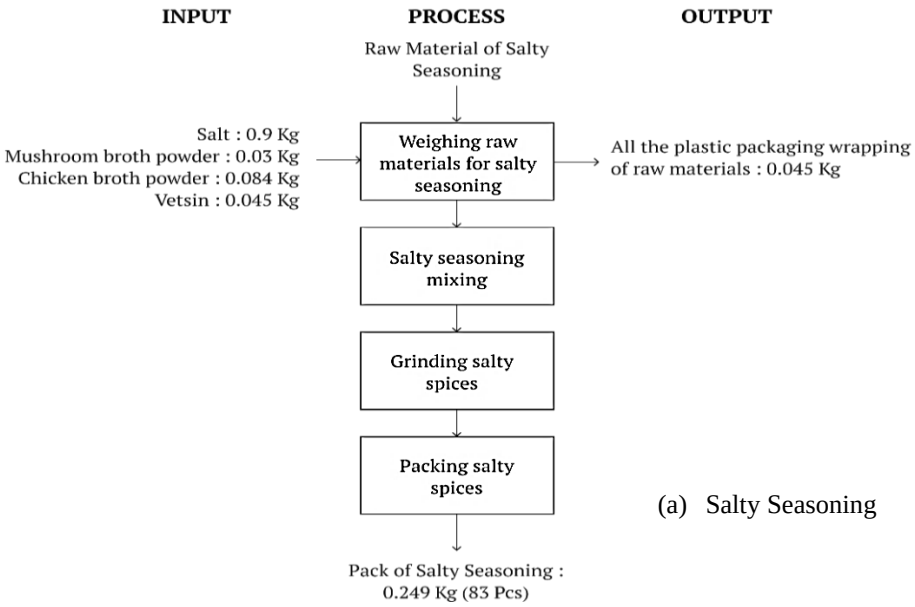
are in the form of CO2 emissions of 0.02 tons/month from LPG gas and the rest of the plastic packaging for meatballs and beef sausages of 0.03 Kg/month.

Meatball Seasoning Components

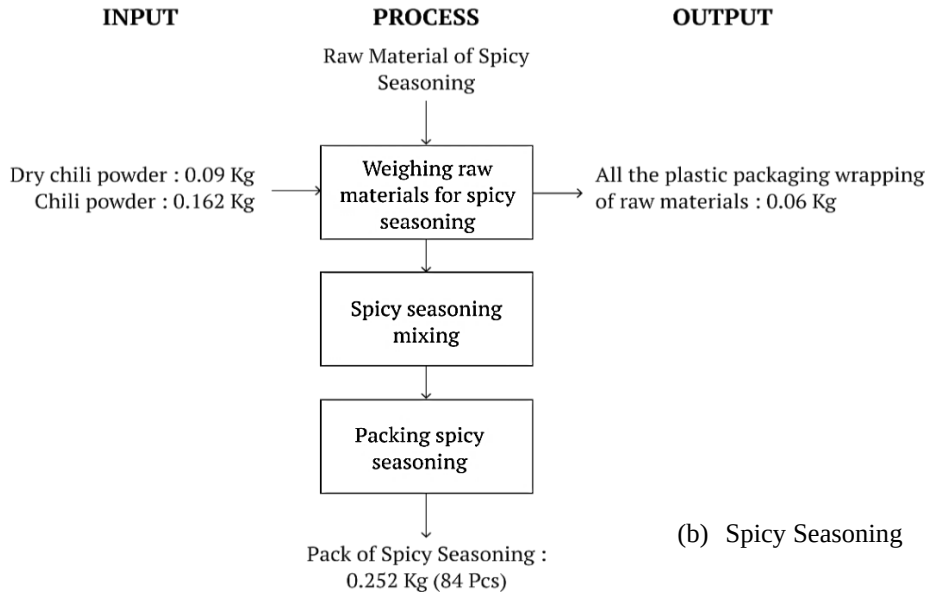
The mass balance calculation process is carried out on the components of the meatball seasoning. To see the calculation of the mass balance of the material flow component of the meatball seasoning, it is divided into 3 seasoning products, namely salty spices, spicy spices, and onion oil.

a. Salty Seasoning

The results of environmental waste in the manufacture of salted meatballs aci are shown in Figure 6a. Salted Seasoning Mass Balance.



(a) Salty Seasoning



(b) Spicy Seasoning

Figure 6. Mass Balance of Salted and Spicy Seasonings

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eISSN 2655-2086
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In the salted meatball component, the source of the generator and the resulting environmental waste are found. The results of generating sources and environmental waste in the form of plastic waste packaging for raw materials for salted spices are 0.045 Kg/month.

a. Spicy seasoning

The results of environmental waste in making spicy meatball aci are shown in Figure 6b. Spicy Seasoning Mass Balance.

In the meatball spicy seasoning component, the source of the generator and the resulting environmental waste are found. The result of generating sources and environmental wastage in the form of plastic waste packaging for raw materials for spicy spices is 0.06 Kg/month.

b. Onion Oil

The results of environmental waste in the manufacture of meatball onion oil are shown in Figure 7. Mass Balance of Onion Oil.

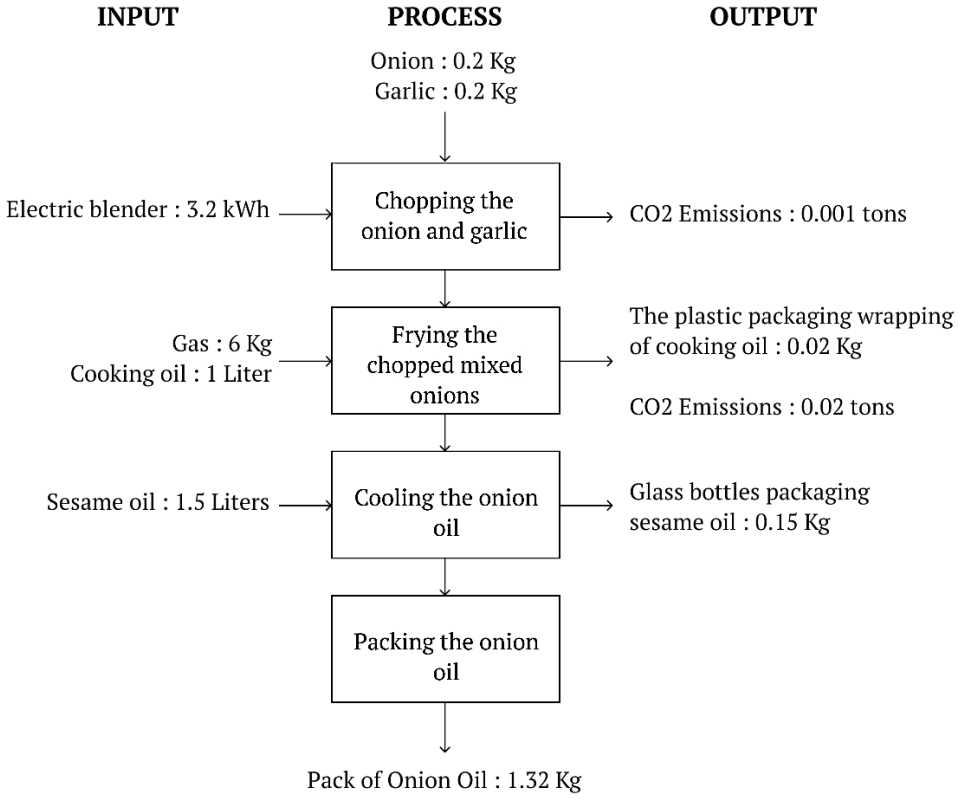

Figure 7. Onion Oil Mass Balance

In the meatball onion oil component, the source of the generator and the resulting environmental waste are found. The results of generating sources and environmental waste in the form of CO2 emissions of 0.04 tons/month originating from the use of electricity and LPG gas and waste from plastic waste packaging cooking oil and glass bottles packaging sesame oil of 0.17 Kg/month.

Aci Meatball Topping Components

The mass balance calculation process is carried out on the topping component of aci meatballs. To determine the mass balance calculation of the material flow of the meatball topping component, it can be seen in Figure 8. Mass Balance of the Meatball Topping Component.

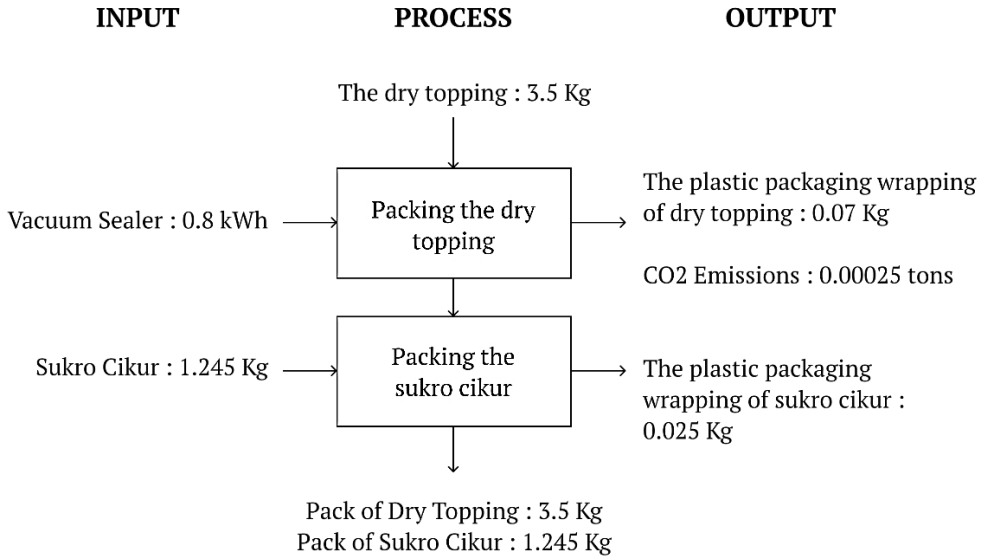

Figure 8. Mass Balance of Meatball Topping Components

In the aci meatball topping component, it is found the source of the generator and the resulting environmental waste. The results of generating sources and environmental waste in the form of waste originating from the rest of the plastic packaging wrapping raw materials are 0.095 Kg/month and 0.00025 tons/month of CO2 emissions

Recapitulation of Meatball Production Waste Results

Based on the results of calculations for each component of the meatball product (BOCIKAR) using a mass balance, the results of the calculation of the amount of waste are summarized in tabular form to facilitate the calculation of the overall environmental waste resulting from the production of Meatballs (BOCIKAR). The results of the summary of the environmental waste can be seen in Table 1. The summary of the results of the BOCIKAR Waste below.

Table 1. Recapitulation of BOCIKAR Waste Results

No.	Activity Process	Environmental Waste						
		Energy	Emission	Water	Materials	Waste	Transportation	Biodiversity
		Aci Meatball Component						
1.	Weighing raw material for aci meatballs	-	-	-	-	0.0104 Kg	-	-
2.	Wet dough mixing							
3.	Wet dough cooking		0.02 tons	4 Liters	0.15 Kg	-	-	-
4.	Cooling the cooked dough	-	-	-	-	-	-	-

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5.	Tapioca flour mixing	-	-	-	0.05 Kg	0.028 Kg	-	-
6.	Rounding the mixed dough	-	-	-	-	-	-	-
7.	Fullfill the filling variant of aci meatball	-	-	-	-	-	-	-
8.	Re-rounding of filled aci meatball	-	-	-	-	-	-	-
9.	Boiling the aci meatball	-	0.02 tons	6 Liters	0.1 Kg	-	-	-
10.	Draining and cooling the aci meatball	-	-	-	-	-	-	-
11.	Packing aci meatball	-	0.00049 tons	-	-	-	-	-
Total Watse of Aci Meatball Component		-	0.04049 tons	10 Liters	0.3 Kg	0.0384 Kg	-	-
Aci Meatball Variant Stuffing Component								
12.	Making seasoning stuffing	-	0.001 tons	-	-	-	-	-
13.	Cooking the corned beef variant stuffing	-	0.02 tons	-	-	0.06 Kg	-	-
14.	Boiling the chicken breast	-	0.02 tons	0.5 Liters	-	-	-	-
15.	Waiting for cold boiled chicken	-	-	-	-	-	-	-
16.	Shredded the chicken breast	-	-	-	0.182 Kg	-	-	-

17.	Cooking the chicken variant stuffing	-	0.02 tons	-	-	-	-	-
18.	Chopping the meatballs and beef sausage	-	-	-	-	0.03 Kg	-	-
19.	Cooking the meatballs and beef sausage variant stuffing	-	0.02 tons	-	-	-	-	-
20.	Diced the mozzarell a cheese	-	-	-	-	0.02 Kg		
Total *Waste of* Meatball Variant Stuffing Component		-	0.099 tons	0.5 Liters	0.182 Kg	0.11 Kg	-	-
Aci Meatball Seasoning Component								
21.	Weighing raw materials for salty seasoning	-	-	-	-	0.045 Kg	-	-
22.	Salty seasoning mixing	-	-	-	-	-	-	-
23.	Grinding salty spices	-	-	-	-	-	-	-
24.	Packing salty spices	-	-	-	-	-	-	-
25.	Weighing raw materials for spicy seasoning	-	-	-	-	0.06 Kg	-	-
26.	Spicy seasoning mixing	-	-	-	-	-	-	-
27.	Packing spicy seasoning	-	-	-	-	-	-	-
28.	Chopping the onion and garlic	-	0.001 tons	-	-	-	-	-
29.	Frying the chopped	-	0.02 tons	-	-	0.02 Kg	-	-

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	mixed onions							
30.	Cooling the onion oil	-	-	-	-	0.15 Kg	-	-
31.	Packing the onion oil	-	-	-	-	-	-	-
Total Waste of Aci Meatball Seasoing Component		-	0.039 tons	-	-	0.275 Kg	-	-
Aci Meatball Topping Component								
32.	Packing the dry topping	-	0.00025 tons	-	-	0.07 Kg	-	-
33.	Packing the sukro cikur	-	-	-	-	0.025 Kg	-	-
Total Waste of Aci Meatball Topping Component		-	0.00025 tons	-	-	0.095 Kg	-	-
Accumulation Waste of BOCIKAR Product Component		-	0.17874 tons	10.5 Liters	0.482 Kg	0.5184 Kg	-	-

From the four components in the production of meatballs (BOCIKAR) it can be seen that the production process causes environmental waste. With a total environmental waste of all components of 0.17874 tons/month of CO2 emissions, 10.5 liters/month of water, 0.482 kg/month of materials, and 0.18 kg/month of waste. The amount of environmental waste produced shows that it can potentially affect the quality of the surrounding environment.

In the waste results, the type of CO2 emissions produced can have an impact and have the potential to cause air pollution. The decrease in oxygen in the ozone layer can be caused by the disposal of CO2 emissions. The size of the resulting CO2 emissions will still have an impact on air quality, especially around the MSMEs.

Furthermore, the type of waste water is also generated in the production process. Disposal of water that is not treated first, especially the absence of a clear water disposal area will have an impact on the quality of water in the soil. Water pollution will cause water quality to decrease and tend to be contaminated with raw materials contained in it.

This type of waste material is also generated in the meatball production process. The resulting material waste will have an impact on the level of productivity carried out by the company. The resulting material is a dough crust when the dough is cooked and the dough is destroyed in the boiling process. The remaining dough crust will be wasted free of charge, reducing the size of the dough produced. The reduced dough will affect the output of the meatball product that will be produced later. In addition, the crushed dough in the boiling process also causes some meatball

products to not pass the quality because they are destroyed. It can also be concluded that it will affect the number of aci meatball output products that can be sold to the market.

The last type of waste generated from the production process is solid waste. Solid waste generated in the production process is in the form of plastic and wrapping materials for raw materials. The plastic waste produced is directly disposed of in the trash without any further processing. The accumulation of plastic waste produced by MSMEs will be one of the contributors to the volume of world plastic waste. This is very influential on the increase in plastic waste in the future, although the volume produced in the production of MSMEs in Sekar Group Bogor is not large, but it will still have an impact on the accumulation of waste..

CONSLUSION

Based on the results of the research on the waste identification process in the meatball product process (BOCIKAR) at the Sekar Group UMKM, Bogor, it can be concluded that the source and form of environmental waste resulting from the meatball production process (BOCIKAR) is 0.17874 tons/month of CO2 emissions from the use of LPG gas, LED lights , as well as tools and machines that use electricity. 10.5 liters/month of water from the rest of the water from the washing and boiling process. The material is 0.482 Kg/month which comes from the rest of the aci meatball dough which is not smooth and crumbles. The last is the type of waste waste as much as 0.18 Kg/month which comes from the rest of the plastic wrapping of raw materials, wrapping glass bottles, and cans used to wrap corned beef. The value of the resulting environmental waste can have an impact on the surrounding environment. The results of this study can be used as reference and evaluation material for similar meatball culinary business people.

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