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SURVEY AND ANALYSIS OF WASTE COMPOSITION IN KHON KAEN MUNICIPALITY, KHON KAEN PROVINCE

Chawalit Hongyon^{1*}, Chulaporn Sota², and Kasom Chanawongse³

^{1,2}Faculty of Science and Technology, College of Asian Scholars, Thailand ³President of a University, College of Asian Scholars, Thailand *Corresponding Author, E-mail: chawalit@cas.ac.th

Abstract

The composition of waste often varies according to era, climate, season, socio-economics, lifestyle, habits, and consumption patterns of people in each community. The composition of waste shows the origin of each type of waste. In order to study the composition of waste generated in Khon Kaen Municipality, Khon Kaen Province, a survey and analysis of waste composition was conducted using the Quartering Method. The survey and analysis of the composition of solid waste of Khon Kaen Municipality, Khon Kaen Province, was conducted to obtain information on the quantity and composition of waste so that relevant agencies can use this information to plan waste management, determine guidelines, policies, and consider selecting appropriate and efficient waste management methods.

Keywords: Composition, Municipality Solid Waste, Quartering Method

Introduction

From the past to the present, the amount of waste generated in the world has a tendency to increase all the time. The amount of waste generated every day comes from humans, whether from the expansion of cities and the increase in population, the production processes of industrial plants, agriculture, including the way of life, eating and using behavior of humans today, which uses more plastics and is often single-use plastics. The various activities that occur have a direct effect on the generation of waste in each type and can be separated into the components of waste. The components of waste often vary according to the era, climate, season, economics, society, lifestyle, habits, and consumption patterns of people in each community. The components of waste show the origin of each type of waste and from the change of eras. Khon Kaen Municipality is located in Mueang Khon Kaen District. There are a total of 95 communities in the area. Khon Kaen Municipality is mostly a trading center, hotel businesses, and department stores, and is a large urban community. As a result, the amount of waste generated consists mostly of organic waste, followed by recyclable waste, due to the population size, various business operations, and human behavior. Khon Kaen Municipality is a municipality that has grown in terms of economy, society, and culture that has changed. Human behavior has resulted in a problem with solid waste, which is important to the social conditions, lives, and livelihoods of people living in Khon Kaen Municipality. Therefore, a study was conducted on the solid waste that occurs in the municipality, the collection of solid waste by the municipality, and the management of solid waste by Khon Kaen Municipality in order to use it as a guideline for managing waste appropriately for each type of waste that occurs.



Research Objective

1. To study the amount of waste and the composition of waste in Khon Kaen Municipality

2. To provide guidelines for waste management that is appropriate for each type of waste generated

Literature Review

In the separation of waste components of Khon Kaen Municipality, the following data was studied to implement the project:

- 1. Waste volume of Khon Kaen Municipality, 2022-2024
- 2. Waste composition separation method by dividing into 4 (Quartering)
- 3. Analysis of chemical characteristics of waste
- 4. Types of waste
- 5. Laws related to waste management in Thailand

1. Waste volume of Khon Kaen Municipality, 2022-2024

Month/Voor	Month of Waste Volume (Tons)					
Month/Year	2022	2023	2024			
January	5,044.58	5,152.60	4,896.45			
February	4,513.92	4,808.64	4,650.08			
March	5,026.15	4.892.28	5,053.98			
April	4,684.17	4,836.13	4,307.80			
May	5,887.68	5,190.18	4,357.23			
June	5,347.52	4,760.70	5,392.01			
July	5,316.12	5,496.88	5,251.93			
August	5,754.03	5,706.30	5,539.76			
September	5,377.47	5,085.33	5,370.29			
October	5,157.14	5,259.44	5,647.65			
November	4,806.09	4,975.24	5,041.15			
December	5,271.43	5,079.22	4,985.42			
Avg./day	172.26	167.79	165.28			

Table 1: Shows the amount of waste in Khon Kaen Municipality

2. Waste composition separation method by dividing into 4 (Quartering) Quartering method

The analysis of waste composition by Quartering Method is done by combining

waste from each source by municipal waste collection trucks. Then, the collected waste is piled together and mixed thoroughly by using a backhoe (front-loading and back-digger type). Then, a backhoe is used to scoop up 1 scoop of waste to analyze the composition of waste. Then, all waste is divided into 4 parts and 2 parts of waste in opposite directions are selected to represent all waste and then separated to find the proportion of waste composition. The details of the waste composition analysis are as follows:

- 1. Collect waste samples from waste collection trucks of Khon Kaen Municipality
- 2. Cut large waste into smaller pieces
- 3. Mix waste together
- 4. Divide waste into 4 parts (Quartering)



5. Select 2 piles of waste on opposite sides and mix them together. The remaining waste is thrown out of the pile

- 6. Mix and remix the selected piles
- 7. Divide waste into 4 parts (Quartering)
- 8. Select 2 piles of waste on opposite sides from the previous selection
- 9. Repeat steps 6-8 until approximately 100 cubic meters of waste is left
- 10. Sort the physical composition of the waste

3. Finding the composition of Waste

Finding the composition of waste is important because it is an analysis to find a way to manage waste appropriately. The analysis of the composition of waste is divided into 3 parts: physical analysis, chemical analysis, which involves taking a sample of waste after finding the physical composition, and analyzing the chemical composition and biological composition.

1. Analysis of Physical Characteristics of Waste

Analysis of physical characteristics of waste (Phudungton, 2018) by taking waste from waste sampling by the Quartering method to analyze normal density and analyze physical composition of waste (Composition) with details as follows:

1.1 Calculation of normal density of waste (Bulk density)

Prepare equipment: 100-liter drum, scale, and random sample of waste. The study procedure to find the normal density of waste will randomly select the sorted waste and put it in a 100-liter drum that has been weighed empty. Scoop the waste into the drum until it is full. Then lift it about 1 foot from the ground and drop it to the ground about 3-4 times to compress the waste and refill it with new waste until the drum is full. Then lift it and drop it to the ground again. Repeat until the drum is full and no more compression occurs. Then weigh all the waste in the drum (actual weight of waste = total weight of waste in the drum - weight of the empty drum). Use the recorded data to calculate the normal density of the waste using the formula:

Normal density (kg/L) = Total mass of waste (kg)/Total volume of waste (L)

The benefits of finding the normal density of waste are: it is used to estimate the size of the area to be used for landfill, calculate the life of the landfill site, and estimate the capacity and number of collection trucks and bins that must be purchased to be sufficient for the amount of waste generated.

1.2 Analysis of physical composition of waste (Composition) (Phudungton, 2018) by taking waste from waste collection trucks, mixing all the waste until it becomes a single substance, and then starting the process of sampling waste using the Quartering method.

When the waste sample group is obtained, a loader will be used to mix all the waste until it is homogeneous and piled in a cone shape. Then the waste sampling process begins by dividing the waste into 4 parts (Quartering) and selecting 2 parts of waste on opposite sides to be combined and mixed again using a loader to assist in the work. The remaining 2 parts will be removed from the group. This is repeated in this manner until there is approximately 80-100 kilograms of waste remaining in the pile.

Analysis of the physical composition of waste (Composition). Waste separation from approximately 80 - 100 kilograms of sample waste obtained from random mixing. Quartering will be sorted by weighing each type of waste and finding the average and calculating the percentage, which can be divided into 12 types because it is a large amount of waste, as follows: food scraps, plastic, paper, cloth, glass, metal, wood/leaves, stones, tiles, rubber, leather, hazardous waste, and others.



2. Analysis of Chemical Characteristics of Waste.

It consists of the analysis of moisture content, calorific value, total nitrogen content, sulfur content, carbon content (C), hydrogen content (H), and oxygen content (O).

2.1 Moisture content refers to the amount of water present in waste. Generally, the amount of water present in waste includes both the water within the waste itself (Inherent water), such as water in plants, vegetables, food scraps, which is approximately 1/3 to 2/3 of the total water amount, and water attached to the outside (Attached water), such as rainwater, water coming out of food scraps, which is approximately 1/3 to 2/3 of the total water amount.

Moisture is the amount of moisture lost after drying a solid sample at 105 °C for 1 hour. It is generally expressed as the amount of moisture in the waste per mass of the waste.

Moisture content of waste (%) = $\frac{\text{(W-D) X 100}}{\text{W}}$

Where W = weight of collected waste (kg) D = Weight of waste after drying at 105 degrees Celsius (kg)

2.2 Calorific value means the amount of heat obtained from burning waste, which will be used to consider the selection of disposal methods, especially whether the incineration method is appropriate or not. Since waste has a calorific value lower than 800 kilocalories/kg of waste, fuel must be used to assist in burning, which is wasteful. In addition, the calorific value of waste is used as information in designing incinerators and related equipment.

2.3 Total Nitrogen Content

Nitrogen content refers to the amount of nitrogen in a waste sample, which is mostly in the form of Organic-Nitrogen or Ammonia-Nitrogen.

Calculation N = ((A-B)xnx14x100/C)

Where N = percentage of nitrogen content

A = Volume of Sulfuric acid standard solution used to titrate the waste sample (ml)

B = Volume of Sulfuric acid standard solution used to titrate Blank (ml)

C = weight of waste sample (mg)

N = Normality of standard solution Sulfuric acid (N)

2.4 Sulfur content

It is a method to determine the amount of sulfur in the form of sulfate by the Turbidimeter Method by measuring the turbidity of barium sulfate (BaSO4) that occurs.

Calculation of sulfur content (percentage by dry weight) = $(\frac{\text{micrograms per liter of sulfur read from graph x 25x50 x 100}}{(106x \text{ sample weight (grams) x volume of solution (ml)})}$

2.5 Carbon content (C) of solid waste

The amount of carbon (C) of solid waste can be calculated using the formula: Carbon (percent by dry weight) = Volatile solids content /1.8 Carbon refers to the component of waste that is carbon. The unit is %. By weight unit, the calculation formula is:



$$C = \frac{V}{18}$$

Where C = Carbon (% by weight) V =Volatile solid (% by weight) on Dry basis

2.6 Hydrogen (H) content of waste

The amount of hydrogen (H) in solid waste can be calculated using the formula: Hydrogen (percent by dry weight) = Volatile Solids/16

Hydrogen refers to the composition of waste that is hydrogen, expressed in % by weight. The calculation formula is:

$$H = \frac{V}{16}$$

Where H = Hydrogen (% by weight) V = Volatile solids (% by weight) on a Dry basis

2.7 Oxygen (O) content of waste

The amount of oxygen (O) can be calculated from the equilibrium calculation as follows:

Oxygen (percentage by dry weight) = Volatile Solids – (Carbon + Hydrogen + Nitrogen + Phosphorus + Sulphur)

4. Types of waste

The Waste and Hazardous Substance Management Office (2012) has classified community waste into 4 types according to physical characteristics:

1) Compostable waste or biodegradable waste is waste that rots and decompose quickly and can be used to make fertilizer, such as vegetable scraps, fruit peels, food scraps, leaves, meat scraps, etc., but does not include remains or scraps of plants, vegetables, fruits, or animals that are produced from laboratory experiments. Biodegradable waste is the most common type of waste, accounting for 64% of all waste in garbage piles.

The Pollution Control Department, Ministry of Natural Resources and Environment (n.d.) defines the term biodegradable waste as waste that naturally decompose and/or can be used to make fertilizer, such as food scraps, animal feces, remains or scraps of plants, vegetables, fruits, or animals, but does not include remains or scraps of plants, vegetables, fruits, or animals that are produced from laboratory experiments.

2) Recyclable waste or waste that can still be used is packaging waste. Or waste materials that can be reused, such as glass, paper, plastic scraps, UHT beverage boxes, beverage cans, scrap metal, aluminum, tires, etc. For this recyclable waste, it is the second most common type of waste in the garbage pile, which is about 30% of the total amount of waste.

(Ministry of Public Health Regulations on General Waste Management, 2017) "Recyclable waste" means general waste that can be reused or used to produce new products.

The Pollution Control Department, Ministry of Natural Resources and Environment (n.d.) defines the term "recyclable waste" as waste that can be reused to produce new products through industrial production processes, such as scrap metal, glass, plastic, paper, etc.

3) Hazardous waste or hazardous waste is waste that contains or is contaminated with various types of hazardous substances, including explosives, flammable substances, oxidizing substances,



toxic substances, pathogenic substances, radioactive substances, substances that cause genetic changes, corrosive substances, and substances that cause irritation. Other substances, whether chemicals or other substances, that may cause harm to people, animals, plants, property or the environment, such as batteries, fluorescent lamps, mobile phone batteries, containers containing pesticides, spray cans containing paint or chemicals, etc. Hazardous waste is the least common type of waste, accounting for only about 3% of the total amount of waste in garbage piles. Pollution Control Department, Ministry of Natural Resources and Environment (n.d.) Hazardous waste means waste that contains or is contaminated with hazardous substances. According to the Hazardous Substances Act of 1992, there are 10 types:

- 1. Explosives
- 2. Flammable substances
- 3. Oxides and peroxides
- 4. Toxic substances
- 5. Disease-causing substances
- 6. Radioactive substances
- 7. Substances that cause genetic changes
- 8. Corrosive substances
- 9. Substances that cause irritation

10. Other substances that may affect the quality of the environment or may cause harm to people, animals, plants or property, such as fluorescent lamps, batteries or mobile phone batteries, containers used to contain insecticides or weed killers. Spray cans containing paint or chemicals, etc.

4) General waste or general waste is waste other than biodegradable waste, recyclable waste, and hazardous waste that is difficult to decompose and not worth reusing, such as plastic wrappers for snacks, plastic bags for detergent, plastic wrappers for candy, instant noodle packets, plastic bags stained with food scraps, food-stained foam, food-stained foil, etc. For general waste, it is waste that is similar in quantity to hazardous waste, that is, it will be found at approximately 3% of the total amount of waste in the garbage pile.

The Pollution Control Department, Ministry of Natural Resources and Environment (n.d.) defines the term general waste as waste that is difficult to decompose or may decompose naturally, but is not worth the cost of reusing it to be made into a new product through industrial production processes, such as ready-to-drink milk cartons, foam, vacuum-sealed food bags or pouches, heat-pressed consumer goods bags or pouches, etc.

(Association for the Development of Environmental Quality, n.d.) There are 4 types of waste that are generally classified:

1. Organic waste It is something that can be easily decomposed, such as food scraps, vegetables, fruits, grass, leaves, branches, plant remains, animal remains, etc.

2. Recyclable waste is something that is still useful and can be reprocessed and reused, such as paper, plastic, glass, metal, UHT beverage cartons, cans, and CDs, etc.

3. Hazardous waste is something that contains or is contaminated with hazardous substances, toxic substances, corrosive substances, infectious substances, and flammable substances, such as batteries, fluorescent lamps, toilet cleaner bottles, and spray cans, etc.

4. General waste refers to other things besides the above that can be reused, but are difficult to decompose and are not worth reprocessing and reusing, such as scraps of cloth, scraps of leather, instant noodle packets, snack wrappers, etc.



5. Laws related to waste management in Thailand (Wichai Tho Suwannachinda, 2015) There are 3 important laws related to waste management:

1. Environmental Quality Promotion and Conservation Act B.E. 2535 This Act was enacted to prevent problems of environmental quality deterioration, such as soil pollution, wastewater pollution, air pollution, and destruction of forests and trees by encouraging the public and private organizations to participate in promoting and maintaining environmental quality. It also stipulates the powers and duties of government agencies, state enterprises, and local governments, as well as guidelines for areas where no agency is directly responsible. This Act establishes national environmental standards for the quality of water, groundwater, coastal seawater, air, noise and vibration levels, and other environmental standards. It also establishes an environmental fund to support waste management systems for government agencies, state enterprises, and the private sector, with the Ministry of Natural Resources and Environment as the responsible party under this Act. Although this law mentions environmental problems, it does not directly focus on waste management.

2. Public Health Act B.E. 2535 This law has principles for protecting the public in terms of environmental hygiene and health or sanitation, by giving the Minister of Public Health the authority to issue ministerial regulations to establish principles. Criteria, methods and measures for public health supervision and setting standards for living conditions suitable for people's livelihoods, and procedures for inspecting, controlling, supervising or correcting things that will affect living conditions suitable for people's livelihoods, and specifying types of businesses that are hazardous to health, as well as stipulating the authority of local administrative organizations to collect, transport or dispose of waste or garbage in the area, having the authority to issue local regulations for enforcement in the local area in order to enforce the law, including the authority to issue fines to those who cause public health problems that affect the environment and public health. This Act was amended in 2007, stipulating that local governments have the authority to collect, transport or dispose of waste or garbage in their jurisdiction, which may be done in conjunction with other government agencies or local governments or allowing any person to act on their behalf under the supervision of the local government. It also gives local governments the authority to set a fee rate for providing waste or garbage collection services not exceeding the rate specified in the ministerial regulations. Although this law emphasizes waste management, it is a solution at the end, not starting from the beginning in a comprehensive manner. 3. The Cleanliness and Orderliness of the Country Act B.E. 2535 is a law that focuses on controlling individual behavior in maintaining cleanliness and orderliness. It is mostly a public order or public road, but does not cover the entire waste management process. This law contains important points such as specifying that the owner or possessor of a building or area of a building adjacent to the sidewalk is responsible for maintaining the cleanliness of the sidewalk adjacent to the building or area of the building. No one is allowed to bathe or wash anything on the road or public place that is not provided for such purpose, or in the water area that the local officer has announced as prohibited. Advertising by posting, leaving, or scattering notices or leaflets without permission is prohibited. Waste disposal in public places is prohibited. Climbing, sitting, or climbing on fences, walls, trees, or tree supports in public places is prohibited. Installation, drying, placing, or hanging anything in a building in a dirty, messy, or disorderly manner that people may see from public places, etc. Violators will be punished according to the law. In addition, there is the Act on the Decentralization Plan and Procedures for Local Administrative Organizations B.E. 2542, which stipulates that there must be a committee to decentralize power to local administrative organizations. The Prime Minister or Deputy Prime Minister assigned by the Prime Minister is the Chairman of the Board by position, 10 people, 12 representatives of local administrative organizations, and 12 qualified persons are responsible for preparing the decentralization plan for local administrative



organizations and the action plan to request approval from the Cabinet and report to the Parliament, determine the management of the public service system according to the authority and duty between the state and local administrative organizations and between local administrative organizations, including other duties. In Section 16, Pattaya City Municipality and local administrative organizations have the authority and duty to organize the public service system for the benefit of the people in their own local areas, totaling 23 matters, including maintaining the cleanliness and orderliness of the city, disposing of waste, garbage, and wastewater. Section 17 stipulates that provincial administrative organizations have the authority and duty to establish and maintain a combined wastewater treatment system, disposing of waste and garbage, and managing the environment and various types of pollution.

Methodology

The separation of waste elements of Khon Kaen Municipality is carried out with materials, equipment, and project implementation steps as follows:

1. Materials and equipment

- 1.1 Tarpaulin
- 1.2 Scale
- 1.3 Rubber gloves
- 1.4 Mask
- 1.5 Bucket
- 1.6 Black bag
- 1.7 Shovel, rake for mixing waste

2. Project implementation steps

- 1. Study data on the amount of waste of Khon Kaen Municipality
- 2. Randomly sample garbage collection vehicles of Khon Kaen Municipality to perform quartering
 - 3. Quartering to separate waste elements

4. Analyze and summarize the results of the data obtained from the separation of waste elements of Khon Kaen Municipality.

3. Waste composition separation process (Quartering)

- 1. Collect waste samples from waste collection trucks of Khon Kaen Municipality.
- 2. Cut large waste into smaller pieces, mix the waste together.
- 3. Divide the waste into 4 parts (Quartering).

4. Select 2 piles of waste on opposite sides and mix them together. The remaining waste is thrown out of the pile.

- 5. Mix and remix the selected pile of waste, divide the waste into 4 parts (Quartering).
- 6. Select 2 piles of waste on opposite sides from the previous selection.
- 7. Repeat steps 5-6 until approximately 100 cubic meters of waste is left.
- 8. Physically separate the waste composition.

4. Project duration

March 27, 2022 – April 2, 2022 (1 week) Procedures for collecting samples and analyzing the physical components of solid waste samples in Khon Kaen Municipality

The collection and analysis of the physical composition of solid waste samples in Khon Kaen Municipality for a total of 7 consecutive days from March 27-April 2, 2024, were carried out as follows:



1. Randomly collect waste samples from the total waste pile, approximately 1-2 cubic meters, by randomly sampling waste into three piles to analyze three sets of data. Then, the average value is calculated to reduce data error.



Figure 1: Combined waste pil



Figure 2: Random sampling of waste into three piles for analysis to obtain three sets of dat





2. Divide the waste in each sample set into four parts (Quartering).

Figure 3: Each set of waste samples is divided into four parts.

3. Select two piles of waste that are opposite each other and put them together. The rest is discarded outside the pile to obtain approximately 500 liters of the selected waste.



Figure 4: Two waste piles that are opposite each other are selected and put together.

4. Quarter the waste again, selecting two piles of waste on opposite sides from the previous selection. Repeat until you have approximately 125 liters of waste.





Figure 5: Quartering was repeated until the waste volume was 125 liters.



Figure 6: The final volume of waste is approximately 125 liters, which is placed in a measuring tank for separation into components.

5. Approximately 125 liters of waste samples were separated into physical components according to the type of component, such as food scraps, plastics, paper, cloth scraps, wood scraps, metal, tiles, rubber, leather, hazardous waste, etc. (Wet composition)





Figure 7: Separation of the components of each type of waste.

6. The waste sorted by type of waste was weighed for each component. Then, the weight of each type of waste from all 3 sample sets was found to be averaged, and the proportions were compared as percentages of all components from the calculation.



Figure 8: Weighing the components of each type of waste to calculate the results.

7.	Calculati	on me	thod: $(C_i = (W_i \times 100) / W)$
	Where	Ci	= percentage of each type of waste composition
		Wi	= Weight of each type of waste or each component
		W	= total waste sample weight
		Ι	= 1, 2, 3,,n means each type of element.



Operational Flowchart





Results

From studying the data on the total amount of waste in Khon Kaen Municipality, the results of the operation are as follows:

1. Total amount of waste in Khon Kaen Municipality in 2022, 2023 and 2024

In 2022, the total amount of waste was 62,186.30 tons.

In 2023, the total amount of waste was 61,242.94 tons.

In 2024, the total amount of waste was 60,493.75 tons.



Graph 1: shows the amount of waste of Khon Kaen Municipality in 2022-2024

2. The physical composition of waste is separated as follows: from March 27-April 2, 2024

Component	Percentage						
Component	27 Mar	28Mar	29 Mar	30 Mar	31 Mar	1 Apr	2 Apr
1. Organic food scraps/vegetables	52.94	62.64	62.07	50.00	60.50	56.05	66.11
 2. Paper 2. Paper 2. White paper A4/notebook 2. Newspaper 2. Books/ 3. Magazines/Cardboard, Snack 4. Brown corrugated paper 3. Milk/juice box paper 	6.52	5.48	6.88	8.32	4.33	8.39	3.92
 3. Plastic Opaque plastic (PP)/container lids, hot bags, coffee straws, hot plastic cups Clear plastic (PET) Plastic that has a bottom welded together at a point in the 	23.03	20.86	22.35	29.20	24.23	24.99	19.07



Commonwet	Percentage						
Component	27 Mar	28Mar	29 Mar	30 Mar	31 Mar	1 Apr	2 Apr
middle, such as soft drink							
bottles, vegetable oil bottles,							
fish sauce, drinking water,							
toothbrush handles, pill boxes.							
- Plastic (PVC) Plastic with							
the bottom welded together							
into lines, clear drinking water							
bottles, vegetable oil bottles,							
clear boxes for desserts							
- Plastic (PS) clear boxes,							
toys, food trays, ice cream							
cups, rulers							
- Plastic (EPS), foam food							
containers, shockproof foam							
- Plastic (HDPE), opaque							
white-water bottles, shopping							
bags, engine oil bottles, crates,							
shampoo bottles							
- Plastic (LDPE) Ziplock bags,							
cosmetic tubes, cooling bags,							
saline bottle caps							
- Plastic snack bags							
4. Glass							
- Tea colored glass	2 1 2	2 70	1 77	2 70	266	2 22	1.57
- White glass	5.12	2.19	1.//	5.79	2.00	2.32	1.37
- Green glass							
5. Metal							
- Aluminum	0.64	0.28	0.59	0.63	0.44	0.43	0.42
- Steel/coated steel	0.04						
- Copper/Brass							
6. Wood, wooden crates,	1.95	1.29	0.88	1.26	0.83	0.62	1 2 1
branches	1.65	1.20	0.00	1.50	0.85	0.02	1.51
7. Rubber	0.71	0.63	0.17	0.55	0.27	0.27	1.05
8. Fabric	5.08	1.12	1.24	2.40	0.83	1.89	1.20
9. Leather	0.58	2.23	-	0.63	-	1.21	1.83
10. Hazardous waste:							
Flashlight/telephone/batteries,	0.38	0.56	0.29	0.57	0.30	0.35	0.39
light bulbs, spray cans							
11. Tile	0.88	0.56	1.03	1.01	1.38	1.62	1.38
12. Other unclassified/sanitary	2.05	1.85	3 84	1 58	2.66	1.62	1 91
napkins/diapers/tissue paper	2.05	1.05	5.07	1.50	2.00	1.02	1.71





Graph 1: Shows the percentage of the physical composition of waste is separated as follows: From March 27 to April 2, 2024.







Discussion

The study was able to separate the physical components of waste as follows:

1. Organic food waste/vegetables 2. Paper 3. Plastic 4. Glass 5. Metal 6. Wood, wooden crates, branches 7. Rubber 8. Fabric 9. Leather 10. Hazardous waste 11. Tiles and 12. Others Each element can be calculated as a percentage as follows:

Organic food waste/vegetables = 58.61, paper = 6.26, plastic = 23.40, glass = 2.57, metal = 0.49, wood, wooden crates, branches = 1.16, rubber = 0.52, cloth = 1.96, leather = 0.92, hazardous waste = 0.40, tiles = 1.12 and others = 2.21. It can be seen from the study that the components are found to be food waste the most and hazardous waste the least.

Discussion

Analysis of waste composition of Khon Kaen Municipality. From the study of the amount of waste of Khon Kaen Municipality in 2022-2024, it was found that the amount of waste tends to decrease. When studying the composition of waste between March 27 and April 2, 2024, the results of the study of the separation of waste composition of Khon Kaen Municipality are as follows: The most common types of waste are food scraps, plastics, and paper at 58.61, 23.40, and 6.26 percent, respectively. The least common types of waste are rubber, metal, and hazardous waste at 0.52, 0.49, and 0.40 percent, respectively. It can be observed that plastic waste is more than other types of waste, indicating that plastic waste has increased due to the increasing popularity of delivery services. In addition, hazardous waste has the least percentage as a result of the campaign to not throw hazardous waste together with general waste of Khon Kaen Municipality. Khon Kaen Municipality has a place to receive only hazardous waste in the toxic waste exchange points project. It can separate hazardous waste and send it for proper disposal in accordance with sanitary principles.



Conclusion

From the analysis of the physical composition of solid waste in Khon Kaen Municipality over 7 consecutive days, it was found that the amount of components in the categories of food waste and organic matter had an average of 58.61 percent, paper had an average of 6.26 percent, plastic had an average of 23.40 percent, glass had an average of 2.57 percent, metal had an average of 0.49 percent, wood had an average of 1.16 percent, rubber had an average of 0.52 percent, fabric had an average of 1.96 percent, leather had an average of 0.92 percent, and hazardous waste had an average of 0.40 percent.Tile/stone type has an average of 1.12 percent, and other types, such as diapers/tissue paper/sanitary napkins, have an average of 2.21 percent.

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