Approaches to develop waste sorting at source of the pipe manufacturing industry In Na Mai Sub-district, Lat Lum Kaeo District, Pathum Thani Province.

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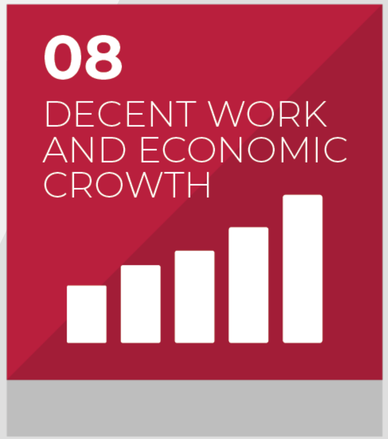
Introduction:

Because garbage or garbage refers to waste that is in solid form. which may have moisture mixed in Garbage generated from residential buildings Industrial factory locations will have different quantities and characteristics. Usually objects That is thrown away in the form of waste will contain both organic and inorganic substances. Some of these various substances can be decomposed by microorganisms in a short time. Especially food scraps and vegetable scraps, but some types cannot be decomposed at all, such as plastic and broken glass. Wastes cause an impact on the environment and human health, including waste that is thrown away and collected inefficiently. Solid waste, hazardous waste If there is a lack of proper management or if it is left in an industrial factory area, when it rains, it will lead to dirt, germs, and toxins from garbage flowing into water sources. Cause water sources to become polluted. And in addition, garbage also affects the quality of the soil. If the garbage contains the remains of batteries, it will have a negative effect on the soil ecosystem, causing an acidic condition in the soil. Waste that is discarded and collected inefficiently can easily cause impacts on public health, such as gastrointestinal diseases caused by bacteria carried by flies or exposure to toxins that come from hazardous waste.

Therefore, this independent study project has studied guidelines for developing the separation of each type of waste in the company. By studying appropriate ways to encourage employees in the company to correctly sort waste in order to collect and dispose of it properly. Helps reduce environmental impacts that may occur in the future. It also contributes to achieving the Sustainable Development Goals (SDGs) in Goals 3, 6, 8, and 12 through effective waste management (Fatimah et al., 2020).



Methodology:

A study was conducted to find ways to improve waste sorting at the waste sorting point of a company in Na Mai Sub-district, Lat Lum Kaeo District, Pathum Thani Province. The study was conducted as follows:

- ❑ Surveying the waste sorting area to identify suitable locations for sample collection.
- ❑ Selecting strategies to address issues in waste sorting. Currently, the company has signs indicating the types of waste in both Thai and English languages, along with corresponding images on the waste receptacles. This research aims to provide additional strategies for improvement, such as:
  - ○ Designing to add Burmese language to the waste type signage. An example is shown in Figure 1.

Figure 1: Design adding Burmese language to the signage.

- Train employees to increase knowledge.

- Collect waste samples by weighing the weight of each waste type.
- Analyze and evaluate the quality of the data obtained from weighing, including the capture rate and contamination rate in the waste bin, as shown in Equations 1 and 2.

$$\textbf{capture rate} = \frac{\textbf{The correct weight of each type of waste according to its category.}}{\textbf{The weight of each type of waste in each bin.}} \textbf{x100\%}$$

Equations 1

$$\textbf{contamination rate} = \frac{\textbf{The weight of waste that has been improperly disposed of according to its respective waste type.}}{\textbf{Total weight of garbage in that bin}} \textbf{x100\%}$$

Equations 2

- The ANOVA statistical method is employed to analyze significant differences within the dataset, with a significance level set at 10%. If significant differences are found, further analysis is conducted using a post-hoc test.
  - If $p < 0.1$, it indicates significance or a statistically significant difference or relationship.
  - If $p > 0.1$, it indicates non-significance or no statistically significant difference or relationship.

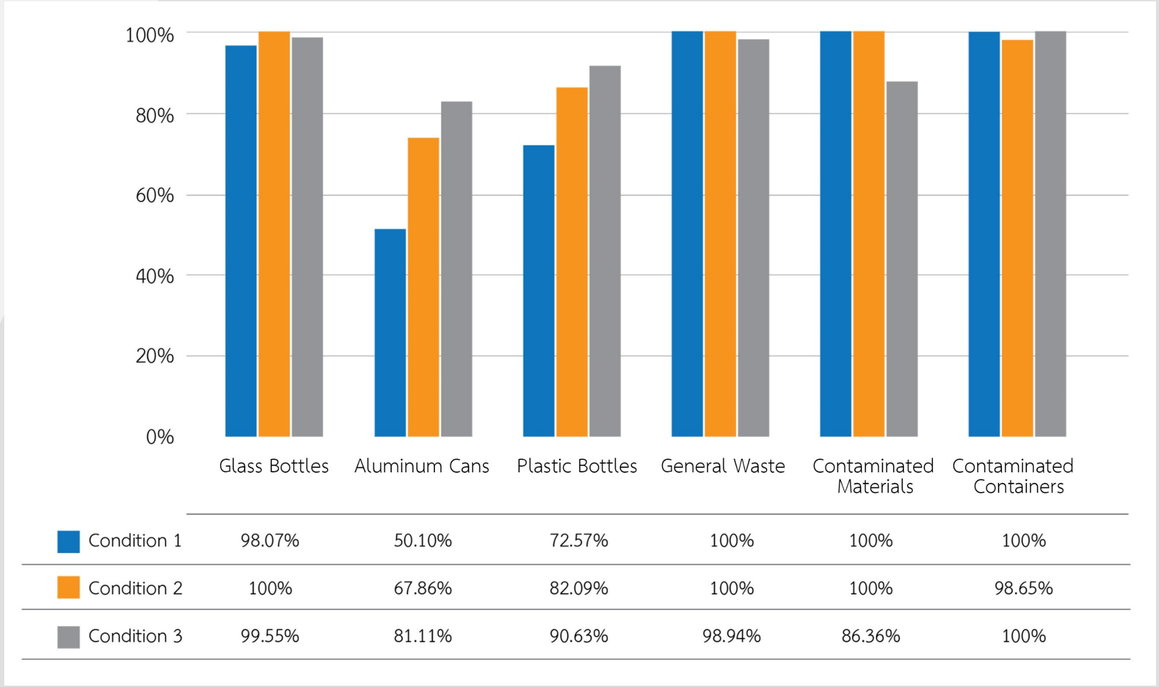
Results:

From the collection of waste samples by weighing each type of waste, the details are as follows:

1. **Condition 1** : refers to having signage indicating the type of waste in both Thai and English languages, along with pictorial representations.
2. **Condition 2** : refers to having signage indicating the type of waste in both Thai and English languages, pictorial representations, and adding the Burmese language.
3. **Condition 3** : refers to having signage indicating the type of waste in both Thai and English languages, pictorial representations, the Burmese language, and providing training for employees.

Results:

The analysis of the capture rate of each type of waste after adding the Burmese language to the waste type signage resulted in an increased capture efficiency of glass bottles by 1.95%, aluminum cans by 30.12%, plastic bottles by 12.31%, and contaminated containers by 1.36%. However, the efficiency decreased for glass bottles by 0.45%, aluminum cans increased by 17.79%, plastic bottles increased by 9.89%, general waste increased by 1.07%, and contaminated materials increased by 14.64%. Nevertheless, statistical testing using ANOVA revealed a significant difference in the capture rate of glass bottles ($p=0.0618$) only at a significance level of 10%. Therefore, from the designed and developed waste separation system, it can be concluded that there is a significant improvement in the capture efficiency of glass bottles.

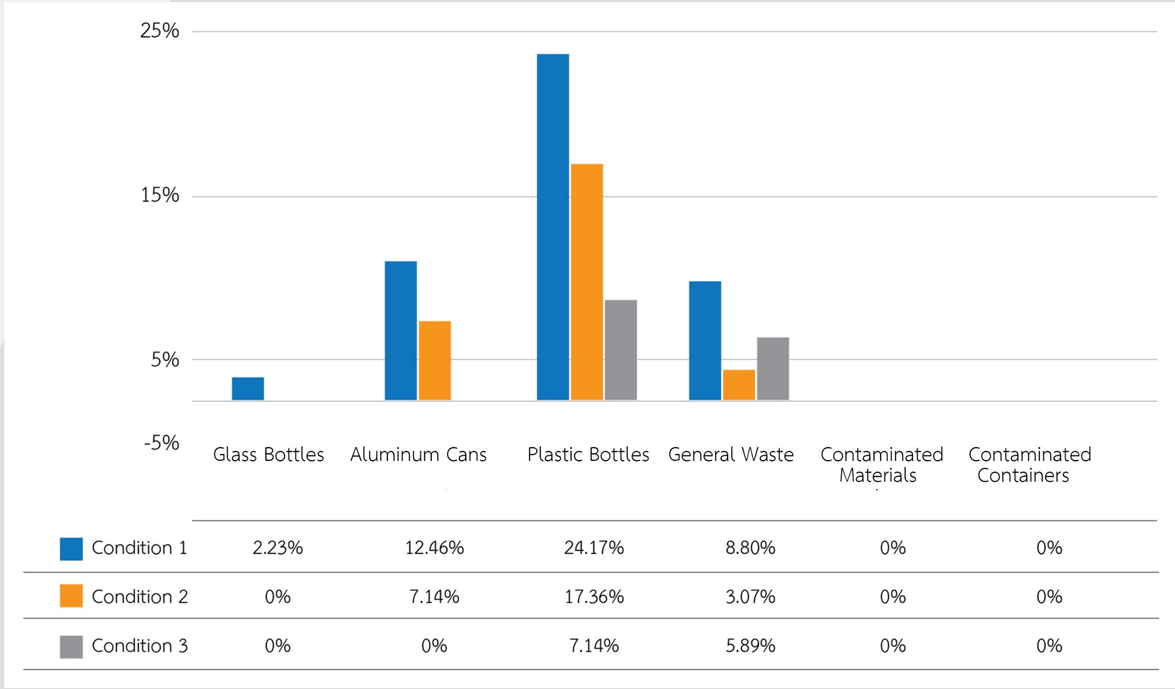


	Glass Bottles	Aluminum Cans	Plastic Bottles	General Waste	Contaminated Materials	Contaminated Containers
Condition 1	98.07%	50.10%	72.57%	100%	100%	100%
Condition 2	100%	67.86%	82.09%	100%	100%	98.65%
Condition 3	99.55%	81.11%	90.63%	98.94%	86.36%	100%

Figure 2: capture rate of each type of waste

Results:

The analysis of the contamination rate of each type of waste after adding the Burmese language to the waste type signage showed an increased efficiency for glass bottles by 200%, aluminum cans by 54.27%, plastic bottles by 32.79%, and general waste by 96.56%. Furthermore, the efficiency increased after training the employees for aluminum cans by 200%, plastic bottles by 83.40%, and general waste by 63.06%, respectively. However, statistical testing using ANOVA found a significant difference in the contamination rate in the glass bottle bins ($p=0.0908$) at a significance level of 10%. Therefore, this waste separation and management system's design and development can significantly reduce the contamination rate in glass bottle bins.



	Glass Bottles	Aluminum Cans	Plastic Bottles	General Waste	Contaminated Materials	Contaminated Containers
Condition 1	2.23%	12.46%	24.17%	8.80%	0%	0%
Condition 2	0%	7.14%	17.36%	3.07%	0%	0%
Condition 3	0%	0%	7.14%	5.89%	0%	0%

Figure 3: contamination rate of each type of waste

Conclusions:

The study in this instance highlights a pathway for improving waste segregation efficiency in factory employees by enhancing clear communication. This includes adding the Burmese language to waste type signage and providing training to employees. As a result, employees have gained a more effective understanding of waste segregation, notably for glass bottles. Therefore, the strategies used in this research to improve waste segregation can be further developed and implemented in other areas or departments within the factory to achieve more comprehensive improvements. Moreover, these strategies can serve as tools for waste management development for relevant organizations in the future, aiming to achieve sustainable development goals.

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