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Study Energy Consumption and Potential Saving At The Recycle Factory

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Abstract: The effects of various methods used to recycle Polyethylene, the temperature required during recycling, the time required for the Polyethylene to be completely recycled, and the energy required recycling the materials and reducing waste, such as heat dissipated. To make high-quality, long-lasting products. Some of the collected trash didn't belong. The study aims to discover the plastic recycling process, improve it, and cut energy costs. There are several recyclable plastics today. This study examines LDPE (LDPE). In Perak's Kinta Recycle and Recovery Factory. This study examines techniques to reduce energy use during factory recycling. It will go into detail on recycling plastic because different elements must be separated before recycling and there are many types of recyclable plastic. This research will help in the development and testing of recycled plastic. This investigation could determine which method and machine work best under given situations. It would help comprehend the recycling method, staging, and manufacturing's effect on the factor. Define the basic technique for recycling Low Density Polyethylene to increase machine energy efficiency. This research will show us why recycling is essential.

Keywords: Recycling, Plastic, LDPE

1. Introduction

Energy is crucial, especially in industry. Advancing technology takes more energy. Energy usage soars, harming the environment. The country was impressed. In emerging countries, energy criteria determine progress. Energy shortages and demand govern Malaysia. Our country needs more energy. Energy saving may raise demand. Using fewer energy services reduces energy consumption. Energy audits help save energy. Saving energy without reducing usage is challenging. This study analyses the Kinta Factory's silver load, calculates the energy used, recommends energy-efficient equipment, and compares the results.

Urbanization, development, and modernization require energy. Rapid urbanization and population growth make many fast-growing countries more energy-intensive. In 2016, the industrial sector

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accounted for 14% of the country's total energy consumption. Construction uses almost 60% of global energy. To fulfil the rising energy demand, many nations continue to use gas and coal, which generate greenhouse gases. IPCC says rising global temperatures are increasing building energy demand.

Construction industry energy use and emissions must be reduced through energy conservation. This is key to reduce carbon intensity long-term. Heating, cooling, lighting, computers, printers, etc. use energy in office buildings. The plant's heating and cooling utilization was roughly 45%. HVAC, lights, and appliances utilize 15% of total energy. A study found that lighting uses 13% of total energy. Globally, industry energy consumption rose 0.4%, 0.1%, and 0.9%. In 2016, these sectors primarily consumed electricity. In Asia, the home sector surpassed industry as the second-largest consumer between 1971 and 2016.

The energy audit process is crucial for saving energy in a building's operation. Energy audits allow building owners to decide if new energy-efficient equipment is appropriate for their facility. Frequent energy audits and commissioning can increase building efficiency and performance.

This analysis examines the building's energy consumption by identifying equipment, power ratings, room types, and running hours. Following the research, feasible and affordable energy conservation options (ECOs) or projected energy savings for the building were discovered, along with an economic impact evaluation

2. Materials and Methods

This chapter goes into the method/process of doing this case study in greater detail, beginning with the identification of the area of study and ending with the collection of all essential data and results. The goal of this chapter is to provide clearer guidelines and explanation/discussion for each approach utilized in this research to aid in a better understanding of the methodologies employed in this case study.

2.1 Materials Preparation

Low-density polyethylene (LDPE) is primarily used in packaging and non-packaging film applications. Other markets include extrusion coatings, cable sheathing, and injection moulding. LDPE is the oldest and most developed polyethylene (PE). Although it lacks the high clarity and processibility of the other PEs, it is distinguished by its short and long chain branching. (Willett and colleagues, 1994) The following materials were used in this study:

- LDPE polymer
- Crusher/Granulator
- Washer
- Heater/Dryer

2.2 Methods

The method utilized in this study is calculation based on manufacturing observations. Data collected at the factory was calculated in the heat radiation equation using the Stefan Boltzmann law and constant. Then, using SolidWorks as the application design the recommended idea to accomplish the study's objectives.

Heat radiation equation:

$$Q/t = \sigma e A T^4 \qquad \text{Eq. 1}$$

Where Q = is the radiation emits by surfaces

e = the emissivity of material (aluminium: 0.85)

σ = Stefan Boltzmann Constant (W/m2K4)

A = Area of the surface

T = Temperature of the surface

3. Results and Discussion

The study to establish the optimal value for the input parameter produced both preliminary and definitive sets of findings.

The following is a list of machines and motors that are currently in use by the factory during peak hours. Crushing plastic is the first procedure for recycling plastic, hence crushers are the first machines. The machine required 15 KW to run, and its normal capacity is 500-600 Kg/h. Because the factory has washing tankers with three motors each, the washing operation requires six motors. The LDPE pieces are pumped up by two pumps. The first pump serves the first washing tank, while the second serves the second tank. After the washing procedure, a blower is used to blow out the LDPE bits. It is installed after the second pump, below the pump, in the second washing tank.

Peak:

Table 1: List of machines runs during peak period

No.	Machine	Total Power Output (KW)
1	Crusher	15.0
2	Washer x6 (1.5KW)	9.0
3	Pump x2 (3.7KW)	7.4
4	Blower	1.0
Total		32.4

Below are the costs for electricity per usage and per month for peak period:

Per Usage: 32.4 K * M0.355 = M.5

Per Month: M11.50 * 12hus * 22 a = M

Off Peak:

Table 2: List of machines that runs during off peak period

No.	Machine	Total Power Output (KW)
1	Heater x2	36
Total		**72**

Below are the costs for electricity per usage and per month for peak period:

Per Usage: 72 K * M0.219 = M.3

Per Month: M15.77 * 12hus * 22 a = M3.

Total cost for electricity bill for one month:

RM 3036 + RM 4163.28 = **RM 7199.28**

At the factory, there are 6 workers that work almost 24 hours. If they work one shift for RM 1800 per month, then the expenditure only for the workers is about

RM10800 per month per shift and it would be RM21600 for double shift.

Total monthly expenses:

RM 21600 + RM 7199.28 = **RM 28799.28**

The fundamental concept is to develop a technique for drying LDPE components after they have been washed and before they are heated. The design was produced using the SolidWorks programed. In order to compute the heat radiated by the heater machine, the radius and length of the heater machine must be measured. Because aluminium conduit is less expensive, it was advised that the steel duct be replaced. In terms of shape and flow direction, the aluminium duct was likewise straightforward to change. Finally, it was requested that an additional conveyor belt be built at the storage tank. The LDPE pieces are transported from the storage tank to the next process via this conveyor belt.

The purpose of this system is to keep the LDPE pieces warm with less moisture on the surfaces. This prevents the heater machine from exerting too much power, which not only raises the cost of electricity but also makes the heater less durable and less effective. The blower will blow the LDPE pieces directly into the heater. The incoming heat came through the aluminium duct.

Below are the list of machines and motor that are currently used by the factory during peak period.

Peak:

Table 3: List of machines runs during peak period

No.	Machine	Total Power Output (KW)
1	Crusher	15.0
2	Washer x6 (1.5KW)	9.0
3	Pump x2 (3.7KW)	7.4
4	Blower	1.0
5	Heater	36.0
Total		68.4

Per Usage:

68.4K * M0.355 = M

To find the cost for one month, the usage of the machines need to be multiplying with 12 hours that is theduration for peak period and 22 working days for one month.

Per Month:

M24.28 * 12hus * 22 a = M5.

There is no off peak period shift because the heater were running at peak period shift. Only single shift required to do the full recycling process.

When the conveyor belt is equipped at the storage tank, therefore no extra workers is needed to transferring the LDPE pieces. From that, it can save RM1800 per month which is quite a big number.

Total expenses per month:

Before:

M3036 + M4163.28 + M21600 = M6.

After:

M6409.92 + M9000 = M5.

Total saving per month:

M28799.28 – M15409.92 = M6

4. Conclusion

As a result, the first goal, outlining the plastic recycling process, has been completed. More knowledge regarding plastic has been gained through journal and article research, as well as observation in an actual recycling factory. Because different kinds of plastic have varied chemical properties, they require different recycling procedures. The second goal is to improve the recycling process by lowering the moisture or humidity of the washed LDPE pieces. Furthermore, the incorporation of the conveyor belt can increase the recycling process since the conveyor belt, rather than human energy, can run nonstop for 12 hours. The third aim of lowering energy costs during the recycling process has been achieved. Because the second and third objectives are linked, finishing the second automatically results in completing the third.

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