

# Implementation of Plastic Fusing Method to Upcycle Products of Plastic Waste

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**Abstract.** Plastic waste is one of the most numerous in number, approximately 10 % of the total waste in the world. Plastic packaging, grocery bags, and home furnishings are the types that often found. There have been many efforts to reduce the amount of waste and the impact it causes, one of them is the up-cycling method. Up-cycling is the utilization method of waste products that have more value or new. By using this method, in addition to being able to reduce the plastic waste amount while creating new products with new value and functionality, namely small wallets, shopping bags, backpacks, gadgets sleeve etc. One method of up-cycling plastic is plastic fusing methods that uses heat and plastic waste to create new materials with thickness and strength. The current utilization of plastic waste has been undertaken by communities to produce a product, namely craftsman group named Kunarti but less variety of processing methods, limited to knitting method only. Based on the phenomenon, this research was conducted to find out how the application of the plastic fusing method so that it can be easily done, and into alternative methods of up-cycling which is can be applied by the craftsmen community in Bandung.

**Keywords:** plastic fusing, plastic waste, upcycle

## 1 Introduction

One of the largest contributors to household waste is plastic. Based on the data from Eco Watch, 10 percent of the total amount of waste in the world is the plastic waste. Indonesia was ranked 2nd as producers of plastic waste in the world, with a total of 187.2 million tons of trash generated garbage [1]. By looking at the condition it needs to be an effort of all lines. One of the most accessible effort to do is reduce the use, wear back and recycle plastic waste that already exists. One of the efforts that are not only able to reduce waste but is also capable of the game after new products from waste with value and a new function called by way of up-cycling. The methods that can be used to up-cycle of waste plastic y is a method of heating. The technique is capable of producing plastic waste material is thicker and more resistant torn so that it is able to be used to obtain products with better quality. One of the products produced by this method is a tote bag, messenger bag, sleeve, shoes, and clothing. This research will examine the application of the method of plastic fusing to make product up-cycle that is made from waste plastic bag household. The study covers the selection of the

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waste material of plastic, engineering application of fusing, method and product design concept that will be generated.

## **2 Literature Review**

### **2.1 Plastic Waste**

Based on data from UNEP (United Nation Environment Program) in 2017 there are an estimated 8 million tons of plastics waste pollute the environment especially the worst is pollution in the ocean [2]. Approximately 80% of plastic waste comes from household use. Most of the waste plastic bags from households. Plastic shopping bags become the largest plastic garbage because only one function is used, after that not being used again for other functions and ending up being waste. Indonesia ranks second after China as the world's largest garbage producer, with 187, 2 million rubbish wasted to oceans [1]. Based on data from the Ministry of Environment and Forestry that it is predicted in 2018 the total amount of waste in Indonesia will touch the numbers 67, 1 million tons. With the composition of the three largest waste producers, is organic waste (38.4 million tons), plastic waste (8.96 million tons) and paper (5.76 million tons). Of the total plastic waste that there is a plastic bag into the type of plastic waste the most produced, which is about 265 thousand kilograms per month. With a tremendous amount of waste, there needs to be effective waste management. While what happens in the field of waste management, especially plastic waste is still not maximal. Approximately 69% garbage only dumped in the landfill without any clear processing. The condition will be a very serious problem if it happens continuously.

### **2.2 Plastic Bags**

Plastics are synthetic or man-made polymers, similar to natural resins found in plants. Oil and natural gas are the main raw materials used for the manufacture of plastics. Due to the many types and current use of plastic in various industries causing plastic as the world's largest garbage disposal. The main contributor to plastic waste in the world is household waste. Here's the fact of waste plastic:

- It takes 12 million barrels of oil to produce 84 -100 billion plastic [3].
- Only 0.6% of the total recycled plastic waste is recycled [4].
- The lightweight form and weight cause plastic waste to fly from landfills blown in winds and caught in tree branches, gutters, canals to caught on the wings and necks of birds.
- Based on marine department data, garbage found on beaches and sea mostly plastic [3].

One of the many plastic wastes we encounter in household environments is plastic food packaging. Waste plastic food packaging and shopping bags dominate the amount and type of household waste. Plastic bags are common in the market there are several types of HDPE, LDPE, and PP. They are the most widely used plastic bags in household use. The following explanation of each characteristic of plastic bags based on the type of plastic. (1) HDPE plastic bags have a stronger, harder and more opaque material. More resistant to high temperatures so when melted requires greater energy. The thickness is between 0.015mm to 0.150mm. Usually used for packing oil or plastic bags to accommodate hot foods. (2) LDPE plastic bags made flexible than HDPE and PP. better known as a crackle bag. Usually used as a container to bring groceries, food, to garbage bags. This type of plastic bag is the most widely found in the landfill. Most of them are household waste. (3) PP plastic bag is

transparent but not clear. Light and strong, resistant to steam and fat. Usually used for wrapping dry food, syrup, ice cubes and other beverages.

### **2.3 Plastic Fusing Method**

The method of fusing or heating is one way of changing the plastic characters to be more rigid flexible with the way heating on plastic stacked several layers. The result of this fusing produces a rigid plastic yet still flexible, unique texture and color. The following techniques for making bags with the method of fusing:

1. Tools and materials to be prepared are as follows: plastic bag, iron, scissors, bread paper or tracing paper.
2. Cut the top and bottom of the plastic. Then open the fold so it opens into a square.
3. Cover the base with a piece of bread or tracing paper, then place the plastic on it. The number of plastic plates adjusted to the plastic thickness. The ideal number of layers of plastic is approximately 5 - 7 layers. Then cover with bread or tracing paper.
4. After that iron slowly and evenly. Use enough heat to keep the plastic from melting.
5. The end result of plastic fusing is ready for bag material.

### **2.4 Kunarti Craftments Group**

This craft group was originally formed because it saw the amount of waste plastic wrap that was thrown away without being used for other useful objects. At the initiative of the initiator of the Kunarti working group, they invite the housewives in the village who usually work in odd jobs to participate in making handbags from recycled plastic waste, besides helping to reduce the amount of plastic waste they get additional income from the creation. Plastic wastes are processed in a simple way, ranging from clean from the rest of the contents, dried until later woven to form the sheet before it is formed into a bag according to the desired design. Currently, the material used more use of plastic waste instant coffee packaging, because it is easier to find and easier processing process. Created bag design tends to refer to existing trends in the market today, with simple geometric shapes.

## **3 Method**

The research that will be done is qualitative research. Qualitative research strategies that will be used is the approach of case studies, the research strategy to investigate carefully a program, event, activity, process, or a bunch of individuals. Cases are limited by the time and activity, and researchers gather the complete information by using a variety of procedures of data collection based on the specified time [5].

### **3.1 Literature Study**

The main literature study is used as a reference for this research is the literature on the concept of plastic fusing method and recycling of plastic waste. The literature of Plastic fusing methods includes technical and equipment needed. Literature about plastic recycling includes data and facts, a method of recycling plastics and recycled plastic products.

### **3.2 Case Study**

The current case study is the design of bags made from recycled plastic waste by Kunarti craftsmen group in Cibeunying, Bandung. Case studies that will be carried out include the

production method of plastic waste recycling bag products, introduction, and application of plastic fusing method.

### **3.3 Data Collection and Analysis**

The process of collecting data will be done in several ways as follows:

1. Observation of activities on the Kunarti craftsmen group in Cibeunying, Bandung.
2. Study alternative types of products resulting from the application of plastic fusing method.

The analysis to be used is qualitative to identify the application of plastic fusing method. Here are the analysis points that will be done:

- a. Analyze the sorting and amount of household plastic waste.
- b. Technical analysis of the application of plastic fusing method.
- c. Analyze alternative types of up-cycle products that will be made using plastic fusing method.
- d. Analyze the result of an application of plastic fusing method.

## **4 Discussion**

### **4.1 Selection of Type and Amount of Plastic Bag waste**

The first step to be prepared is to select the type and number of plastic bags to be used. The choice of plastic bag waste will affect the color, texture and shape. While the number of plastic bags will affect the thickness and strength of material products.

- Selection of plastic bag waste type

Avoid the use of waste biodegradable plastic bag type, plastic bag type is able to decompose itself with time and certain environmental conditions. The use of these types of plastic bags is not recommended because when heated the material will be more easily destroyed and melted compared with non-biodegradable plastic bag types.

The recommended type of plastic bag is LDPE type, this type is the most widely used and found in household waste. Commonly used as a shopping bag. The material is not easily destroyed and melts and the amount of availability is quite a lot

Plastic bags on the market usually consist of two types of thickness. Thin plastic is usually widely used for shopping bags in the market, minimarket to modern supermarkets. The second type is a thicker type of plastic, usually used as a shopping bag in the shopping center and mall.

- The number of plastic waste used

The number of thin plastic bags required about 5-7 sheets of plastic. With that amount, strength and thickness can be achieved well.

A thicker number of plastic bags requires around 2 to 3 sheets. With that amount will produce a material that is strong enough and flexible.

### **4.2 Technical Application of Plastic Fusing Method**

The method of processing plastic waste material used is the heating process using a simple tool in the form of an electric iron. The focus of the material used is plastic bag waste. This material is chosen because of the abundant amount of plastic bags, besides plastic garbage bags are not picked up by garbage collectors because it is difficult to be recycled into quality

plastic products. Heating device used is iron, this tool is chosen because many belong to the household and hot enough to process waste plastic bag.

Here are the steps for processing plastic waste into basic materials products:

- Collect the plastic bags waste in accordance by the type and thickness, choose the type of nondegradable plastic bags that thick enough but not too thick. Clean from the rest of the dirt by washing it with water and then let it dry.
- Prepare waste plastic bags that have been cleaned. Fold according to the new plastic bag folding line. Tidy up wrinkles.
- Cut waste plastic bags on the upper side of the straight, to remove the plastic bag handle. Then cut the bottom side straight. Give the distance between the cut line with the end edge of the bottom, approximately 1-2 cm.
- After both sides of the plastic bag are cut, stretch and tidy up. Cut one end of the side of the plastic bag. Expand the result of the plastic bag piece, the result of the stretch to get the width of the material to be processed by plastic fusing technique.
- Prepare duplex paper as a heating pad. Prepare two-sheet tracing paper with customized sizes. The tracing paper is used to protect the plastic when the plastic heating process does not melt. Spread tracing paper on duplex paper, then put plastic and cover with tracing paper on top.
- To produce a material that is strong enough it takes approximately 2-5 pieces of plastic bag layer. The number of sheets of plastic layers depends on the thickness.
- Make sure the pile of layers of plastic bags is arranged and neatly arranged before the heating process.
- Prepare the heater, which we will use is household electric iron. Adjust the heat adjustment setting on the iron at the hottest level. The level is hot and fast enough to be used in the plastic fusing process. After the heat on the iron is enough, can be seen from the indicator lights on the iron off. Make moves such as ironing clothes on the sheet of plastic bag that had been prepared earlier.
- After enough warming is done on the plastic pile, make sure all the plastic layers are united and stick to each other. Ease the trace of trace paper from the top of the plastic slowly until all the plastic parts are removed from the tracing paper layers that wrap them.
- Voila, the result is a plastic sheet with unique character and has enough thickness and strength to use for new and valuable product material

The result of processing using plastic fusing method is a plastic sheet with a unique character which then can be used as craft product material such as a bag, wallet, iPad sleeve, and Dopp kit.

### **4.3 Concept of Product Design**

The concept of product design that will be made should consider the following parameters:

- Ease of application of plastic fusing technique, to be easily done by the craftsmen are mostly unskilled.
- Efficient use of tools, as much as possible the tools used are simple tools that are easy to get and use by the craftsmen.
- Products designed are functional products
- The capacity of the product is not too much and heavy considering the strength of plastic.
- Product market targets are young people who have environmental awareness and love to use upcycled products.

From the above parameters eating the recommended product is a stationery product. Here is one example of product recommendations that can be produced with the application of plastic fusing technique.

## **5 Conclusion**

Based on the results of research that has been done on plastic fusing method to process plastic bag waste can be concluded as follows:

- Most plastic bags come from household waste
- Plastic bag processing is still not maximized, just burned in the landfill area or in melting in garbage collectors
- One of the creative methods to process plastic bag waste is plastic fusing
- Selection of type and number of plastic bags will affect the results of the application of plastic fusing method
- Application of plastic fusing method by using simple tool gives an opportunity for housewife as the new side job.
- The results of waste processing by plastic fusing method is able to produce products with unique material characteristics. Suggestion for research and development of plastic fusing method based on this research are:
- Still need further research in applying the method of plastic fusing to produce products that are stronger material
- Need development and combination of application of plastic fusing with other plastic processing techniques to create new product quality and variation.

The continuity plan of this research is the application of plastic fusing method to the community in order to be used for the management and processing of their household waste. In the next research will proceed with the development of methods of plastic fusing and a combination of sewing techniques to produce products that are more powerful and have more functions than just a bag. For the next research targets to be achieved is to produce more processed products waste plastic bags are more varied both types and functions. Here is the research continuity plan:

- Application of plastic fusing technique by the community widely.
- Development of the next method of plastic fusing.
- Combination technique of plastic fusing with other technique. For example, combining with sewing techniques.
- Development of product variation result of plastic fusing method.

## **Reference**

1. J.R. Jambeck, *Plastic Waste Inputs from Land into the Ocean* (University of Georgia, 2015)
2. United Nation Environment Programe, *Plastic Waste Management*, International Environmental Technology Centre (IETC) Osaka, Japan
3. Facts and figures regarding the true cost of plastic bags. [www.reusablebags.com](http://www.reusablebags.com)
4. *World Watch Institute's Good Things?* <http://www.worldwatch.org/taxonomy/term/44>
5. J.W. Creswell, *Research Design: Pendekatan Kualitatif, Kuantitatif, dan Mixed* (diterjemahkan oleh: Achmad Fawaid) (Pustaka Pelajar, Yogyakarta, 2010)