

## Study on Solubility of Plastic Bottle Waste in Phenol Solution

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### Abstract

Plastic waste becomes a problem for the environment because it is difficult to degrade (non-biodegradable). In this research, PET (polyethylene terephthalate) plastic bottle waste is used. The purpose of this research is to know solubility of plastic bottle waste in phenol in different concentration. The previous research showed that waste plastic bottle can be renewable fuel. Many researchers degrade plastic waste by techniques that require high temperatures. Researcher want to convert plastic bottle waste into fuel with low temperature techniques. Before being converted to fuel, plastic bottles waste must be dissolved first. This method is inefficient because it requires a lot of fuel for heating. The method is inefficient because it requires a high cost for heating. Therefore, it is necessary to do a cheaper research. The researcher proposed a new method that uses low temperatures. The research was conducted by dissolving the plastic waste that has been cut into small pieces into phenol solution which has different concentrations of 0 M, 1 M, 3 M, 5 M and 7M. The results obtained 0 M and 1 M can not dissolve plastic waste, and at concentrations of 3 M, 5 M and 7 M can dissolve plastic waste. Based on the results of research and analysis, it is known that the best solution to dissolve plastic waste is phenol at 7 M concentration because the boiling point required is at least 87 °C. The results showed that the higher the concentration of phenol in the required temperature the lower the required solvent. This research provides a solution for the processing of waste plastic which is increasingly increasing day by using low temperature. In addition to plastic waste processing this research also has the advantage of making renewable fuels.

**Key Words:** Plastic Bottle Waste, Solubility, Phenol Solution

### Introduction

Plastic is a material that often used in everyday life. With the increasing use of plastic, the more plastic waste generated. Since it was used in the 20th century, it was growing remarkably of its use from just a few hundred tons in the 1930s, to 150 million ton / year in the 1990s and 220 million tons / year in 2005. (Danarto YC et al, 2012). Based on assumptions by Ministry of Environment (KLH), every day the Indonesian population produces 0.8 kg of garbage per person or in totals much as 189 thousand tons of waste / day. From the amount is 15% in

the form of plastic waste or 28.4 thousand tons of wasteplastic / day (Pahlevi, 2012).

The increasing production of waste will increasingly add problems in environmental pollution, it is necessary to find a solution to overcome the enhancement of waste. there are three popular method for handling waste 3R, that is reuse, reduce, and recycle. First, is reuse, but this method has the disadvantage that garbage if continue to be used more and more day will be less feasible. The second is the reduction of the use of plastics, but this is difficult, because of the unavailability of cheaper and more practical materials that can replace the plastic. The third is the recycle of waste plastic processing into other useful materials this method is less effective because the quality or plastic will be decrease.

The most widely used plastic bottles in the whole country are polyethylene terephthalate plastic bottles (PET) because it has excellent mechanical and thermal properties (Kim et.al., 2007). PET is widely used in the chemical industry. PET are usually used for bottles of mineral water, bottles of cooking oil, juice, chilli bottles, medicine bottles, and cosmetic bottles. The ability of PET to be biodegradable in a short time compared to other materials causes increased production is not small. This causes the disposal of large quantities of PET bottles to cause serious environmental problems. Therefore, the processing and recycling of PET bottles continues to be developed. (Nikles and Farahat, 2005).

Research is needed for plastic waste treatment. In this research was checked the solubility of PET plastic bottle waste in phenol. This includes the way of processing plastic waste by recycling using PET bottle plastic waste dissolution method in the phenol solvent. In addition to studying the solubility of PET plastic bottle waste in phenol, this research can also be used to convert PET plastic waste into fuel. But, further studies are required to investigate its possibility for up-scaling plastic recycling process.

### **Materials and Metodology**

#### **Materials**

Materials used are plastic bottles (PET), it cuts into small pieces approximately 1-2 cm. phenol used is 0 M, 1 M, 3 M, 5 M, and 7 M.

#### **Methodology**

Prepared 5 (A-E) samples in a beaker. Each beaker containing 0.2 grams of plastic bottle waste (PET) and 25 mL phenol. Each sample have different concentrations of phenol. that is 0, 1, 3, 5, and 7 Molaritas.

After all is ready, the five samples are heated and observed whether the waste plastic bottle decomposes or not and at which temperature of the waste plastic bottle (PET) dissolved. In the process of solvent and stirrer, it was used stirrer for uniform the heating.

### Result and discussion

The results of research on the solubility of waste plastic bottles (PET) can be seen in table.1

Table.1 solubility of Bottle plastic waste

No	Phenol Concentration (M)	Dissolved	Not Dissolved	Temperature (°C)
1	0	-	V	-
2	1	-	V	-
3	3	V	-	158
4	5	V	-	124
5	7	V	-	87

In table. 1 shows that at 0 M and 1 M phenol concentrations, the waste of plastic bottles (PET) is insoluble. In table one shows that at concentrations of 0 M and 1 M phenol the plastic bottle (PET) waste is insoluble, because in observation at the time the solvent has grown all, the plastic waste (PET) has not been dissolved. At concentrations of 3 M, 5 M and 7 M The plastic bottle waste (PET) is soluble. But at concentrations of 3 and 5 the temperature required for melting is high enough, that is 158 °C and 124 °C. The lowest on PET solubility is 87°C.

Concentration affects the time required for the melting. Because of the higher concentration of phenol used to dissolve plastic bottle waste (PET). in the case of waste plastic bottle (PET) dissolved at a concentration of 3 M phenol takes 40 minutes, for 5 M 35 minutes, and at concentration 7 M is 20 minutes.

### Conclusion

Bottle plastic waste that has type Poly ethylene terephthalate can be dissolved by using phenol as solvent start from concentration 3 M. in all experiments we found that the best concentration used is 7 M. To dissolve Bottle plastic waste does not need more energy, because in concentration 7 M only take duration 20 minutes in temperature 87°C. The higher concentration used, the lower duration needed.

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