INVESTIGATION OF PYROLYSIS OF BROMINATED FLAME RETARDANT PLASTIC

ZarZar Hlaing[1], Mariko Adachi[1], Juehui Ma[1] and Hideki Nakagome[1]
Fumiyo Takeuchi[2], Kouji Omote[2], Koichi Kimura[2]

Graduate School of Engineering, Chiba University, Chiba, Nakagome Laboraory,Japan 1
Environmental Technology Research Division, Fujitsu Co-Ltd, Japan 2
e-mail: zarzarhlaing.mm@graduate.chiba-u.jp

Abstract

Bromine has been used as a component of the most effective flame retardant plastics industry can be used. Brominated flame retardants (BFR), the various electrical and electronics (E & E) to be used in order to prevent fire accidents. These flame-retardant plastic, the influence of flame retardants are included to burn less, difficult to recycle after use. In this study, we examined the recovery of energy, brominated flame retardant ABS itself and polyethylene mixture(1:1) , using the addition as a material, sulfuric acid, NaOH, the mixed carbonate by pyrolysis liquefaction experiments were conducted at 450℃. The problem of recycling by pyrolysis, to cause the blockage, so how to separate bromine and consider how to reduce the bromine content from the produced oil.

Keywords: *DTG analysis, flame retardants ,ABS, thermal decomposition, energy recovery*

1. Introduction

We miss the life of television, mobile phones and personal computers, electronic appliances, such as automotive interior parts, insulation and building materials also has been used by many plastic parts and materials. They have been working a lot of flame retardant to protect lives and property from fire hazard. As flame retardants for plastics (including chlorine or bromine atom), halogen-based flame retardants are "high efficiency flame retardant"is the most widely used.

Figure (1) shows that has been drained of used electrical and electronic equipment each year about 2.5 million tons,in Japan. Recalled product in home appliance recycling law is actually a total of approximately 500,000 tons (2008), merely to use most electrical and electronic equipment except for some equipment that contains many cell phones and other precious metals Resources contained in the products that are not effectively recovered and reused [1].This study,We examined flame retardant ABS pyrolysis oil in the virgin material and computer giant. The problem of recycling by pyrolysis, to cause the blockage, so how to separate bromine and consider how to reduce the bromine content in the produced oil.

2. Materials and Methods

In this study, we used samples, ABS resin virgin material of UMG ABS Co- Ltd of UMG ABS ® UV 800. and the scrap computer giant . (ABS-FR 17 <) of Fujitsu Co -Ltd. Virgin material which contain ABS 70 %,25 % of (FR)and Sb2O3 is 5 %.

Figure 2 shows the experimental apparatus diagram. Samples will be packed into the reactor, and nitrogen substitution. Then we used tubular electric furnace, temperature settings 5 ℃/ min , 3℃/ min until (450℃), and made by pyrolysis. ABS-FR waste and pellets itself or mixed polyethylene (1:1) and using the addition with catalyst, and each experiment used approximately (60 g).

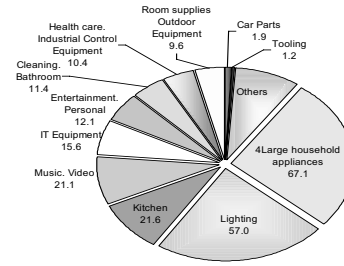

Fig.1. Used (E& E) equipment emissions (tons)

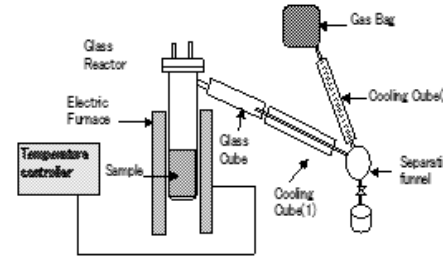

Fig. 2. Experimental apparatus diagram

2.1 DTG (60) -analysis

To take the basic data of the sample,using the Shimazu-Ltd of DTG-60 and were measured DTA 5℃/ min until

550 ℃ .It will be show figure (3). We observed endothermic at 308 ℃ ,338 ℃ ,402 ℃ ,407 ℃ . Above 300℃ which is considered to be a melting point of ABS and from above 400 ℃ the melting point which is a flame retardant.

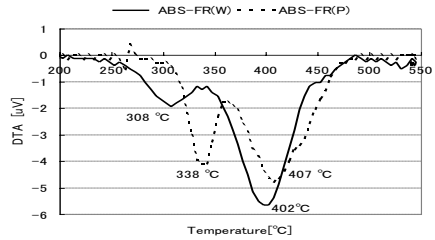

Fig.3. DTG thermal analysis of ABS-FR waste and pellet

3. Results and Discussion

The sample constitution and product distribution shown Table 2.We studied flame retardant ABS pyrolysis oil at 450 ℃ .In case of waste and pellet after thermal decomposition, 38 ~ 27 % was collected as the oli product.When we used catalyst ,the producted oil was about 40 % but when using sulfuric acid, liquid yield was 33%.Liquid yield is high when mixed 1:1 with polyethylene,get about 80 % of oil.In this study, representation of (Oil + FR) is a thing that was recovered from the glass tube after the experiment.

Table 2. Material composition and product distribution

*(P)=Pellet (W)=Waste	Oil	Residuce	Gas	Oil+FR
ABS-FR (W)	37.60	40.85	6.00	15.64
ABS-FR (P)	27.31	37.06	9.72	25.91
ABS-FR(P) : H2SO4 (11:1)	33.56	41.98	4.91	19.53
ABS-FR(P) : NaOH (11:1)	40.00	32.16	6.05	21.70
ABS-FR(P) : [Na:K:Li] (11:1)	40.80	39.95	3.83	15.42
ABS-FR(P) : PE (1:1)	79.10	7.82	13.08	0.00

The yield of the product graph is shown in Figure 4. The product yields, the catalyst used in the experiment and a single experiment collected 30-40% of produced oil,40% residual rate.The mixed PE experiments produced about 80% of oil recovery,10% of residue and10% of gases.

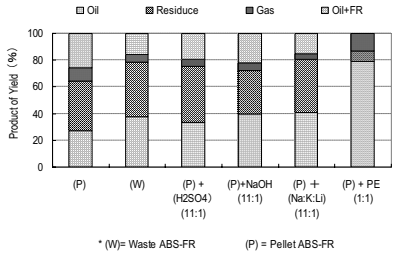

Fig.4.Product yield of single,PE mixture,catalyst addition

We examined the amount of produced oil to the bromine component analysis by the chromatogram.This result will show figure (5). This result,we found when the mixture of NaOH or PE than other, to decrease bromine in oil.

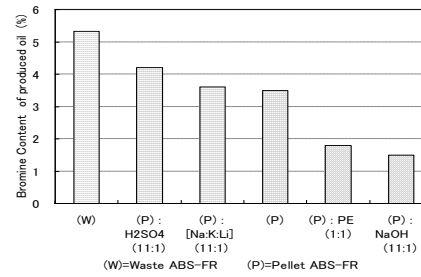

Fig.5. Bromine content of produced oil

The effect of mixed PE of products yield shown figure(6). In case of (PE), (ABS-FR) is the result of two thermal decomposition of single plastics.We calculated based on single experiments for mixing When calculated values are compared to the observed value, the additive rule relatively applies, although the residue and (Oil+FR) decreased and the product oil increased 22%.

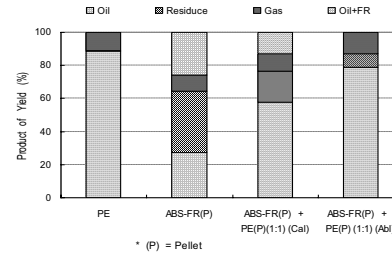

Fig.6.The effect of mixed PE of products yield

4. Conclusions

In this study, we examined the recovery of energy, brominated flame retardant ABS itself and mixed polyethylene (1:1), using the addition with catalyst at 450ºC.

[1] From DTG thermal analysis result above 300ºCis considered to be a melting point of ABS and from above 400 ºCthe melting point of flame retardant.

[2] The product oil of pellet and waste were 38 ~ 27 % and collect 40 % of residue and 15~25 % (Oil + FR).

[3] When the catalyst utilization rate of recovered oil was approximately 40% was obtained. When using NaOH, the residue is decreasing, (Oil + FR) is increased, the lowest rate of bromine found in the produced oil than others.

[4] From the analysis, the product oil of the polyethylene mixture of bromine in the oil recovery (Br) content decreased, it was confirmed that increasing the yield of recovered oil.

References

[1] T.Kamo , electronic materials, 49, pp.165-168, (2010)