POSTER

CARBONIZATION AND SURFACE CHARACTERISTICS OF γ -IRRADIATED POLYPHENYLENE ETHER AND NYLON-MXD6

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INTRODUCTION.

Previous studies [1,2] have shown that γ -irradiated polycarbonate resins of differing viscosity suffer an alteration in carbonization process, carbon yield and sintering character.

In the present paper, the carbonization process and carbonized materials of γ -irradiated polyphenylene ether (PPE) and nylon-MXD6 resins (RE) of differing viscosity were studied.

EXPERIMENTAL

Commercial tips(Mitsubishi Gas Chemical CO., INC.) of PPE of low (PPEL), and middle (PPEF) viscosity and RE of low (RE1) , and middle (RE2) viscosity were used without further treatment. The samples were irradiated by the 4.1 PBq Co-60 unit of the JEARI in air, and total dose was 2.5×10^3, 2.5×10^4 and 7.5×10^4 C/kg.

A thermal analysis was carried out using a Shimadzu DTG-30 up to 800 ℃ with flowing nitrogen (99.9995%, 2.4 l/h), a heating rate of 300 ℃/h and 0.5 hour soaking time.

Surface areas were obtained with a Micromeritics Shimadzu Flowsorb II 2300 by the single point BET method at liquid nitrogen temperature. (the flowed gas composition: nitrogen 30% and helium 70%)

RESULTS AND DISCUSSIONS

Typical chemical structure of PPEL and RE are shown in Figure 1.

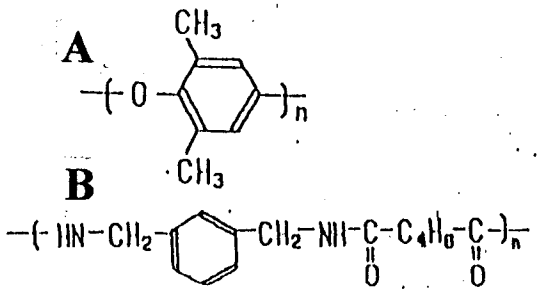

Fig. 1. Typical chemical structure of PPE(A) and RE(B).

Table 1 C:H:O atomic ratio of PPEL and PPEF (normalized as C=8)

Dose (C/kg)	PPEL		PPEF	
	H	O	H	O
0	8.10	1.02	8.12	1.01
2.5×10^3	8.07	0.98	8.14	1.01
2.5×10^4	8.09	1.07	8.08	1.07
7.5×10^4	8.03	1.18	7.98	1.21

These values in table 1 show a decrease of H and an increase of O, and PPEF suffer greater changes than PPEL . About 20 % of the unit molecules in the γ -irradiated PPE were damaged. This value is much smaller than in natural polymers such as starches.

Table 2. C:H:N:O atomic ratio of RE1 and RE2. (normalized as C=14)						
Dose C/kg	RE1			RE2		
	H	N	O	H	N	O
0	18.07	1.99	2.23	18.88	1.97	2.42
2.5×10^{3}	18.30	1.99	2.27	18.85	1.97	2.49
2.5×10^{4}	18.33	2.00	2.33	18.67	1.94	2.56
7.5×10^{4}	18.11	2.01	2.27	18.83	1.95	2.60

Table 2 shows about 18 % of RE2 unit molecules were damaged. The damage is greater on RE2 than RE1.

In the FT-IR spectra of PPE, a peak appears at 1730 cm^{-1} and becomes stronger with γ -irradiation. The FT-IR spectra patterns show differences among PPEL and PPEF.

In TG curves of PPE, rapid weight loss started at 410 ℃. Decomposition occurred within a small temperature range. The resins treated with a higher dosage began decomposing at slightly lower temperatures. Differences between the decomposition curves of PPEL and PPEF were small. All DTA curves show endothermic curves at lower temperatures than decomposition temperatures. These curves indicate that the samples melted at temperatures lower than decomposition temperatures.

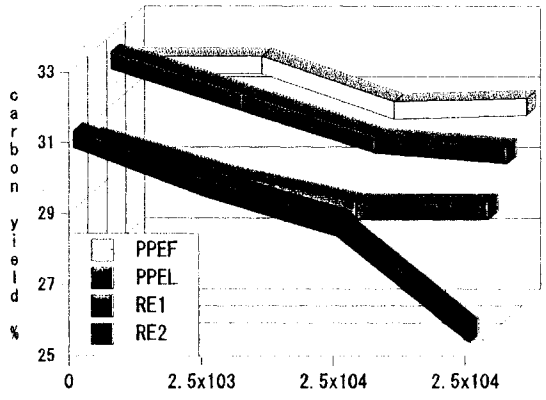

Figure 2. Carbon yields of PPE and RE. (carbonized at 800 ℃ in nitrogen.)

Figure 2 shows carbon yield of all samples. These curves suggest that higher viscosity and higher γ -ray dosage decreased carbon yields.

Table 3. Apparent surface area of PPE and RE carbon. (carbonized at 800 ℃, nitrogen)				
	PPEL	PPEF	RE1	RE2
0	491	482	217	231
$2.5x10^{3}$	424	411	208	217
$2.5x10^{4}$	303	298	201	204
$7.5x10^{4}$	243	211	191	197

Apparent surface areas of PC carbon which carbonized at 800 ℃ in flowing nitrogen were measured. The areas were 491, 482, 217 and 231 m^2/g for PPEL, PPEF, RE1, and RE2, respectively. The areas decreased when γ -ray dosages were increased, because of the shrinkage of produced carbon. PPEF and RE2 carbons of 7.5×10^{4} C/kg were 211 and 197 m^2/g, respectively.

CONCLUSIONS

1. γ -ray irradiation induced molecule cleavage of -C-C- bonds and oxidation in PPE and RE.
2. Higher viscosity and γ -ray doses caused lower carbon yields, because -C-C- bond cleavage is greater.
3. Apparent surface areas of γ -irradiated PPE and RE carbon decreased when γ -ray dosage was increased, but greater decrease occurred in PPE.

REFERENCES.

[1]Y.NAKAYAMA,K.HORI,S.KITANI and K-.HOSOKAWA, In Extend. Abstr., 21st Biennial Conf. on Carbon (Buffalo) 359 (1993).

[2]Y.NAKAYAMA, K.HORI, T.UMEMURA, and K.HOSOKAWA, In Extend. Abstr., CARBON'94 (Granada), 422 (1994).