INTRODUCTION OF CARBOXYLIC ACID GROUP ONTO POLYETHYLENE FILM BY ELECTRON BEAM

Hae-Jeong Kang, Jang-Seong Choi
Korea Dyeing Technology Center, Dept. of Environmental Technology,
Taegu 703-016, Korea
Phone: +82-53-350-3722, Fax:+82-53-350-3789
E-mail: sealove@dyetec.or.kr

Kwang-Pill Lee and Seong-Ho Choi
Department of Chemistry Graduate School, Kyungpook National University,
Taegu 702-010, Korea

Abstract: Carboxylic acid group was introduced onto polyethylene (PE) film by the grafting of acrylic acid onto PE film irradiated with electron beam. The grafting condition such as reaction temperature, additives, total irradiation dose, thickness of PE film, and monomer concentration was examined. The extent of grafting was found to increase with increasing reaction temperature and total irradiation dose. The grafting yield was much enhanced with the addition of both $FeSO_4$ $7H_2O$ and H_2SO_4.

1. INTRODUCTION

Grafting polymerization provides a convenient method for the modification of chemical and physical properties of polymeric materials, and is of particular interest for the synthesis of hydrophilic membranes since commercially available polymer film can be as the substrate. Radiation grafting is one of the most promising methods because of large transmittance of ionizing radiation into polymer matrix, readily creation active sites for initiating grafting.

In this study, the PE film modified with carboxylic acid group was prepared by radiation grafting of acrylic acid(AAc) onto PE film. The grafting condition such as reaction temperature, additives, total irradiation dose, thickness of PE film, and monomer concentration was discussed, Furthermore, the PE film modified with carboxylic acid group was characterized by IR, SEM, and ESCA.

2. EXPERIMENTAL

2.1 Material

Commercially available polyethylene film(Tea-Syeng Chemistry Co., in Korea) of thickness 300, 500 and 900 ㎛, respectively, were obtained. The PE film with porosity was used. The AAc(Merck KGaA, in Germany) and methyl alcohol(Merck KGaA, in Germany) was used as received. Other chemicals were reagent grade and used without further purification.

2.2 Grafting procedure

The PE film of size 5× 5cm was irradiated by electron beam under atmospheric pressure and ambient temperatures, and then immediately irradiated PE film was reacted with monomer. The monomer and homopolymer after grafting of AAc were removed with distilled water and then

methyl alcohol. PE film obtained by grafting copolymerization was dried in vacuum oven at 60℃ for 7hrs. To study the effects of various parameters on the grafting copolymerization, the degree of grafting is defined as

$$\text{Grafting yield}(\%) = ((Wg - W_0)/W_0) \times 100$$

Where Wg and W_0 denote the weights of the grafted and the ungrafted PE film, respectively.

3. RESULTS AND DISCUSSION

Figure 1 shows the effects of total irradiation dose on the grafting of AAc onto PE film with a various thickness at 60℃ for 1hr in MeOH in the presence of both 0.2wt%$FeSO_4 \cdot 7H_2O$ and 0.01 vol.% H_2SO_4.

The degree of grafting increases with total irradiation dose. In the case of PE film with porosity, the degree of grafting is higher and is 148% at dose 38.9kGy.

The effects of AAc concentration on the grafting of AAc onto PE film at 60℃ for 1hr in MeOH in the presence of both 0.2wt%$FeSO_4 \cdot 7H_2O$ and 0.01vol.% H_2SO_4, as a function of various irradiation doses are showed in Figure 2. As irradiation doses and AAc concentrations increase, the grafting yield becomes high. The degree of grafting increases rapidly above the irradiation dose of 20.9kGy.

The reaction time on the grafting of AAc onto PE film irradiatied with 16.7kGy at 30℃ is showed in Figure 3. The grafting yield increases with increasing reaction time..

Figure 4 shows the effects of additives on the grafting of AAc onto PE film at 30℃ for 1hr in MeOH in the presence of both 0.2wt%$FeSO_4 \cdot 7H_2O$ and 0.01 vol.% H_2SO_4 and in the absence of them. Here, irradiation dose is at 20.9kGy, and the thickness of PE film is at 500 ㎛. In the presence of both 0.2wt%$FeSO_4 \cdot 7H_2O$ and 0.01 vol.% H_2SO_4 the grafting yield is higher than in the absence of them.

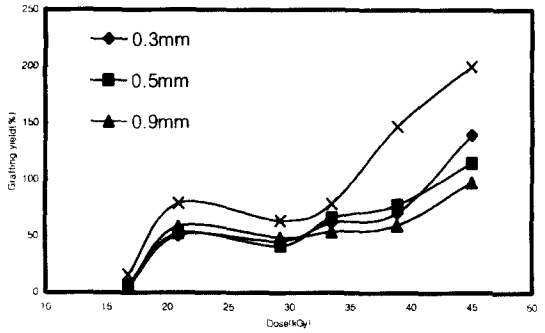

Figure 1.

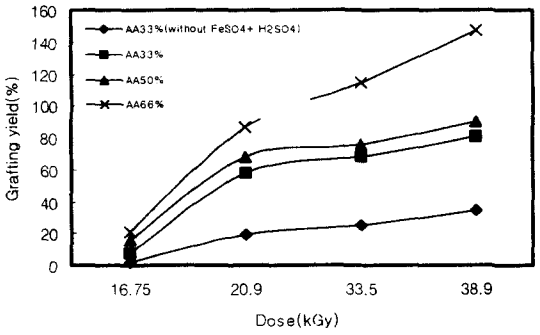

Figure 2.

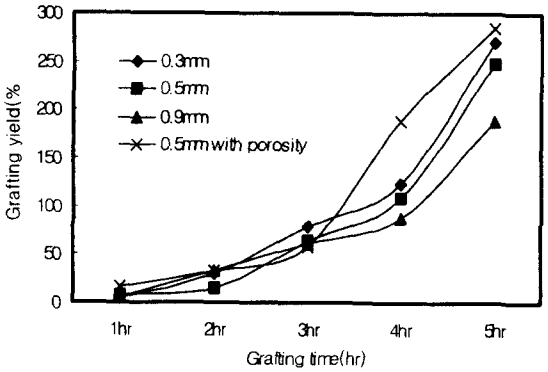

Figure 3.

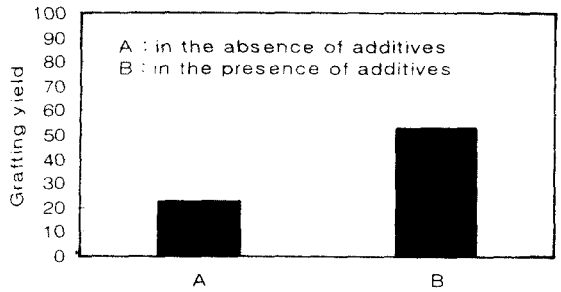

Figure 4.

REFERENCES

Choi S. H. and Nho Y. C., "Readiation-induced graft copolymerization of mixture of acrylic and acrylonitile onto polypropylene film", *Kor. Polym. J.*, 6(4), 287(1998).

Choi S.H and Nho Y. C., "Adsorption of Co^{2+} by stylene-g-polyethylene membrane bearing sulfonic acid proups modified by radiation-induced graft copolymerization", *J. Appl. Polym. Sci., in press*(1999)

Giovannoni R. T. and Vaidyanthan H., "Separators for nicel-hydrogen batteries", *Braz. Pat. BR 8804397(1989)*

Haddadai-Asi V., Burford R. P., and Garnett J. L., "Radiation graft modification of ethylene-propylene rubber-Ⅱ. Effect of additives", *Radiat. Phys. Chem. 45(2), 191(1995)*

Choi, S. H., Nho, Y. C. and Kim, G. T., "Adsortion of Pb2+ on Polyethylene Membrane with Amino Group Modified by Radiation-induced Graft Copolymerization", *J. Appl. Polym. Sci., 71, 643(1999)*