APPLICATION OF RADIATION GRAFTING TECHNIQUES TO PREPARE THE HIGH MOLECULAR WEIGHT WATER-SOLUBLE POLYMER

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INTRODUCTION

The high molecular weight water-soluble polymers is one of the materials that can be prepared from hydrophilic monomers/or polymers based on polymerization; crosslinking/ or grafting processes by using the chemical or radiation methods. When the water-soluble polymers are crosslinked by radiation or thermal-chemical catalyst, they produced new materials that only swelling and unsoluble in water or partly soluble in water.

Hydrogels have become increasingly important for use in separation processes including microfiltration, ultrafiltration, gas permeation, pervaporation, dialysis and reverse osmosis [1]. In the biomedical field, hydrogels are used in diagnostic, therapeutic, and implantable devices such as catheters, biosensors, artificial skin, controlled release drug delivery systems, and contact lenses[2-3]. The hydrogel was also supposed to be used as a carrier for immobilizing microorganisms for wastewater [4]. Hydrogels may contain functional groups that interact with the external environmental conditions such as temperature, ionic strength, and pH of the swelling media [5-7]. In parallel the above-mentioned applications, the hydrogel was also studied for use in exploration, production and recovery of petroleum oil. In 1964, Necmettin Mungan reported that the use of dilute aqueous polymer solution could recover more oil than is 30% in comparison with ordinary water flood from linear and radial flow models in the laboratory [8]. By the studied results obtained, Mac William [2] showed that the polymers were used for oil recovery must have one or more six functions: i) water-loss control; ii) viscosity control; iii) flocculation; iiii) suspension (dispersion); iiiii) turbulent friction reduction; iiiiii) mobility control. The research and application of the dilute aqueous solution of polysaccharide, poly (acrylamide), carbonyl methylcellulose and poly(ethylene oxide) to reduce the mobility of oil reservoir and to increase the oil-water ratio have been carried out in the decade' s 60. In many cases, the amount of oil recovered is increased by 30 to 50% over that which would have been realized with water alone. However, the application of the original water-soluble polymers still have some problems in stability for long periods of time, frequently at the high temperature, pressure and salinity. Some easily decomposed of them for example polysaccharide (xanthan gum) or CMC, and precipitated in the mineral and the high salinity media, at the high pressure and temperature conditions [2-3].

Nowadays, the Daw Chemical and Getty Oil companies have commercialized several polymeric materials for production and oil recovery but these were only used at temperature of 60 to 80°C. Meanwhile most of oilfields, in Vietnam, were at high temperature (from 90 to 140°C). Therefore the above-commercialized products are not suitable to be utilized for the oilfields in our country. As we known that the property of many polymeric materials can be improved by the radiation modification techniques such as cosslinking/ or grafting.

This report briefly presents the results on the preparation of the high molecular weight water-soluble polymers by radiation grafting and their properties.

RESULTS AND DISCUSSION

Preparation of high molecular weight polymer

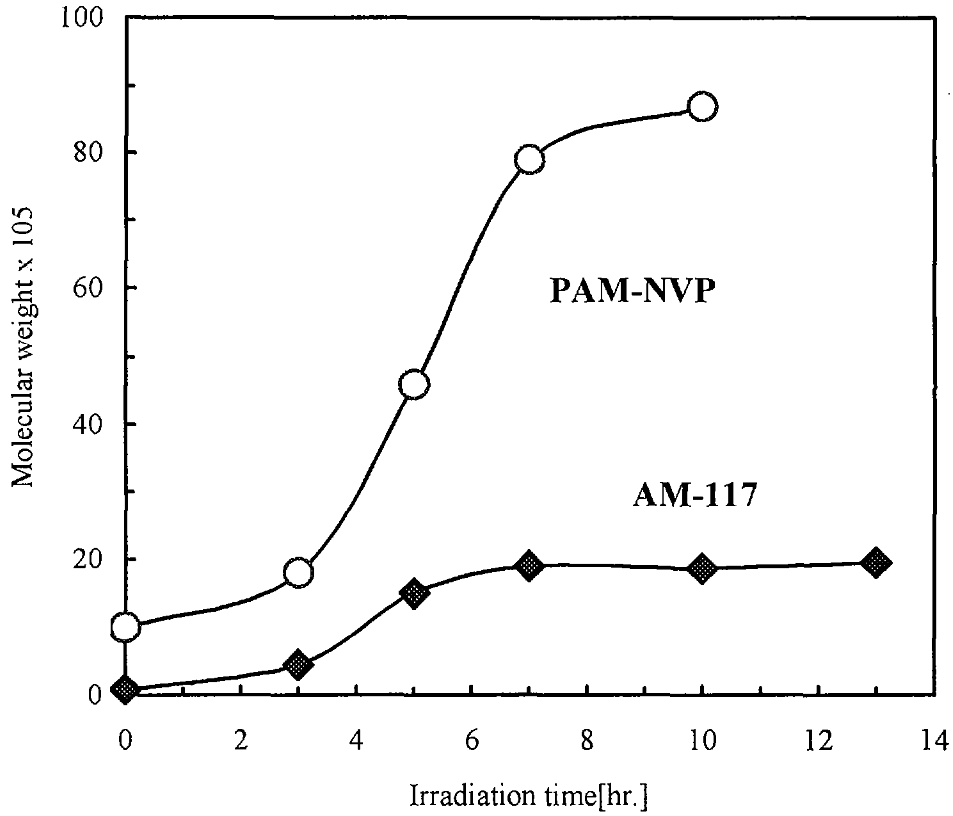

Fig. 1. Molecular weight of grafted polymers virsus irradiation time, dose rate of 1.4kGy.h^{-1} and at room temperature

The results from Fig. 1 show that molecular weight of AM-117 (polyvinyl alcohol 117 was grafted with acrylamide monomer) and PAM-NVP (polyacrylamide was grafted with N-vinyl pyrrolidon) systems increase rapidly with the increase of irradiation time. In case of PVA, the molecular weight increase 20 times at 5kGy in irradiation while for PAM, the molecular weight increase more The results from Fig. 1 show that the molecular weight of AM-117 (Poly vinyl alcohol 117 slowly than for the first case.

The effect of acrylamide concentration on grafting was presented in Fig. 2. It can be seen that the viscosity of grafted polymer solution increased with the increase of acrylamide concentration. The viscosity of grafted polymer solution in case of 30% acrylamide increase so fast. It is very difficult for controlling process.

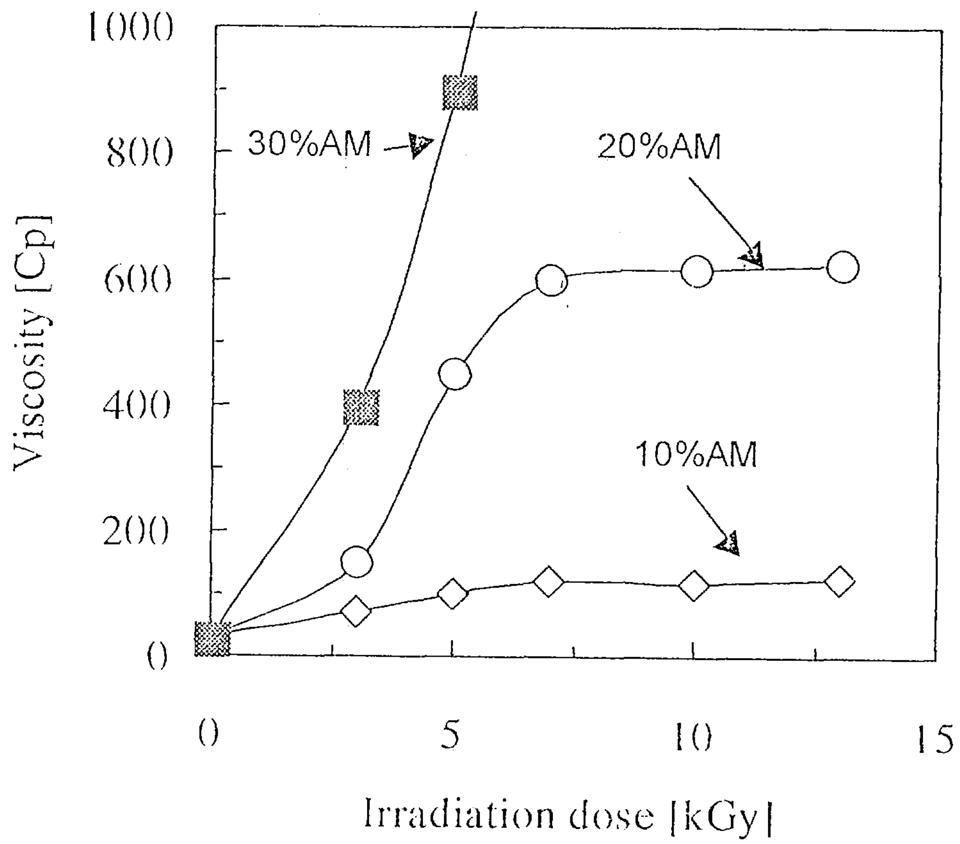

Fig. 2. Effect of acrylamide concentration onto grafting of polyvinyl alcohol. Dose rate of 1.4 kGy

The thermal stability of grafted polymer solutions are showed in Table 1 and 2

Table 1. The viscosity of grafted polymer solution before heating

No.	Testing date	Code	Content pm	Dose (kGy)	Viscosity cP	Density g/cm³
1	20/ 8/ 2001	HPAM-NVP	1000	12.0	83.5	1.038
2	above	PVA-AM	2000	12.0	103,34	1.033
3	above	PVA-MMA	5000	12.0	>100	-
4	28/12/2001	PVA-AM	10000	6.0	>100	-
5	above	PVA-AM	15000	6.0	>100	-
6	above	-	2000	6.0	>80	-
7	16/1/2001	PVA-AM	10000	12.0	174	-
8	above	PVA-AM	15000	12.0	184	-
9	01/4/2002	PAM-AM	15000	12.0	41.0	-
10	above	PAM-AM	5000	12.0	47.0	-
11	above	PAM-AM	15000	12.0	60.0	-

Table 2. The viscosity of grafted polymer solution after heating for 20days, at 140°C

No.	Testing date	Sample code	Content ppm	Dose (kGy)	Viscosity cP	Heating time (hr.)	Status of sample
1	20/ 8/ 2001	HPAM-NVP	1000	12.0	3.73	240	Non
2	above	PVA-AM	2000	12.0	23.12	above	Non
3	above	PVA-MMA	5000	12.0	0.98	above	Precipitate
4	28/12/2001	PVA-AM	10000	6.0	2.53	240	Precipitate
5	above	PVA-AM	15000	6.0	2.67	above	Precipitate
6	above	**SANYO**	2000	6.0	**0.95**	above	Precipitate
7	16/1/2001	PVA-AM	10000	12.0	20	240	Non
8	above	PVA-AM	15000	12.0	31	above	Non
9	01/4/2002	PAM-AM	15000	12.0	12.0	480	Non
10	above	PAM-AM	5000	12.0	4.4	above	Non
11	above	PAM-AM	15000	12.0	20.0	above	Non

From the results obtained we can see that the grafted polymer was improved clearly in the stability in the high pressure and salinity condition, after heating for 20days, at 140°C.

CONCLUSIONS

From the results obtained, it can be concluded that:

- By radiation grafting, the molecular weight of PVA was increased 20 times, and PAM was increased only 3 times
- The thermal and medium stability of poly(vinyl alcohol) grafted with acrylamide was obviously improved. The grafted PVA with acrylamide can be used at the high temperature and salinity conditions.

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