Sulfonation of Styrene–co–EGDMA gels

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INTRODUCTION

Ion Exchange resins represent an important class of materials which have different research and industrial applications[1]. Sulfonated resins can be applied as catalysts in reactions such as etherifications, esterifications and biodiesel production[1,2]. The current literature presents many studies on styrene-co-divinilbenzene (SDVB) sulfonated gels. From molecular point of view, divinilbenzene is a relatively small molecule, which, in theory, entails polymer networks with main chains close to each other, limiting accessibility from molecules to the gel. In this context, it is worth testing different crosslinkers with longer chain extents in order to verify their impact on the ion exchange capacity (IEC) of novel resins. The present work aimed to study the production of sulfonated resins of styrene crosslinked with ethylene glycol dimethacrylate (EGDMA). A shrinking core mathematical model based on differential molar balance was developed for the sulfonation process and its predictions were evaluated.

METHODOLOGY

Suspension copolymerizations of styrene with ethylene glycol dimethacrylate in presence of toluene and heptane were carried out in batch reactor of 1 L during 6 h at 80°C. The polymer particles produced were washed, dried and sulfonated with H_2SO_4 98% at different temperatures. Table 1 and Fig. 1 summarize conditions and results.

Table 1 – Experimental data and parameter values.

Run	Y_m	Y_{dma}	Y_{tol}	T (ºC)	Yield (%)	D_A (cm²/s)	K (cm/min)
1	0.3	0.1	0.4	50	28	$1x10^{-9}$	0.001
2	0.3	0.3	0.5	65	55	$3x10^{-8}$	0.040
3	0.4	0.3	0.6	50	100	$7x10^{-8}$	0.006
4	0.4	0.5	0.4	65	64	$2x10^{-8}$	0.040
5	0.5	0.1	0.6	65	32	$2x10^{-10}$	0.045
6	0.5	0.5	0.5	50	89	$1x10^{-7}$	0.001

Y_m and Y_{tol} are volumetric fractions of monomer in the organic phase and toluene in the solvents mixture respectively. Y_{DMA} is the molar fraction of EGDMA in the monomer mixture.

The diffusion coefficient of H_2SO_4 to the particle (D_A) and rate coefficient (K) were the model parameters.

RESULTS AND DISCUSSION

Experimental results indicate that EGDMA is an alternative crosslinker to produce styrene-based ion exchange resins.

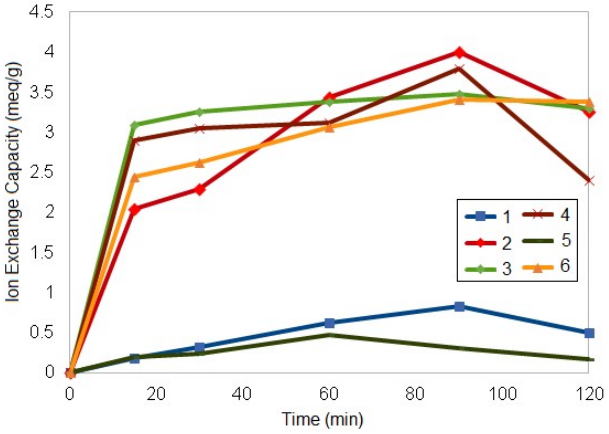

Fig. 1 – Experimental IEC results.

Most of obtained IEC values are in the range 2 – 4 meq/g, which reaches commercial specifications of SDVB resins such as Amberlyst®. Parameter values obtained with shrinking core model are in agreement with gel characteristics expected from each initial condition.

CONCLUSION

Sulfonated Styrene-co-EGDMA is a promising material to be applied as an ion exchange resin. Experiments suggest that compositions in the range 30% – 50% of EGDMA in the copolymerization process can produce resins with IEC of about 3 meq/g. At low sulfonation temperatures, the polymer yield can be increased.

REFERENCES

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