Synthesis of Crosslinked Poly(vinyl chloride): Study of Polymer Properties

Tomás[1],A., Gil[2], M.H., Bordado[3], J.C., Gonçalves[1], P., Rodrigues[1], P.
[1] Companhia Industrial de Resinas Sintéticas, CIRES, S.A., Estarreja, Portugal
[2] Chemical Engineering Department, Coimbra University, Coimbra, Portugal
[3] Chemical Engineering Department, Instituto Superior Técnico, Lisboa, Portugal

Keywords: Poly(vinyl chloride), copolymerization, crosslink, polymer properties.
Topic: Advancing the Chemical and Biological Engineering Fundamentals

The world consumption of poly(vinyl chloride) (PVC) in 2007 was around 33.5 million of metric tons, only second considering the different types of poly(ethylene) (Bryen, 2007). Although the vast majority of applications are linked directly with its excellent mechanical properties, compatibility with additives, recyclability and good cost to performance ratio, the major disadvantages comes from its lower heat stability and limited range of temperatures on the final applications (Beltran *et al*, 1998; Yong-Zhong *et al*, 1999). To overcome these deficiencies, the application of the copolymerization technique intends to incorporate a new monomer on the poly(vinyl chloride) growing chain, in order to provide new properties or improve the original ones (Burgess, 1982)

A particular type of copolymerization, consists in the application of a small amount of a difunctional (divinyl or diallyl) monomer to prepare a chemically crosslinked PVC (Burgess, 1982). Besides other properties, this technique has been continuously studied and developed for the production of special polymers for matte surfaces in top coated finished products (Amano *et al*, 1992; Yong-Zhong *et al*, 1999; Koga *et al*, 1997).

The crosslinked polymer normally follows significant changes on the structure and final behaviour of the material. If previous soluble in the presence of a solvent, the crosslinked polymer swells as the solvent penetrates the network, producing a solvent-swollen crosslinked polymer so called a gel (Stevens, 1990).

The denominated crosslinking agents, such as divinylbenzene, glycol dimethyl acrylate, diallyl maleate or phthalate, have been reported on the literature as efficient gel promoters (Burgess, 1982). Nevertheless, a new investigation was carried out with new difunctional monomers, like ethyl glycol dimethyl acrylate (EGDMA), polyethylene glycol dimethyl acrylate (PEG Mn: 550) and the correspondent high molecular weight (PEG Mn: 750). Also, besides the study of the effect of co-monomer dosage on the obtained gel fraction, the study of the correspondent thermostability and influence on Tg, can give a valuable information over the produced copolymer and potential market applications.

Moreover, the application of a given standard formulation and procedure for the processing of the final crosslinked polymer, can provide a further evaluation of its processability, mechanical toughness and type of obtained top surface (matte/bright).

Figure 1, shows the polymer gel fraction *versus* the EGDMA dosage on a vinyl chloride suspension polymerization. Also, in figure 2, the obtained matte top effect of a crosslinked polymer dry blended with a homopolymer product in different mass fractions.

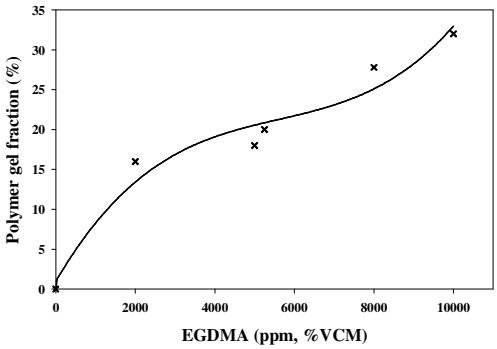

Figure 1: Polymer gel fraction *versus* the EGDMA dosage on the vinyl chloride suspension polymerization.

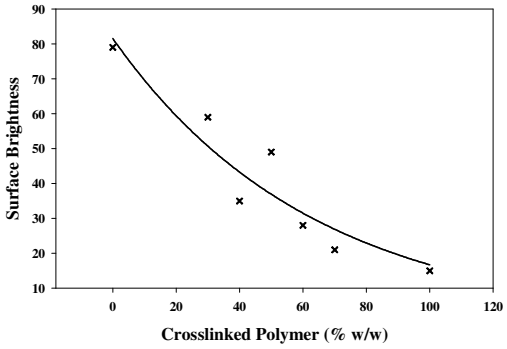

Figure 2: Matte top effect of a crosslinked polymer dry blended with a standard homopolymer in different mass fractions.

Acknowledgments

The financial support of FCT, SFRH/BDE/15534/2005, is gratefully acknowledged.

References

Bryen, S. (2007). Vinyls Industry update. *World Vinyl Forum 2007*, Boston, USA.

Yong-Zhong, B., Zhi-Xue, W., et al. (2000), Synthesis of chemically crosslinked poly(vinyl chloride) by vinyl choride/divinyls suspension polymerization. *Europ. Polym. Journal*, 36, 981-986.

Beltran, M.I., García, J.C., et al. (1999), Thermal decomposition behaviour of crosslinked plasticized PVC. *Polymer Degradation and Stability*, 65, 65-73.

Amano,T., Hoshida, S. (1992). US patent, 5,130,387.

Koga, T., *et al.* (1997), US patent, 5,614,593.

Burgess, R.H. (1982), Manufacture and Processing of PVC, Applied Science Publishers LTD, London, UK.

Stevens, M.P. (1990). Polymer Chemistry 2nd Edition. Oxford University Press, New York, USA.

* Corresponding author. Tel + 351-234-811212. E-mail: arnaldo.tomas@cires.pt