DOSE EFFECT ON THE TENSILE STRENGHT OF NATIONAL POLYPROPYLENE

MUSICO F$^{\underline{o}}$, W. & GUEDES, S.M.L.
Instituto de Pesquisas Energéticas e Nucleares, IPEN-CNEN/SP
Cx.P. 11049, CEP 05499-970 - São Paulo/SP - Brasil

INTRODUCTION

Polypropylene (PP) is a thermoplastic polymer employed in the medical supplies fabrication, which must be sterilized before the use. The radiosterilization has advantages and it is a commercial process world-wisely employed since 60's. In Brazil this process is employed at little scale. The PP radiosterilization can change its properties as consequence of crosslinking and main chain scission [1]. When the isotatic PP is irradiated with dose < 400 kGy the hydrocarbon radicals are formed as consequence of main chain scission [2,3]. The peroxy radicals are formed in the amorphous region in the presence of air and decay by diffusion controlled mechanism [3]. In the cristalline region the hydrocarbon radicals are stables and they migrate to amorphous region slowly and they react with O_2 [4,5]. These reactions affect the TS of radiosterilized PP.

In this paper will be presented only the dose effect on the tensile strenght (TS) during 30 days of post-irradiation of national PP. The facts were related to radicals formation.

METHODOLOGY

The isotatic national PP is a commercial product. Its cristallinity is about 80% [6]. The dumbbell-shaped samples was prepared by injection at 180 °C [6] and they was irradiated with γ-rays, from Co^{60} source (dose rate = 1,1 kGy/h) in the presence of air at room temperature. The dose range was 0-150 kGy. These samples was maintained in the presence of air and in the absence of light at room temperature and the tensile testings were obtained after 0-30 days of irradiation end according to the ASTM D-638.

RESULTS AND DISCUSSION

The Figure 1 shows the post-irradiation time effect on the TS. The TS of no irradiated PP is 2960 MPa. Immediately the irradiation and the TS decreases only about 8% up to 100 kGy. During the irradiation of PP (or PPH) the polimeric radicals formation (P. and .PH) occurs as consequence of the main chain scission (reaction 1) and the C-H bond (reaction 2) [4,2]. The radicals formed in the cristalline region are

$$PPH \rightsquigarrow P. + .PH \quad (1)$$

$$PPH \rightsquigarrow PP. + .H \quad (2)$$

stables and they migrate to amorphous region slowly [4,2]. The peroxy radicals formed in the amorphous region as consequence of oxidation reactions and they decay by diffusion controlled mechanism more quick than hydrocarbon radicals [3]. When the dose=150 kGy the TS decreases about 38 %. The processing additives protect the PP up to 100 kGy [7] but with 150 kGy they lose the efficiency partially.

Post-irradiation effect (dose <100 kGy) shows the TS increases up to about 2960 MPa in the sixth day after that it decreases slowly. The radicals formed in the cristalline region with small mobility migrate slowly and react among themselves (reactions 3-5). The reaction 3 of crosslinking predominates. After sixty day the oxidation reactions occur [3,8].

$$P. + P. \longrightarrow PP \quad (3)$$

$$PP. + PP. \longrightarrow PPPP \quad (4)$$

$$P. + PP. \longrightarrow PPP \quad (5)$$

The Figure 2 shows the dose effect on the TS of PP for three times of post-irradiation: 0, 6 and 30 days. When the dose increases up to 5 kGy the TS decreases lightly and becames constant up to 100 kGy. From 100 kGy the TS decays pronounced but it is independent of post-irradiation time. The TS is biggest in the sixty day after the irradiation end.

Nevertheless TS has the same value immediately and 30 days of irradiation end. The radicals are being to investigate by ESR.

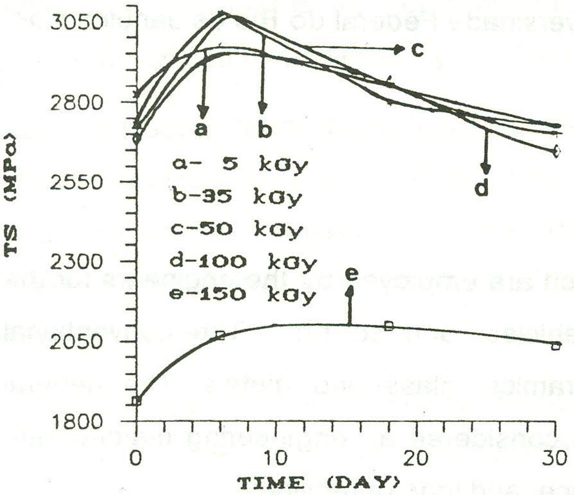

FIGURE 1 - Post-irradiation effect on tensile strenght.

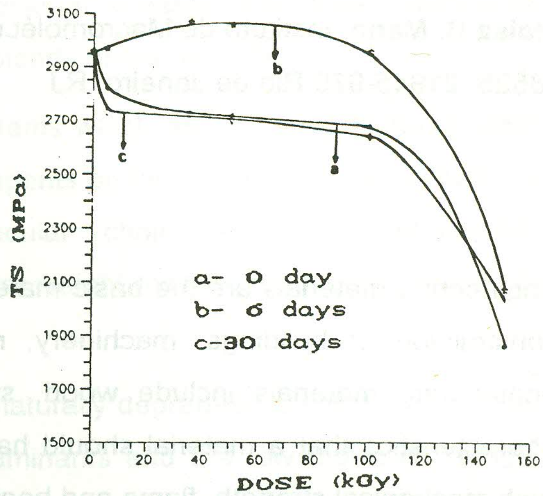

FIGURE 2 - Dose effect on tensile strenght

CONCLUSION

The radiosterilization of national PP produces a small decrease of 8% on the TS and it has the same value after 30 days of irradiation end.

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