MOLECULAR RADIOLYTIC DEGRADATION OF NATIONAL POLYCARBONATES

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INTRODUCTION

Actually in Brazil a new series of polycarbonates (PC) are commercialized which are fabricated with reagents of high purity. This new material has high stability and needs only a small amount of processing additives [1]. These kinds of polycarbonates are also used in medical applications and they require sterilization before use. The best efficient method of sterilization is by gamma radiation at a dose of 25 kGy [2]. At this dose the polycarbonate does not change its mechanical properties [3], but the scissions in the main chain of polymer cause changes in its optical properties produzing a yellowness which is not desirable in medical applications.

The national PC of old series was already radiolitically stabilized by the incorporation of the sinergic mixture of additives [4]. The radiolytic stabilization of the new series of PC, will be studied and compared with the old PC series.

The radiolytic degradation was quantitative evaluated through the viscosity at the molecular level and through the tensile strength (TS) at macroscopic level.

EXPERIMENTAL

The new series of PC made in Brazil is mainly used in medical applications. This polymer has good stability and the molecular weight is 22000 g/mol. The samples for mechanical testing was made by injection process and they were irradiated with γ rays at a doses between 0 to 300 kGy. The testings of TS were carried out using an INSTRON, dynamometer, model 1125 according to the ASTM - D638.

The viscosity measurements were perform with a UBBELOHDE viscometer,

using purified dichloromethane solvent with 6 g/L of PC. The viscometric average molecular weight, $\bar{M}v$, was obtained using the equation 1 [4], where $[\eta]$ is the intrinsic viscosity.

$$[\eta] = 1.23 \times 10^{-5}\ \bar{M}v^{0.83} \qquad (1)$$

RESULTS AND DISCUSSION

The radiation interaction with polymers can causes the crosslinking and/or the scission of the main chain, which affect the properties of the material.The irradiation in polycarbonate produces scissions of the main chain and consequently the formation of phenyl and phenoxy radicals [5].

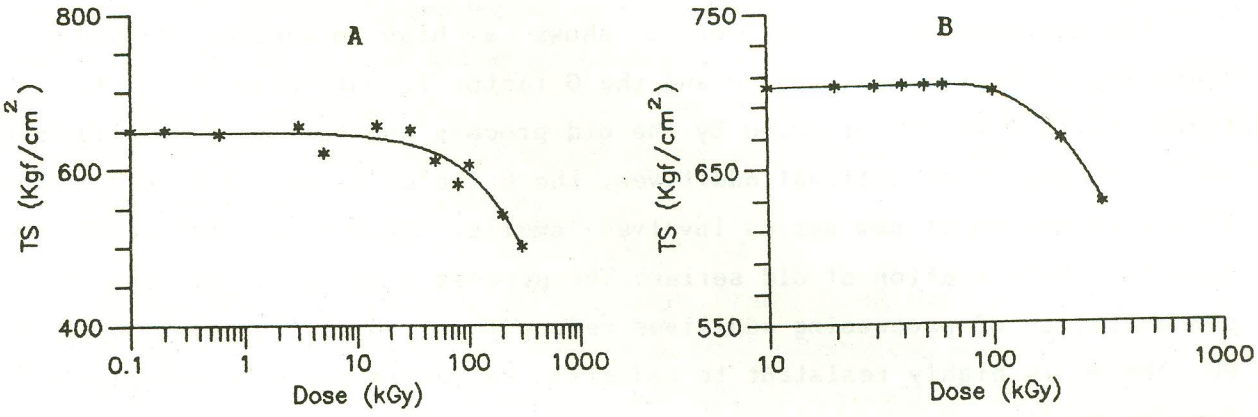

Figure 1 - Dose effect on TS of PC a) old series; b) new series.

The Figure 1 shows that TS doesn't change up to 80 kGy approximately. The degree of molecular degradation caused by radiation can be calculated from the figure 2. The G value was obtained by equation 2, were G is the

$$10^{6}/\bar{M}v = 10^{6}/\bar{M}v' + 0{,}054\ G\ R \qquad (2)$$

number of main chain scission by 100 eV of absorbed energy R is the dose in kGy, $\bar{M}v'$ and $\bar{M}v$ are the viscometric average molecular weight of no-irradiated and irradiated PC respectively.

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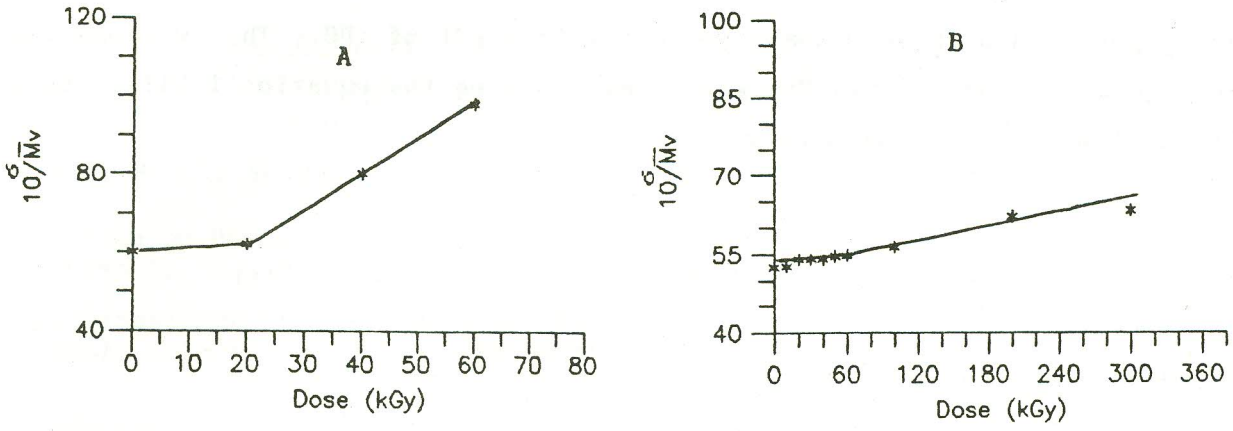

Figure 2 - Dose effect in the molecular degradation of PC
a) old series b) new series

CONCLUSION

The national PC of new series shows a high molecular radiolytic stability at sterilization dose and the G factor is only 0.73 while the G factor is 16.7 for PC produced by the old process and when it is stabilized radiolitically, with national additives, the G factor is only 0.4 [4]. The PC stabilization of new series involves smaller quantities of additives than the stabilization of old series. The process impurities or the high concentration of processing additives reduce the radiolytic stability of PC. The PC is highly resistant to radiation but it reacts with radiolytical species easily.

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