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# ELECTRON BEAM RADIATION EFFECTS ON RECYCLED POLYAMIDE-6

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Applications of electron beam processing in the treatment of polymers are commonly used. The interaction of high energy radiation with polymers may cause permanent modifications in the polymer's physicochemical structure. The induced modifications may result in degradation of the polymer or in improvement of its properties (crosslinking), which are simultaneous and competing processes, depending on the radiation dose utilized. Crosslinking occurs more readily in the polymer's amorphous content and this process makes the glass transition temperature (Tg) of the polymers to increase [1,2].

Successive recycling cycles promote changes in polymers properties, such as breaking of structure, molecular weight reduction, melt index increase and mechanical resistance reduction [3].

The polyamide-6 resin was recycled for three successive recycling cycles and the polyamide-6 specimens were molded by the process of injection molding. These specimens were irradiated at the Nuclear Energetic Research Institute (IPEN) radiation facility, on a JOB 188 model accelerator, with a 1.5 MeV electron beam, doses of 200, 300, 400, 500 and 600 kGy, and dose rate of 22.61 kGy/s. The DMA tests were performed using DMA-983 equipment from TA Instruments and two heatings were adopted in order to eliminate the moisture absorption. The X-ray diffraction analysis was carried out at the Philips PW 1830 model equipment.

It may be observed in Table 1 that after the second heating, the Tg decreased, specially in the virgin polyamide-6. The cooling process was very slow (~40 min), so that modifications should have been introduced into the polymer's molecular structure and this affects the glass transition temperature. For this reason it was considered only the first heating DMA data. The recycled and virgin samples present an increase in *Tg* as a function of the radiation dose.

Table 1: Virgin and recycled polyamide-6 glass transition.

| Dose (kGy) | Tg virgin (º C) First heating | Tg virgin (º C) Second heating | Tg recycled (º C) First heating | Tg recycled (º C) Second heating |
|---|---|---|---|---|
| 0 | 70.8 | 70.0 | 72.7 | 72.6 |
| 200 | 71.3 | 69.9 | 74.5 | 74.2 |
| 300 | 72.7 | 67.6 | 76.4 | 74.0 |
| 500 | 74.2 | 69.4 | 78.9 | 77.7 |
| 600 | 76.0 | 71.4 | 76.4 | 74.9 |

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Figures 1 and 2 present the X-ray diffraction diagrams of polyamide-6, virgin and recycled, irradiated at different doses. It was observed that for these specimens the crystallinity has not changed.

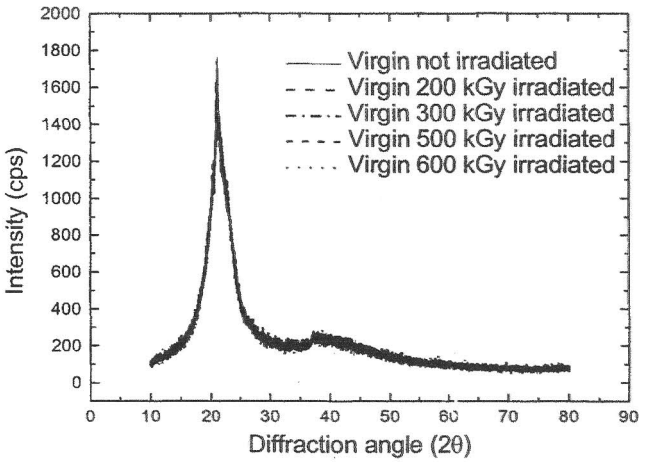


Figure 1: X-ray diffraction diagrams of virgin polyamide-6 irradiated at different doses.

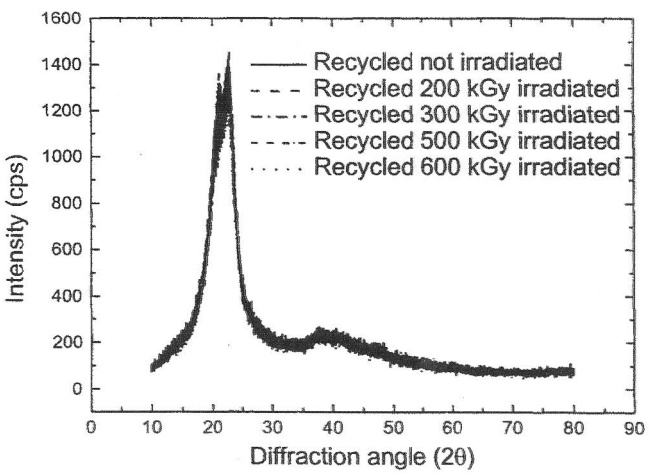


Figure 2: X-ray diffraction diagrams of recycled polyamide-6 irradiated at different doses.

## REFERENCES

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