RADIATION EFFECTS IN PA6/EPDM BLENDS

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Purposes of study

Investigation of elastomer effects on radiation stability of polyamide 6

Preliminary qualification of PA6/EPDM as cable insulation
Materials

The compositions of blends consists of PA-6 as basic component and EPDM at different loadings (0, 10, 20 and 30 wt%).

Irradiation

The exposure to $\gamma$-radiation ($^{137}\text{Cs}$) was performed in air at room temperatures at five total doses: 10, 25, 50, 100 and 160 kGy dose rate being 0.4 kGy.h$^{-1}$. 
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RESULTS AND DISCUSSION

The availability of polyamide-6 to provide radicals during radiation processing is related to the energetic differences of bonds (bond energies expressed in kJ mol^{-1}: C – N 293, C – C 348, N – H 391, C – H 413).

Radiation stability of PA6 is higher than the radiochemical strength of EPDM.
FT-IR spectroscopy

FTIR spectrometer JASCO 4200 (Japan) in the attenuated total reflection mode (ATR).
FT-IR spectroscopy

ATR/FTIR spectra in interesting ranges recorded on unirradiated PA-6/EPDM blends:
(1) 100:0, (2) 90:10, (3) 80:20, (4) 70:30
FT-IR spectroscopy

Variation of carbonyl index for PA-6/EPDM blends

- (■) 100/0
- (●) 90/10
- (▲) 80/20
- (▼) 70/30
Chemiluminescence

\[ R'\overline{C}R'' \xrightarrow{O^*} R'\overline{C}R'' + h \]
Chemiluminescence

Isothermal CL spectra recorded on inirradiated PA6/EPDM blends at 210 °C.
PA6/EPDM concentrations: (1) 70:30 (2) 80:20 (3) 90:10
Isothermal CL spectra recorded on PA-6/EPDM (80/20) samples at 200 °C in air after γ-irradiation. (1) 0 kGy; (2) 10 kGy; (3) 50 kGy; (4) 160 kGy.
Chemiluminescence

Nonisothermal CL spectra recorded on two PA-6/EPDM formulations irradiated at different doses.

- (■) 0 kGy;
- (●) 10 kGy;
- (♦) 25 kGy;
- (▲) 50 kGy;
- (♦) 100 kGy;
- (▼) 160 kGy.
Scanning electron microscopy

SEM - Auriga (Carl Zeiss, Germany)
Scanning electron microscopy

SEM photos on PA6 and PA6/EPDM (80/20) after their exposure to 100 kGy
Conclusion

The increase in the elasomer loading induces an advanced degradation degree, as the irradiation dose brings similarly about. The separation of the two phases works effectively, because the interchain bridges are not formed as chemical bonds.

The growth in carbonyl indexes is not too large as elastomer concentrations are different, because the polyamide-6 is a barrier for oxygen diffusion in the feeding of inner oxidation.
Thank you for your attention