

DOI: <http://doi.org/10.21698/simi.2025.ab24>

## THERMAL AND RADIATION AGING EFFECTS ON SBS/EPDM POLYMER BLENDS: INFLUENCE OF $\gamma$ -IRRADIATION AND HEAT TREATMENT ON MATERIAL PROPERTIES

Marius Bumbac<sup>1</sup>, Cristina Mihaela Nicolescu<sup>2</sup>, Traian Zaharescu<sup>3</sup>, Costel Bumbac<sup>4</sup>, Elena Elisabeta Manea<sup>4</sup>, Cosmin Ștefan Gherghinoiu<sup>2</sup>, Ion Valentin Gurgu<sup>2</sup>, Bogdan Cătălin Șerban<sup>5</sup>, Octavian Buiu<sup>5</sup>, Ana-Maria Hossu<sup>1</sup>

<sup>1</sup>Valahia University of Târgoviște, Faculty of Sciences and Arts, Sciences and Advanced Technologies Department, 13 Aleea Sinaia, 130004, Târgoviște, [marius.bumbac@valahia.ro](mailto:marius.bumbac@valahia.ro), Romania

<sup>2</sup>Valahia University of Târgoviște, Institute of Multidisciplinary Research for Science Technology, 13 Aleea Sinaia, 130004, Târgoviște, Dambovită, Romania

<sup>3</sup>INCIE ICPE CA, Radiochemistry Center, Bucharest, 313 Splaiul Unirii 030138, Romania

<sup>4</sup>National Research and Development Institute for Industrial Ecology-ECOIND, 57-73 Drumul Podu Dambovitei, district 6, 060652, Bucharest, Romania

<sup>5</sup>National Institute for Research and Development in Microtechnologies, IMT-Bucharest, 126 A Str. Erou Iancu Nicolae, 077190, Voluntari, Ilfov, Romania

**Keywords:** *ethylene propylene diene monomer rubber, polymer aging, styrene butadiene styrene,  $\gamma$ -irradiation*

### **Introduction**

Styrene-butadiene-styrene (SBS) and ethylene propylene diene monomer rubber (EPDM), along with their compounds, are widely used in clinical devices such as drug delivery systems (*e.g.*, infusion pumps and reservoirs), flexible medical tubing, and catheters. Blending SBS with EPDM in varying weight ratios enhances material properties. EPDM provides superior weather resistance, UV stability, and flexibility, while SBS improves elasticity, toughness, oxidation resistance, and processability. This study examines the effects of gamma radiation and temperature on SBS/EPDM compounds.

### **Materials and methods**

Polymer blends with different SBS weight contents (0% - E100, 25% - E75, 50% - E50, 75% - E25, 100% - E0) were prepared using an electrically heated laboratory roller mill (model ZG-160YRDB).

Samples underwent three treatments:  $\gamma$ -irradiation at 50 kGy,  $\gamma$ -irradiation at 50 kGy followed by heating at 100 °C (T1 procedure as denoted in the manuscript), and heating at 100 °C for one hour followed by a 50 kGy  $\gamma$ -irradiation (T2 procedure). Thermal analysis by differential scanning calorimetry (DSC), Shore A hardness tests, and specific weight analysis were conducted to analyze the effects of combined thermal and radiation aging on the polymer blends.

### Results and conclusions

Infrared spectroscopy (FTIR) analysis reveals structural changes, indicated by shifts and absorbance variations in the 1000–1100, 1600–1700, and 3200–3600  $\text{cm}^{-1}$  regions. DSC results show an exothermic effect near 200 °C for all samples, which shifts to lower temperatures in heated and/or irradiated samples, indicating structural modifications, oxidation reactions, and chain cleavage (Figure 1).

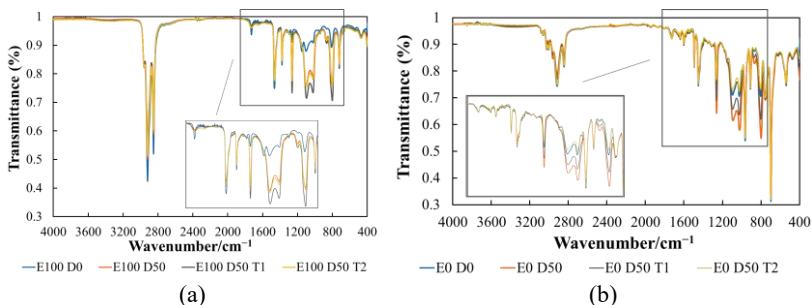


Figure 1. IR spectra of: a) E100, and b) E0 samples

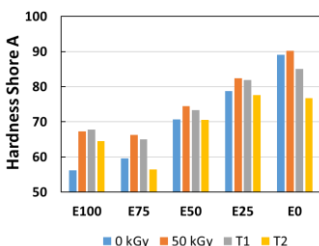


Figure 2. Hardness Shore A of aged blends

For the blends E75, E50, and E25, heating followed by irradiation causes more significant structural changes (Figure 2). Specific weight remains unchanged across treatments, while Shore A hardness increases. However, thermal treatment slightly reduces hardness in irradiated samples heated at 100 °C for 1 hour.

FTIR and DSC analyses were conducted to compare irradiated and non-irradiated samples, identifying new functional groups or changes in bonds that indicate degradation, cross-linking, or oxidation. While measured infrared spectra showed minor modifications, thermal behavior exhibited significant differences. Thermal treatment at 100 °C (a typical temperature for clinical laboratory conditions) following irradiation reduced Shore A hardness to values close to the initial samples.

### Acknowledgment

This work was supported by Ministry of Education and Research – UEFISCDI, project PN-IV-P7.1-PTE-2024-0653 – contract no: 38PTE/2025, and by project CNFIS-FDI-2025-F-0421.