ACCELERATED ELECTRON BEAMS FOR PRODUCTION OF HEAT SHRINKABLE POLYMERIC PRODUCTS AND PTFE WASTES RECOVERY

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Radiation curing, i.e. curing under the action of ionizing radiation (predominantly electron beams) is one of the most important areas of radiation processing.
There are many practical applications of electron beam processing. Our research activity was focused on two of them:

- radiation cross-linking of polymeric materials;
- recovery of PTFE wastes.

For this purpose we have used: an industrial electron accelerator ILU-6 with 2.5 MeV electron energy and 40kW beam power, equipment for the transport of materials under the electron beam, and a technologic line with typical equipment for the expansion process.

It is generally accepted that the result of polymer cross-linking process induced by irradiation is a three-dimensional network, where each polymer chain is linked to another one.

This structural change induces beneficial changes in mechanical and chemical properties and thermal stability of polymer.

In order to settle the radiation dose experimental measurements were done on different materials: polyethylene, polyethylene antioxidative stabilized and flame retardant polymeric compound. these samples had different wall thickness.

The material investigated had to provide some special properties:

- a large shrinkage range;
- tensile strength and elongation at break no less than a minimum value, (fig 1) ;
- heat resistance to allow a high temperature classification.

Cross-linked polymeric materials were used to obtain heat shrinkable products: tubes, sheds.

Because of their excellent features heat shrinkable products are suitable for a wide variety of applications such as electrical wire and cable insulation, voltage power cable joints, and voltage power cable indoor and outdoor terminations.

The main-chain degradation of polytetrafluoethylene (PTFE) wastes was another important technology where the electron beam curing was used.

Teflon is known as one of the most inert polymer towards heat, solvents and most corrosive chemicals. Moreover it has excellent grease properties, wear out resistance, electrical and mechanical properties.

In contrast it is extremely sensitive to radiation and suffers marked damage in its mechanical strength after very low radiation doses.

The researches were carried on to provide:

- the irradiation of samples with a radiation dose in the range of 0,3-62,4 kGy;
- elongation at break and tensile strength;
- weight loss.

The experimental results settled the irradiation dose for a high degradation of the polymer. The PTFE wastes became brittle and have been crumbled into powder with a special device.

After the milling of the PTFE wastes, granulometric measurements were carried out and the variation of the density with the milling time was determinate for different irradiation doses, (fig 2).

On the other hand, because of the gas removal (CO, CO_2, COF_2), during the PTFE radiation curing, the dependence irradiation dose-weight loss was determined..

Because of the main structural changes of the irradiated PTFE wastes, the powder was used to obtain semi-finished electrical and mechanical products, filler for special greases, metallic pieces covering, so.

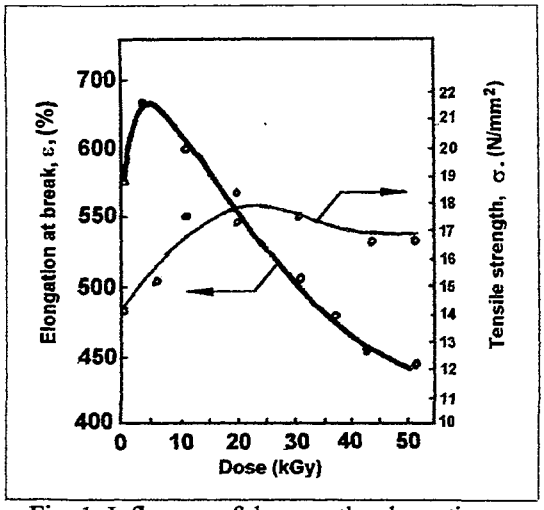

Fig. 1. Influence of dose on the elongation at break and tensile strength

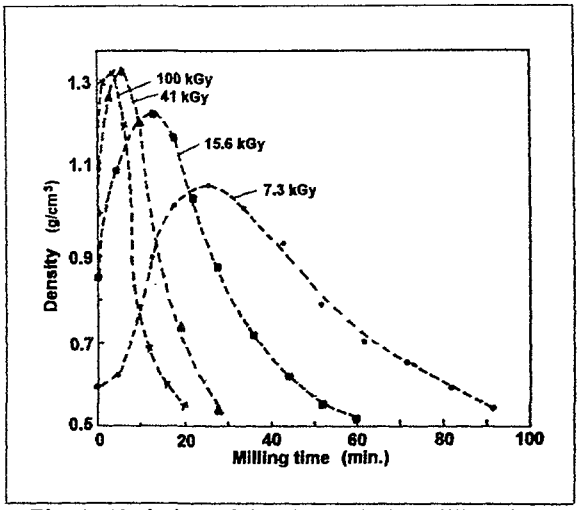

Fig. 2. Variation of density with the willing time subjected to various doses

REFERENCES:

1) MACHI, Sueo., "Prospects of Radiation Technology for Industrial and Environmental Protection" Interregional Training Course, Warsaw, Poland, Oct 1997
2) ZYBALL,A., "Irradiation Cross-linking of Polyethylene in the Presence of Polymerizable Additives", Kunststoffe, German Plastics 67 (1977) 8 p. 461.
3) MARIN, Gh., a.o., "Pilot Station for Materials processing by Irradiation with Accelerated Electrons" (Proc. RadTech Asia'95 Conference), Guilin, China, (1995) 481-486.