Invention of irradiated polymeric composites as nuclear ray counters

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ABSTRACT

This research demonstrates that gamma radiation could cause changes in the absorbance spectra of polymers. The study examines the feasibility of the effect of gamma rays on some physical properties, the degradation and cross-linking reactions resulting from irradiation was examined. The samples of pure epoxy were irradiated for (1,2,3,4,5,6 months). Observed changes in the color of epoxy composites, color varied from yellow up to dark brown gradually as a result of different radiation doses effect on the expose epoxy composites. The change in the color of the overlays as a result of nuclear radiation can be used as an indicator of the extent of exposure in time and its clear effects on its properties due to exposure to radiation. Gamma cell 900 was used in this study to irradiate all the samples. A series of composites has been prepared by adding lead powder with different masses to the epoxy resin. The degradation process slowed when the samples were exposed to radiation for longer time periods.

Key word: color variation of epoxy composites, gamma irradiation,

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Introduction:

Gamma ray's interactions with composites occurs by electronic excitation and electronic ionization and mainly by atomic displacement of orbital electrons. The effect of radiation on the material depends on the dose rate and parameters of the compound, including its thickness and composition. [1]. Radiation can extract hydrogen atoms from the epoxy chain and thus generate hydrocarbon radicals. Two of these radicals combine to form an extended epoxy molecule. With this process repeated, a polymer network is formed. Industrial applications of cross-linking by irradiation with gamma radiation doses do not require catalysts, so there are no catalyst residues in the final product that interfere with the physical properties. Two main things occur, degraded or entangled in the presence of the irradiation processes, as both processes usually occur simultaneously [2].

. Gamma-rays emitted by an artificial radioactive element. cobalt-60 was used to study the absorption coefficient of pure epoxy.

The probability of irradiation effects for a long period time for hard epoxy resin at plasma action and the change of FTIR absorption spectra were elucidating as shown in figure 1 [3].

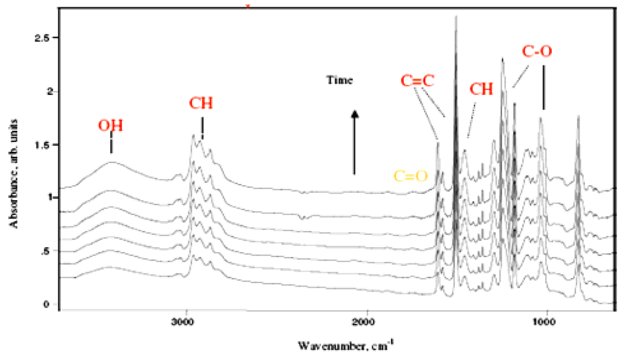

Fig.1: FTIR transmission spectra with time of plasma treatment.

Sample Preparation:

The mixing ratio is 3:1 by weight. The dimensions of all samples (12.5, 1, 6) cm.

Composites Preparation :

Epoxy and Lead composites prepared as a five variable weights (10,20,30,40,50) gm. of lead powder for several times irradiation. The irradiations were performed on five identical samples.

Gamma irradiation tests :

Test irradiation by gamma cell of Epoxy/Lead powder composites. Gamma cell 900 was used in this study to irradiation all the samples for (1, 2, 3, 4, 5 and 6 months). Co-60 Gamma cell was used as the irradiation source [5]. Samples were irradiated with various doses. The rate of the dose is (0.1669) KGy/h. The irradiated samples were checked with doses: 120,240,360,480,600 and 720 KGy.

One sample of pure epoxy was irradiated to six months to Study the effects of the long time dose irradiation and the probability variation of chemical structure of Epoxy resin.

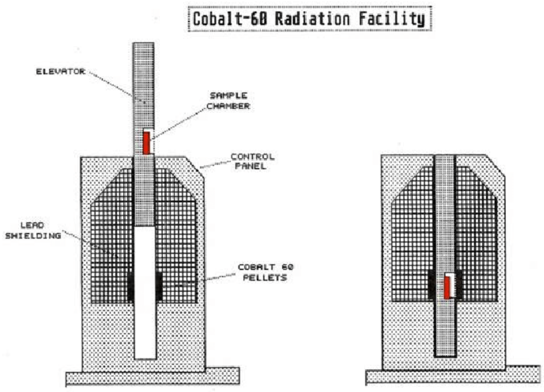

Fig 2: Gamma cell 900.

Results and conclusions:

The gradual color change of epoxy composites and the variation of its chemical properties dependence on the increasing of the time exposure doses as shown in figure (3). When the doses was less than 6.7 MGy , the curing process would dominant.

6-month 5m. 4m. 3m. 2m. 1m. Non-irradiated

Fig. 3: The effect of gamma irradiation dose of epoxy for different periods.

When the pure Epoxy expose to gamma source of Co-60, the absorption coefficient was found to be 0.141 1/cm for thickness (0.6 cm.).. The pure epoxy and the epoxy/lead powder irradiated to gamma ray with irradiation dose rate with respect to time [7].

Table (1) represent the time with dose of exposure for pure epoxy and its composites. Transmittance of epoxy with dose irradiation as shown in Figure (4).

Table 1: Time and gamma irradiation dose for pure epoxy and its composites.

Time	Dos(KGy)
0.0	0.0
1week	28.05468
2week	56.10996
3week	84.164
4week	112.2199
1month	140.274
2month	240.471
3month	360.706
4month	480.9425
6month	721.413

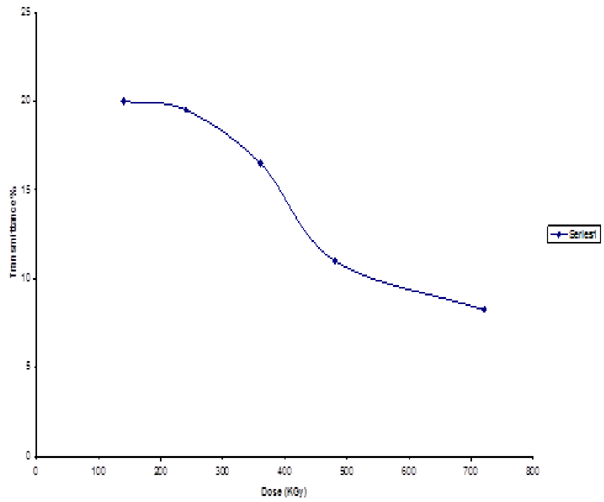

Fig.4: Transmittance of epoxy as a function of irradiation dose.

Table (2) represents the flexural as a function of dose for pure Epoxy and figure (5) shows the relation between deflection and dose for epoxy.

Table 2: Flexural as a function of dose for pure Epoxy.

Dose KGY	Max. Flexural (N)
0	150
28.055	189
56.11	190
84.16	190
112.22	195
140.27	200

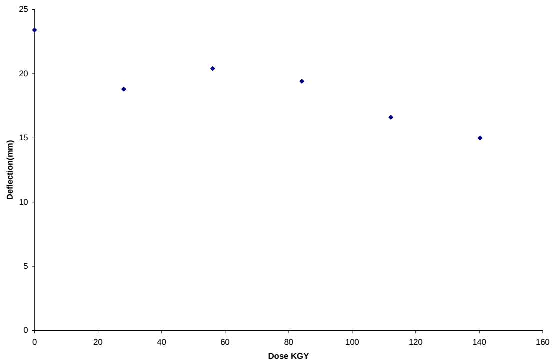

Fig.5: The relation between deflection and dose for epoxy.

The flexural of pure epoxy increases slightly as the doses increase, these variations are tabulated in table (3). The behavior of flexural as a function of dose for pure epoxy is shown in figure (6). The behavior of the composites with respect to the flexural of epoxy variation is due to the cross linking reactions produced in its components because of irradiation with various interval time. [9].

Table 3: Flexural strength and dose for epoxy / Pb powder composites.

Dose KGY	Max.Def.10gm Pb powder	Max.Def.20gm Pb powder	Max.Def.30gm Pb powder	Max.Def.40gm Pb powder	Max.Def.50gm Pb powder
28.055	122	134.6	109.4	120	143.9
56.11	132	138.9	116	130	144
84.16	200	189	140.6	200	200
112.22	200	186	150	209	220
140.27	202	194.2	161	206.8	211

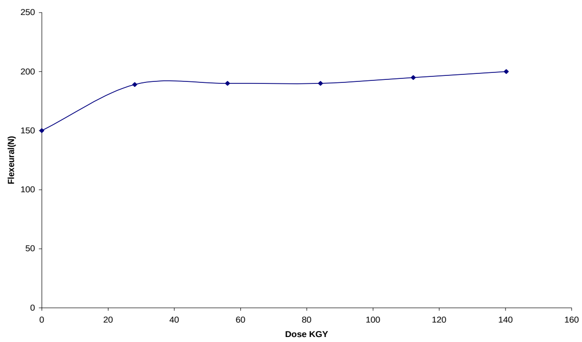

Fig.6: The relation between flexural strength and dose for epoxy

According to our calculations, the [[Ionization] processes resulting from the radiation may lead to a change in the local charge, forming new electronic levels with absorption bands in its fields [10]. they electronic excitations captured in called the ionic spaces of epoxy composites, for example, irradiation of sodium chloride leads to a brown color, potassium chlorine to a blue color, lithium chlorine to a yellow color, and lithium bromine to a red color. After it was all transparent. Irradiation may cause crosslink and degradations at the same time of irradiation. All results are clear that epoxy irradiation processes slow down with time and accelerate with increasing exposure time, Furthermore, with corresponding with the strength of the gamma source [11].

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