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Fourier analyzes for polymeric materials exposed to gamma rays

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***Abstract*---**The study of epoxy exposed to gamma radiation for different periods of time up to six months of several period irradiations with the dose range of 28.05468 KGy with the first week to the six months with the accumulations dose of 721.413 KGy. FT-IR technique with FTIR analyzes of the samples was using. These results were varied comparison with the previous researches because they do not show identical destruction under similar irradiation conditions. The six-month period of exposure to gamma rays had a very large impact on the results of the current study. The broad peak ranges from 3380 to 3340 1/cm are because OOH stretches, and the sharp peak at 910 1/cm. because of the epoxide vibration peak. The the carbonyl group predominant peak is 1730 1/cm.and the broad 3500 1/cm. The strong band for the non-irradiated epoxy appears at 763.67 1/cm., but the other irradiated samples the bands is shifted to the left at 771.47 1/cm. The previous bands disappear for the samples which irradiated for three and four months by gamma ray. The the absorption disappears at 914 1/cm because of the asymmetric

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epoxide ring stretch. FTIR is useful to elucidate favorable molecular interactions, such as hydrogen bonding. the carbonyl radical =C=O will be generated and absorbs the infrared with the wave length of 1705 ~ 1720 1/cm., and the yield of the carbonyl radical is proportional to the absorbed dose. the transmittance of epoxy as a function of irradiation dose for 1,2,3,4 and 6 months as results obtained from the FTIR spectrums. Transparency decreases inversely with the duration of exposure and the amount of exposure.
***Keywords*---**FTIR, Epoxy, Gamma Dose, transparency, functional group.

Introduction

Studying the radiation encourages changing polymers recently to be expanded research. Because it has been applied in technology, it drew a big attention and extensively studied. Modifications sometimes help in the achievement of desired physical and chemical polymer features, therefore changing them for specific uses. Therefore, an article like this comprises physico–chemical variations in polymers because of the importance of irradiation [1-15].

Modifications are caused by superimposition of interacting incident particles with matter, initiating various secondary reactions. Accordingly, the changes rely on the radiation doses, polymers inside formation functional group kinds, chain lengths, etc. Generally, most radiation-induced modifications are due changes in the parent polymer structure. Some are because the incident ions scisson the polymer chains, breaking covalent bonds, promoting cross-linkages, forming carbon clusters, liberating volatile species and forming novel chemical bonds.

Fourier Transform-Infrared Spectroscopy (FTIR) can be relied on and cost-effective as a tool to identify polymers and assess the quality of plastic materials. FTIR analysis identifies organic, inorganic, and polymers by infrared light for scanning the samples. Changing features pattern of absorption bands clearly modify the material makeup.

Polymers fall into: thermosetting plastic or thermoset and thermoforming plastic or thermoplastic. Upgrading to an FTIR from an existing dispersive infrared instrument is the spectral qualities, speed of data collection, data reproducibility, and maintenance and use ease.
Films, solids, powders, or liquids are identified. Identify contamination on or in a material (e.g., particles, fibers, powders, or liquids). Additives on extraction from a polymer matrix are identified. FTIR is used widely to characterize quantitative analysis of polymer blends, identify their compatibility via intermolecular hydrogen bonding, and study their degradation. FTIR shows the chemical bonds in a molecule by production of an infrared absorption.

FTIR-tests:

The different samples for different irradiation times of low viscosity epoxy injection resin system were studied by FTIR -8400S, SHIMADZU, which was made in Japan as shown in Figure (1) [3]. The goal of these FTIR-tests to study the relation between the radiation dose and the transparences for different times.

Fig 1: FTIR -8400S, SHIMADZU

FTIR that was conducted in this study. The results from the FTIR spectroscopy demonstrated a very high stability of epoxy towards gamma radiation under the experimental condition in this study because of the short period of irradiation.

The strong band for the non-irradiated epoxy appears at 763.67 1/Cm., but the other irradiated samples, the bands is shifted to the left at 771.47 1/Cm. Benzene ring absorption appears only in the four month irradiated sample at 1434.94 1/Cm. and for the sample which irradiated for six month, the benzene ring appear at 1450.37, and 1589.33 1/Cm.

FTIR testing results:

Fourier transform infrared spectroscopy (FTIR) for non-irradiated epoxy show that the C-O absorption (strong and broad) at 1203.50 and 1265.22 1/cm. A medium intensity asymmetric band between 941 and 840 1/cm. appears for non-irradiated epoxy as shown in fig.(2).

The strong band for the non-irradiated epoxy appears at 763.67 1/cm., but the other irradiated samples the bands is shifted to the left at 771.47 1/cm.The previous bands disappears for the samples which irradiated for three and four months by gamma ray.

The C-O-C band for non-irradiated epoxy appears a strong absorption at 1265.22 and 1203.50 1/cm.as shown in the FTIR spectrum in fig. (2).and shifted to the left at 1288.36 and1218.93 1/cm. for one month irradiated sample as shown in fig. 3.[4].

The infrared spectrum shows aromatic C-H absorptions to the 3000 1/cm left. and the aliphatic hydrogen to the right. In addition, one observed a C=O stretching group at 1720 1/cm.. Benzene ring absorption appears only in the four month irradiated sample at 1434.94 1/cm. and for the sample which irradiated for six month, the benzene ring appear at 1450.37, and 1589.33 1/cm.

The C-H band appears at 3109.04 1/cm. for the non-irradiate sample, and for the (1,2,3,4,6 months) irradiated sample appears at 3186.18,3196 .90,3196.96,3196.90,3186.18 1/cm.respectivly [5]. The strong band C=O appears at 1735.81,1650 1/cm.for non-irradiate sample, this band is shifted to the right at 1728.10 1/cm. for the other irradiated samples. The C=C band generally absorbs only weakly [6].

The carbonyl group C=O is a strong absorption in 1820-1660 1/cm region, with the peak being the strongest in the spectrum and medium width. The O-H is broad absorption of 3400-2400 1/cm and the ester C-O is strong intensity absorption near 1300-1000 1/cm. The double bonds/ or aromatic rings –C=C is a weak as an absorptaion at 1650 1/cm, medium to strong absorption in 1650-1450- 1/cm..The aromatic and vinyle CH to the left is 3000 1/cm. and the aliphatic CH to the right. These previous bands appear in the samples irradiated to gamma-ray for 2,3 weeks and 6 months [7].

The hydrocarbons are a major absorption in CH region near 3000 1/cm. and the simple variation appears in the one week irradiated sample at 3047,2970 1/cm. and in the three week irradiated sample at 3062,2993 1/cm..These previous bands disappears for the samples which irradiated for six months by gamma ray as shown in fig.(4) and appears at 3039,2970 1/cm.Very simple spectrum appears near 1450,1375 1/cm. for the samples which irradiated for six months by gamma- ray as shown in fig.(4).

Yet, the broad peak from 3380 to 3340 1/cm results from OOH stretch, and the sharp 910 1/cm. because of the epoxide vibration peaks. The predominant carbonyl is at 1730 1/cm. and the broad at 3500 1/cm. [8].

The absorption disappears at 914 1/cm because of the asymmetric stretch of the epoxide ring. FTIR is a useful to elucidate favorable molecular interactions, like hydrogen bonding [9]. If the irradiation of epoxy resin generates the carbonyl radical =C=O. In addition, it absorbs the infrared and wave length 1705 ~ 1720 1/cm., yielding the carbonyl radical proportional with the absorbed doses [10].

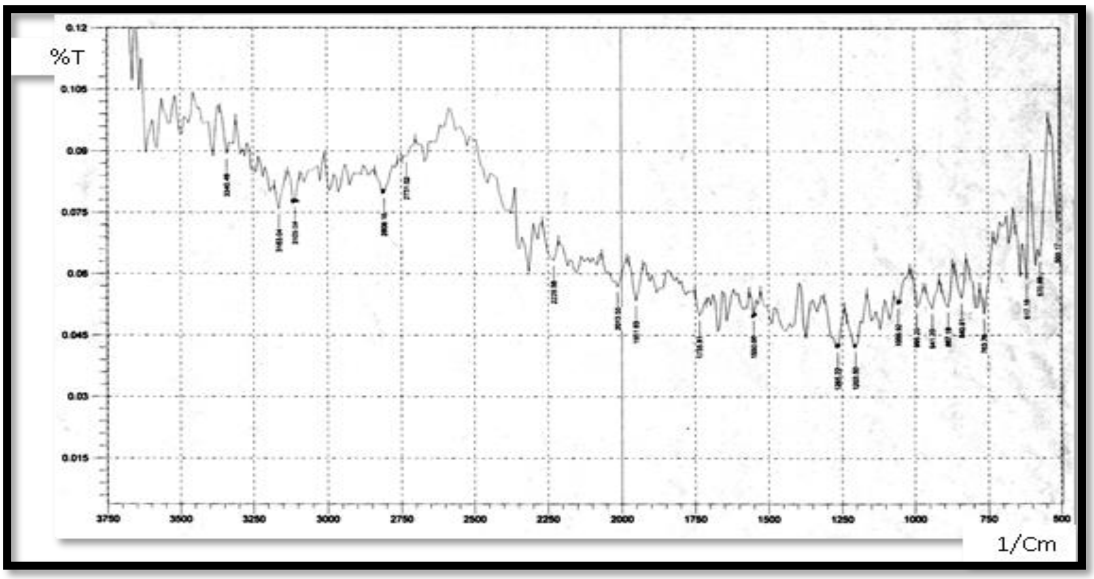

Fig . 2: spectrum for nonirradiated Epoxy

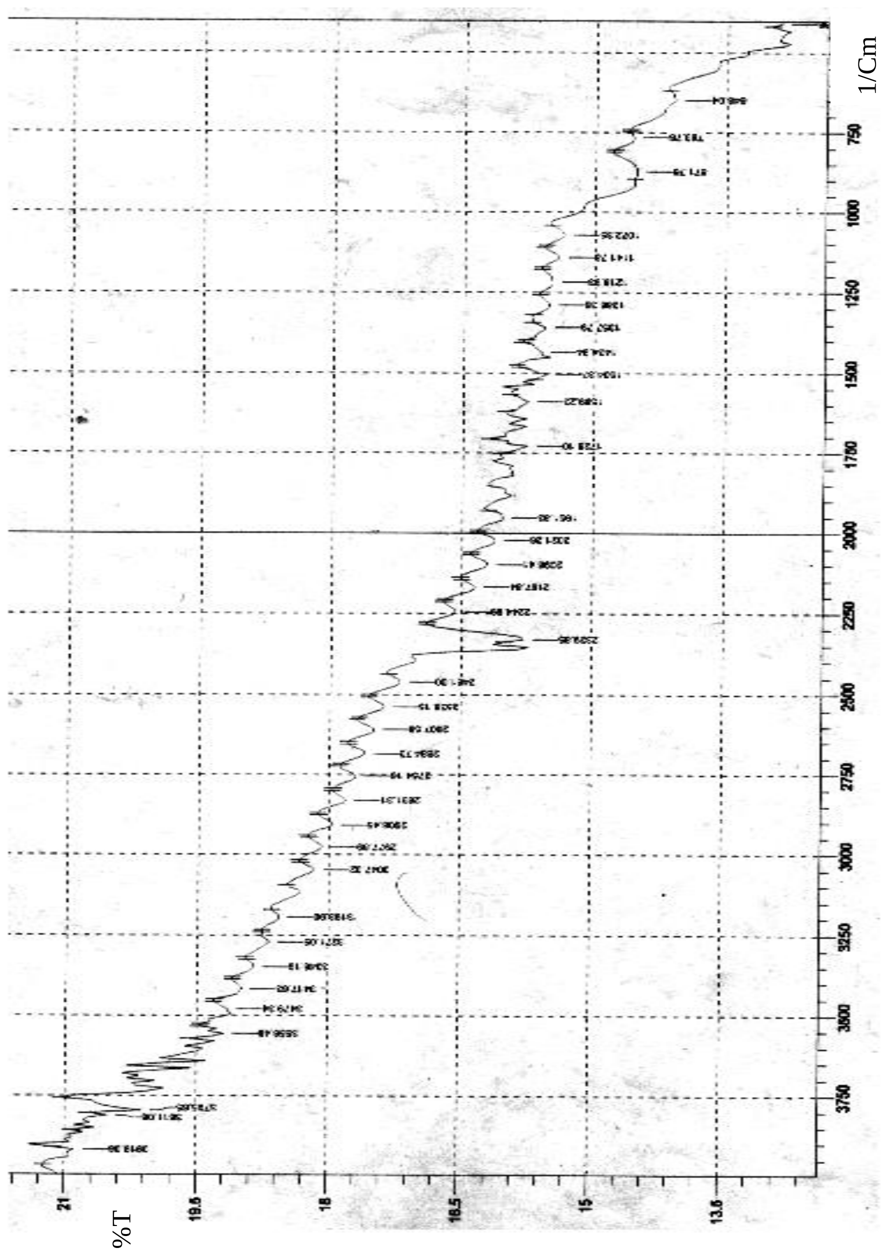

Fig. 3: FTIR spectrum for 1-month irradiated Epoxy

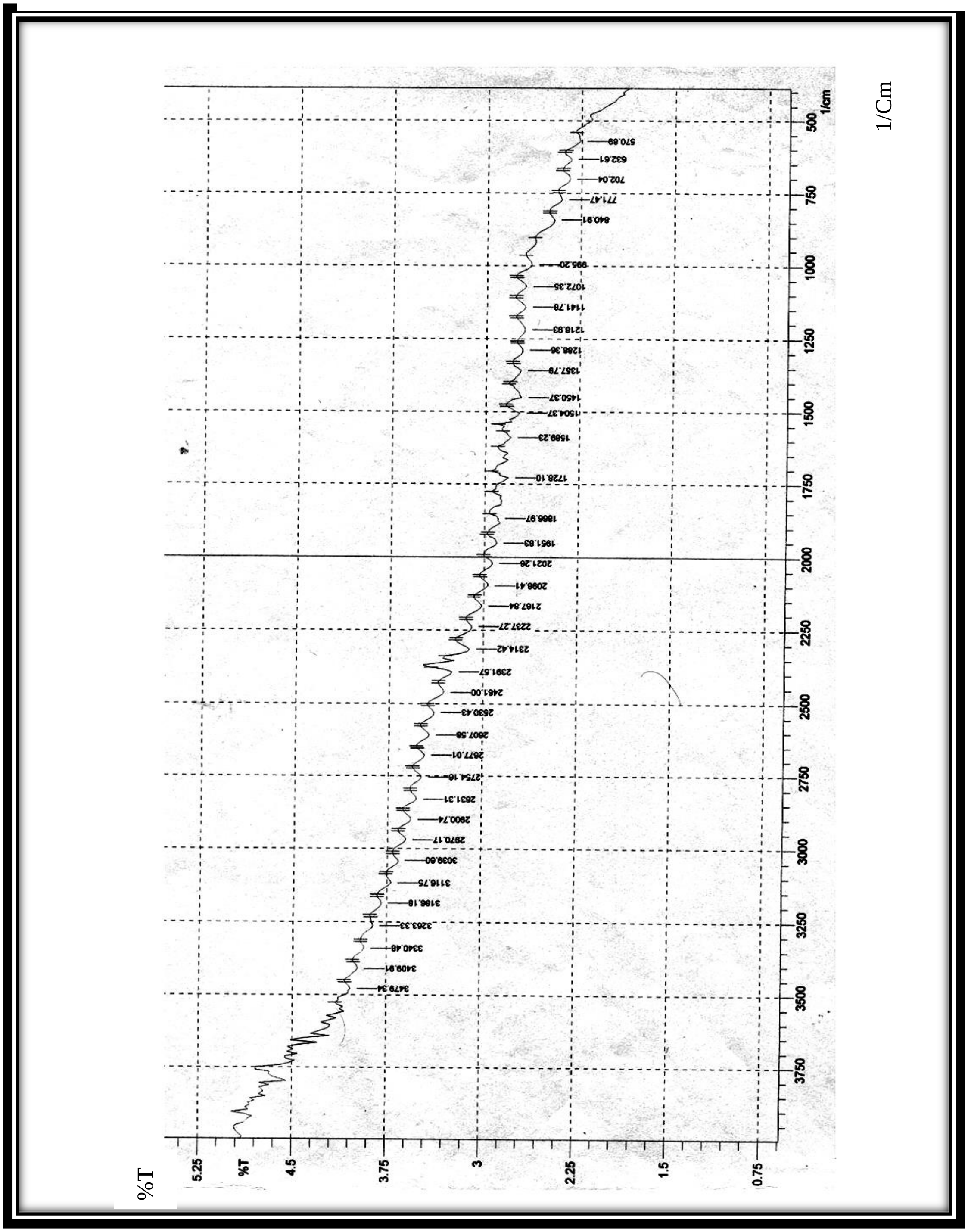

Fig .4: FTIR spectrum for 6-month irradiated Epoxy

The doses make irradiation and time in Table (1) and Fig. 5 represents the epoxy transmittance of as an irradiation dose function for 1,2,3,4 and 6 months as results obtained from the FTIR spectrums. Transparency decreases inversely with the duration of exposure and the amount of exposure.

Table 1: The pure epoxy week and gamma irradiation doses

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

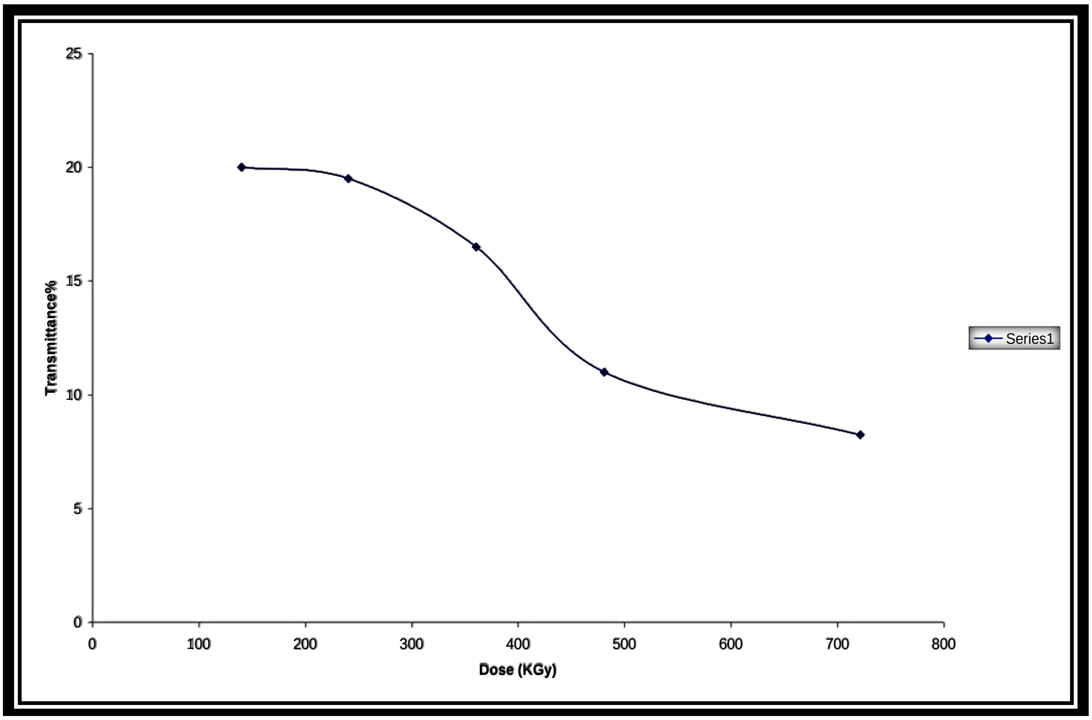

Fig. 5: Transmittance of epoxy as a function of irradiation dose.

The results from the FTIR spectroscopy demonstrated a very high stability of epoxy towards gamma radiation under the experimental condition in this study because of the short period of irradiation [8]. This summarizes work on the oldest, most recent, and issues. This helps to understand the formation of network in the curing reaction affecting the concrete features of the resulting epoxy resin [9]. The absorption peak by the FTIR shows a changes by γ ray of intensity, bandwidth, and position explaining an impact due to the chemical changes in the polymeric chains and crosslinks [10] providing useful insights to design and build different thermoplastic polymer systems-currently popular materials like bottles over epoxy resin [11].

Conclusion

Treatment of polymers radiation is fairly recent following new uses from the nuclear field. Chemical changes are central to understand the effects of radiation on polymers. They according to the explanation of physical modifications and the establishing how the chemical change happens and is a prerequisite to knowing the reaction mechanism. The most significant impacts are cross linking analogous for dimerizing and depredating analogously to main-chain scission, in respect. FTIR that was conducted in this study. The results from the FTIR spectroscopy demonstrated a very high stability of epoxy towards gamma radiation under the experimental condition in this study because of the short period of irradiation. Studying these FTIR bands reveals the amine, /oramide function and the epoxy aromatic cycle parts.

The strong band for the non-irradiated epoxy appears at 763.67 1/Cm., but the other irradiated samples, the bands is shifted to the left at 771.47 1/Cm. Benzene ring absorption appears only in the four month irradiated sample at 1434.94 1/Cm. and for the sample which irradiated for six months, the benzene ring appear at 1450.37, and 1589.33 1/Cm.

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