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Title of the thesis : **Studies of Radiation Effect in Some Selected Polymers**

ABSTRACT

Gamma irradiation plays an important role in the modifications of materials properties. The energy deposited by ionizing radiations is so localized and so relatively large that chemical bonds which characterize a molecular species can be broken and possibly reconfigured after a very short time interval. This is the physicochemical basis of the use of ionizing radiation in polymer research. Ionization involves the transfer of sufficient energy to a bound electron located in an atomic or molecular orbital of the irradiated material so that the electron becomes free. Such ejected electrons eventually lose their excess kinetic energy via electronic, vibrational and rotational excitation of the molecules in the medium. This leads to changes in Physical and chemical properties of the polymers. Using the gamma irradiation the properties of the polymers can be tailored to achieve new class of materials.

Gamma irradiation of polymers can induce irreversible change of the structure and the chemical composition. Gamma ray-polymer interaction is a complex process where a lot of primary and secondary effects are involved. The major processes observed in irradiated polymer molecules are, (i) gas evolution; (ii) creation of double and triple bonds; (iii) main chain scissions reducing mechanical strength; (iv) combination of macro radicals link the polymer chains with one another, generating cross-linked structures.

In the present case, three types of procured polymers (PET, PES and Kapton) have been used for gamma irradiation. We have chosen these polymers due to their technological importance in various fields of applications

In the present work we study the effect of gamma irradiation on the three polymers (PET, PES and Kapton). These polymers were irradiated with 1.25 MeV gamma radiation emerging from Co^{60} source in the dose range of 0-300 kGy. In order to know the induced changes in physical (optical, electrical, structural and morphological) and chemical properties, various techniques (UV-VIS, FTIR, XRD, HFIA and SEM) were used.

Main changes observed due to gamma irradiation are follows:

- The band gap (E_g) decreases with the increase of gamma irradiation dose.
- Crystallinity and Crystallite size showed oscillatory behaviour with dose(Recovery Characteristic)
- AC conductivity of polymer samples was found to increase with increase in radiation doses and increasing frequency.
- The dielectric constant/loss showed the frequency dependence behaviour and obeyed universal law of dielectric materials.
- The blisters formation on the surface of the polymer was observed.
- The molecular re-orientation at higher gamma irradiation dose and recovery of virgin structure in Polymers.