High Energy Radiation Effects on Halogenated Butyl Rubbers

D J T Hill, M C S Perera and P J Pomery

Polymer Materials and Radiation Group
Department of Chemistry
University of Queensland
St Lucia Qld 4072 Australia

Aliphatic halides, with the exception of fluorides, are among the organic compounds most sensitive to radiation. In these compounds carbon halogen bonds are weaker and the main effect of radiation is to break this bond to give halogen radicals. Due to the differences in reactivities, the final products obtained from chloro and bromo compounds are different. For example, radiolysis products from chloro compounds tend to include hydrogen chloride whereas bromides give bromine as well as hydrogen bromide.

Due to the above behaviour of low molecular weight alkyl halides when exposed to high energy radiation, it is interesting to see the behaviour of polymers which contain halogen atoms. While butyl rubber is known to undergo predominantly chain scission during exposure to high energy radiation, a drastically different response towards high energy radiation has been reported for the halogenated butyl rubbers. Rapid gelation occurs in these polymers at low doses.

No detailed study has been reported on the radiation induced reactions in halogenated butyl rubbers. We have used ESR and NMR techniques to study these reactions. Information regarding the changes in structure during exposure of butyl, chlorinated butyl and brominated butyl rubbers, to high energy radiation will be presented.

Butyl rubber is predominantly polyisobutylene with 1-2% isoprene units incorporated. The isoprene units in the halogenated butyl rubbers are of exo structure. ESR spectra indicate that during high energy irradiation, most of the radicals are generated in halogenated isoprene units. A higher radiation yield for scission was observed in chlorinated butyl rubbers than brominated butyl rubbers.