



## SYNTHESIS AND THERMAL DEGRADATION STUDIES OF P-TOLUDINE, ETHYLENEDIAMINE, AND FORMALDEHYDE COPOLYMER RESIN

Chetana G. Kohad and Wasudeo B. Gurnule\*

\*Department of Chemistry, Kamla Nehru Mahavidyalaya, Sakardara, Nagpur- 440024, Maharashtra, India

Email: [wbgurnule@gmail.com](mailto:wbgurnule@gmail.com) and [che\\_khot@rediffmail.com](mailto:che_khot@rediffmail.com)

### ABSTRACT

A copolymer resin involving *p*-toluidine and ethylenediamine with formaldehyde (p-TEDF) was synthesized by the condensation of *p*-toluidine and ethylenediamine with formaldehyde in the presence of 2M hydrochloric acid as a catalyst with 1:1:2 molar proportions of reacting monomers. The structure of newly synthesized copolymer has been elucidated and confirmed on the basis of Elemental analysis and various spectral techniques, that is, UV-visible, FT-IR, and  $^1\text{H-NMR}$ ,  $^{13}\text{C-NMR}$  spectroscopy. Number average molecular weight ( $M_n$ ) has been determined by conductometric titration in non-aqueous medium. The studies have been further extended to nonisothermal thermogravimetric analysis for determination of their mode of decomposition and relative thermal stability. Activation energy ( $E_a$ ) and order of reaction ( $n$ ) were calculated by Sharp-Wentworth and Freeman-Carroll methods. Activation energy calculated by Sharp-Wentworth and Freeman-Carroll methods are in close agreement with each other. Thermodynamic parameters such as free energy change ( $\Delta F$ ), entropy change ( $\Delta S$ ), apparent entropy change ( $S^*$ ), and frequency factor ( $Z$ ) have also been evaluated based on the data of Freeman-Carroll method. SEM was used to establish the surface morphology and nature of the copolymer.

**Keywords:** Synthesis, condensation, thermogravimetric analysis, activation energy, spectra.

### INTRODUCTION

The synthesis of copolymer has stimulated an enhanced interest in recent years due to their wide applications. Since last few decades many scientist are working to develop new and easier techniques for synthesis and characterization of copolymer due to its versatile applications in domestic as well as in industrial sector. copolymer found very useful applications as adhesive, high temperature flame resistance, melting temperature control, fibers, coating materials, semiconductor, catalyst, ion exchange resin, flexibility impact modifier for engineering plastic, heat sealing film in car interior, pipelines, electrical resistance textiles, bullet-proof vests biomaterials, light guide panel laptop computers and pharmaceutical uses[1-4]. The polymeric material is often not a single component and hence simple chemical analysis will rarely provide all information required. Characterization of new copolymer resins requires several physicochemical techniques and spectral studies [5]. Thermogravimetric analysis comprises a group of techniques in which a physical property of substance is measured as a function of temperature when the substance is subjected to a controlled temperature program. Thermally stable terpolymers have recently become boon to polymer chemist due to their superior and high performance utility. Many researchers tried to improve the thermal stability at elevated temperature by changing the monomer composition in polymer synthesis. The thermal degradation study of terpolymer being an important property which primarily decides thermal stability and processability. A wide variety of thermally stable polymers has been synthesized and studied their thermogravimetric