ABSTRACT

This dissertation embodies in detail the synthesis and characterization of novolac type phenolic resin-based materials with special emphasis to their applications such as adsorptive removal of azo dye pollutants and antimicrobial system. Efforts to broaden phenolic resins (resole and novolac) properties, structures, functionalities, and applications have grown rapidly in the sphere of research because of their many desirable characteristics. In particular, novolac resin chemistry is a matter of great interest since it facilitates tailoring of polymer physico-chemical properties to fulfill different applications. From this viewpoint, there remains a host of new opportunities to develop materials derived from novolac resin for pollution removal and antimicrobial applications, which have not yet been addressed.

The first part of this work (*Chapters- 2, 3 & 4*) focuses on the design and synthesis of novolac type phenolic resin-based polymeric network materials to remove azo dye contaminants for environmental remediation.

Chapter-2 describes the synthesis of novolac type phenolic resin-based networks bearing ethylenediamine and diethylenetriamine units and their characterization by FTIR, ^{13}C NMR, SEM, BET, TGA and elemental analyses. In this study, adsorption performance of obtained networks in removing selected azo dyes such as methyl orange (MO), orange-II (OII) and orange-G (OG) from aqueous solution was investigated.

Chapter-3 presents the utilization of obtained networks to develop polymer-inorganic hybrid materials incorporating iron(III). Hybrids were characterized by FTIR, XRD and TGA. Hybrids were found to exhibit enhanced adsorption capacity and azo dye removal performance.

Further study (*Chapter-4*) describes the synthesis and characterization of pyridine-rich novolac-based network, which displays remarkable efficiency toward the removal of selected azo dyes, MO, OII and OG, from aqueous systems. FTIR, ^{13}C NMR, elemental, FESEM, BET and TGA were used for complete characterization of this network. Compared to the reported adsorbents in *Chapters-2* and *3*, the obtained network turned out to be admirable adsorbent for removal of azo dyes (MO/OII/OG) over a wide pH range (acidic-neutral-basic conditions), which is crucial for field use of wastewater treatment.

The second part of this work (*Chapter-5*) is based on antibacterial application. This part reports the simple preparation of hybrid derived from functionalized novolac resin and AgNPs. The prepared hybrid held the antibacterial activity against Gram-positive (*Staphylococcus aureus* MTCC 3160, *Staphylococcus epidermidis* NCIM2493, *Bacillus subtilis)* and Gram-negative (*Pseudomonas aeruginosa* ATCC27853, *Escherichia coli*) bacteria as assessed by disc diffusion and minimal inhibitory concentration (MIC) methods. This finding may be useful in the development of potential antimicrobial materials.