ABSTRACT

Antimicrobial resins are currently gaining importance due to their applications in developing bacteriostatic and bactericidal fabrics and coatings for use in the contaminated environment especially in hospitals. The traditional melamine formaldehyde resins were rendered antimicrobial by inteoduction of N-halamine groups and by introduction of silver nanoparticles.

Melamine Formaldehyde resins are thermosetting amino resins which are commonly used as finishing agents in textile. Two types of these resins were synthesized using water and n-butanol as solvents with different mole ratios of melamine and formaldehyde. For the synthesis of N-halamine containing melamine formaldehyde resins, methylol monomers were chlorinated to develop N-Cl bonds and then polymerized. The presence of N-Cl groups on the melamine rings in the resin was confirmed with FTIR spectrometry. The FTIR spectra showed the presence of N-Cl functionality at the three amino positions of melamine rings. These N-halamine based resins were used to developed antimicrobial fabrics. These fabrics were found very effective in inhibiting microbial growth.

Another approach in the development of antimicrobial surfaces was inclusion of nanoparticles of Silver, Gold and Silver doped Zinc Oxide in the melamine formaldehyde resin. The Silver and Gold nanoparticles were prepared using cell lysate of *Bacillus licheniformis*. The modified resins and pieces of resin-loaded fabrics were characterized for their physical, physio-chemical properties and for the evaluation of their antibacterial and antifungal potential. The images taken by SEM and SEM-EDX show the morphological behavior of fabric loaded with melamine formaldehyde resin. The electron micrographs of these polymer treated fabric samples showed that these were like entangled masses of threads; the texture of some samples is like vermicelli or noodles. Some samples show textures of irregular or uneven threads. The SEM-EDX analysis of non-chlorinated and chlorinated melamine formaldehyde resin loaded fabric samples shows the complete elemental analysis. The thermal behavior of the original and N-halamine based resins was compared using TGA and DSC. The TGA of melamine formaldehyde resin samples shows their thermal behavior in terms of weight loss and DSC analysis of melamine formaldehyde resin samples shows their curing behavior at

different temperature ranges. The powder XRD analysis of both chlorinated and non-chlorinated melamine formaldehyde resin samples were analyzed to observe the physical properties as well as their particle size. These XRD-spectra show the amorphous and semi-crystalline nature of melamine formaldehyde resins in every sample. The Powder XRD Spectra provided valuable information regarding crystalline, semi-crystalline nature and particle size (grain size) of each melamine formaldehyde resin. The investigations showed that the fabrics loaded with chlorinated melamine formaldehyde resins and nanoparticles containing melamine formaldehyde resins were active against *Bacillus subtilis*, *Staphylococcus aureus, Escherichia coli and Asperigillus niger*. The fabrics maintained their antimicrobial potential up to five washings. The antimicrobial fabrics, thus developed were low in cost, economically feasible and effective at low concentrations. Moreover, it is quite obvious that the applications of these antimicrobial substances are wide spread on industrial scale, in hospitals and clinical laboratories.