Conclusions

- **Bamboo rayon fabric was successfully grafted with vinyl monomers** (AA and AAm) individually and in their blends using KPS initiator. The optimum conditions worked out on the basis of present work were as follows:
  - **AA grafting**: grafting temperature, 60 °C; grafting time, 3 h; KPS concentration, 1.5%; monomer:fibre ratio, 1:1.
  - **AAm grafting**: grafting temperature, 65 °C; grafting time, 3 h; KPS concentration, 2%; monomer:fibre ratio, 0.75:1.
  - **AA-AAm grafting**: grafting temperature, 65 °C; grafting time, 2 h; KPS concentration, 2%; monomer:fibre ratio, 0.5:1.

- The grafted products showed higher thermal stability compared to corresponding parent backbone. The grafted product showed improvement in moisture regain which was further enhanced especially when the samples were treated with NaOH after grafting. The dyebility was imparted to bamboo rayon using grafting as a tool. The AA grafted product showed multifold increase in colour strength of cationic dyeing with distinct improvement in all kinds of fastness properties. AAm grafted product showed increase in colour strength of acid dyeing with improvement in fastness properties. The AA-AAm grafted product showed increase in colour strength of both the dyeing with improvement in fastness properties.

- **Continuous grafting of vinyl monomers** onto cotton fabric was successfully carried out using padding technique. The suitable padding technique was optimized to get optimum graft add-on. The various parameters of grafting were optimized, which were found to be identical in case of AA grating, AAm grafting and AA-AAm mixture grafting and are as follows
  - **AA, AAm and AA-AAm grafting**: process, pad-cure; curing temperature, 140 °C; curing time, 5 min; KPS concentration, 15 gpl; monomer concentration, 100 gpl.

- **In case of mixture of AA-AAm grafting**, graft add-on improved as compared to that in case of individual monomers. The graft add-on varied with the varying ratios of AA-AAm and the optimum graft add-on was found at the ratio 50:50.

- All the grafted cotton fabrics showed increased thermal stability. The mechanical properties like tensile strength and tearing strength decreased to some extent in all the cases. Crease recovery angles improved with some stiffness being imparted to the grafted fabric. The grafted fabric showed the enhancement in dyeability towards acid and cationic dyes, depending on the
type of monomer used for grafting, with improvement in fastness properties. The grafted fabric dyed uniformly indicating the uniformity of grafting. The continuous grafting using padding technique hence claimed to be efficient, uniform and operation friendly grafting method for textile fabrics.

- **The grafted bamboo rayon fabrics were successfully studied for their electrokinetic properties** along with their dyeing behavior with respective dyes depending on the monomer used (Cationic in case of AA, acid in case of AAm and both in case of mixtures of AA-AAm). The optimum pH for dyeing was found in each case and summarized as pH-6 for cationic dyeing and pH-3 for acid dyeing. The zeta potential measurements in presence of dye showed the changes occurring because of adsorption of dye. The various graft add-on fabrics were dyed and the colour values were successfully correlated with the corresponding zeta potential values. The results showed promising correlation between the electrokinetic properties and the dyeing behavior of grafted bamboo rayon fabrics.

- **In order to get broad spectrum and durable antibacterial properties, the grafted bamboo rayon-metal nanoparticles composites were successfully prepared** and the multifunctional properties were explored. The composites showed enhanced thermal stability and presence of nanoparticles on the grafted chains. Grafted bamboo rayon-Ag nanoparticles composites showed efficient antibacterial property which was durable till 50 washes irrespective of the monomer used (AA, AAm or their mixture). The composites also showed efficient UV protection till 50 washes. The release of silver from composite fabric was also found to be minimal showing proper immobilization of Ag nanoparticles on the grafted bamboo rayon. However, slight grayish-brown tint was imparted due to Ag nanoparticles which can be used advantageously in case of dark shades.

- **Grafted bamboo rayon-Cu nanoparticles composites also showed the efficient antibacterial properties** which were durable till 50 washes. The composites also showed efficient UV protection till 20 washes. The bluish tint imparted can be used advantageously like
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that in case of optical brightener tint. The release in aqueous media was found to be lower indicating proper immobilization of nanoparticles on grafted bamboo rayon.

- **Grafted bamboo rayon-ZnO nanoparticles composites also displayed efficient antibacterial activity** which was durable till 40 washes and UV protection durable till 20 washes. However, the system can be claimed advantageous as ZnO does not impart any coloured tint to the fabric.

- **Bio-waste chitosan successfully utilized for the application as durable antibacterial agent for grafted bamboo rayon.** The chitosan finished product showed antibacterial activity against both gram positive and gram negative bacteria. Grafting with acrylic acid was found to be efficient tool for enhancing antibacterial activity and durability of the same was enhanced due to its ability to react with amino end groups in chitosan. Hence, this process can be employed for manufacturing hygienic textiles.

- **Bio-waste chitosan was also utilized for the application as binder in pigment dyeing of cotton.** An enhanced colour values were obtained using chitosan as a binder. The washing and light fastness properties were found to be good to excellent grades, indicating positive role of chitosan as a binder. The rubbing fastness properties, especially wet rubbing fastness though were found to be improved, but were inferior and this aspect can be utilized as a tool to obtain the wash-down effect on fashion garments. The additional antibacterial properties were also obtained against both gram positive and gram negative bacteria.

- **Bio-waste chitosan was successfully utilized for the application as an additive in multifunctional finishing of cotton.** The finished fabric showed excellent functional properties which were durable till 20 washes. Chitosan addition in the recipes clearly indicated the role of the same as formaldehyde scavenger. Addition of boric acid was also justified as it resulted in increased crease recovery angle, antibacterial efficacy and flame retardancy of the finished cotton. The inherent disadvantages of cotton fabrics can be countered using such kind of multifunctional finishing formulation, which results in value addition.

In all, the efficient methods of polymer modification were developed for performance enhancement of fibrous polymers. The outcome of the research is expected to explore new arena for utilizing the commonly known grafting technique in efficient modification of textile fibres.
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for their application in apparels as well as medical textiles. The antibacterial textiles invented, especially nanoparticles composites, can help in preventing cross infections through clothing in hospitals. The chitosan modified fabric can be utilized as safe antibacterial textiles for apparels as well as medical textiles.