RADIATION INDUCED HYDROPHILIC POLYMERS FOR BIOMEDICAL APPLICATIONS

by

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CERTIFICATE

This is to certify that the thesis entitled ''RADIATION INDUCED HYDROPHILIC POLYMERS FOR BIOMEDICAL APPLICATIONS'' being submitted by Mr. Harpal Singh to the Indian Institute of Technology, Delhi for the award of the Degree of DOCTOR OF PHILOSOPHY in the Department of Textile Technology, is a record of bonafide research carried out by him. Mr. Harpal Singh has worked under our guidance and supervision and has fulfilled the requirements for the submission of the thesis.

The results contained in this thesis have not been submitted, in part or in full, to any other University or Institute for the award of any degree or diploma.

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A B S T R A C T

Various methods of preparation of synthetic polymeric hydrogels and their biomedical applications are discussed. Radiation induced hydrophilic copolymers and graft copolymers were synthesised and evaluated for biomedical applications. Specifically the aspects of biocompatibility and applications of hydrogels in sustained delivery of drugs and male fertility control were examined.

In the first part of the thesis a new method of fertility control in male has been proposed and tested in rat as an experimental model. The technique involves the use of polymer which when injected into the vas deferens get precipitated there and lower the pH to kill the spermatozoa passing through it. Poly (hydroxyethylmethacrylate-methacrylic acid) poly(HEMA-MAC), and poly(styrene-maleic anhydride) poly(S-MA) were synthesised for this purpose. Polymers were characterised using viscosity measurements, pH titration and swelling measurements in saline as well as distilled water. The results indicated that MAC content in the poly (HEMA-MAC) copolymers was roughly proportional to the percentage of MAC taken in the HEMA : MAC monomer mixture. Viscosity increased with increasing the MAC content in HEMA-MAC copolymers. *In vitro* as well as long term *in vivo* experiments were carried out to assess the contraceptive

action of the polymers. It was found that this method of male fertility control is non-occlusive, reversible and has contraceptive effect upto six months in rats.

In the second part of the thesis, radiation grafting with hydrogels using vinyl monomers was envisaged to increase the biocompatibility as well as heat and ageing resistance of polyvinyl chloride (PVC). Grafting of vinyl monomers onto PVC films and tubes was carried out in different solvents at various dose, dose rate and monomer concentration in nitrogen atmosphere. HEMA, MAC, acrylic acid(AC) , and N-vinyl-2-pyrrolidone(NVP) were used as monomers in grafting experiments. Effect of Cu^{++} ions on the grafting efficiency of HEMA, NVP and their different mixtures was also studied in aqueous medium. Graft copolymers were characterized using pH titration, nitrogen estimation, swelling measurements in different media, scanning electron microscopy and thermogravimetric analysis.

It was observed that the grafting percentage was higher at low dose rate and increased with increasing monomer concentration and total dose. With increase in the MAC content in the HEMA-MAC mixture, the percentage grafting also increased. Cu^{++} ions did not have a marked effect on grafting when only HEMA or NVP was used but with the mixture of HEMA-NVP, grafting increased significantly. Thermal stability of PVC increased after grafting with MAC and HEMA.

The tissue and blood compatibility of PVC was found to be increased after grafting with hydrogels. The feasibility of formulating a drug depot for sustained delivery using PVC grafted with functional hydrogels was also examined. It was found that immobilized quaternary ammonium antimicrobial drugs retained their activity against microorganisms and the release was sustained upto 40 days.

C O N E N T S

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