

**Preparation of radiation crosslinked
superabsorbent hydrogel using
carboxymethylcellulose**

by

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award of the Degree of Master of Science in Polymer Science and
Technology on 13th of August 2008**

DEDICATION

I dedicate this thesis to my parents, husband, brother, teachers and all my family members who helped me in my academic achievements.

“The work described in this thesis was carried out by me under the supervision of Mr.J.T.S Lal Motha and a report on this has not been submitted in whole or in part to any University or any other institution for another Degree or Diploma”.

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LIST OF ABBREVIATIONS

AAc :Acrylic acid	Ws : Swollen weight
CMC : Carboxymethylcellulose	Temp : Temperature
Carboxymethylchitin	Wd : Weight of the insoluble gel
CMCTS : Carboxymethylchitosan	
CMS : Carboxymethylstrach	
cP :centi poise	
DS : Degree of Substitution	
FT-IR : Furere Transmission Infra Red	
γ : gamma	
Gf% : Gel fraction	
Wi : Initial weight of dried gel	
LDPE : Low density polyethylene	
MAA : Methacrylic acid	
PEO : Polyethylene oxide	
PEG : Polyethylene glycol	
PVA : Polyvinyl alcohol	
PVP : Polyvinylpyrrolidone	
KMnO ₄ : Potassium permanganate	
SEM: Scanning Electron Microscopy	
SR : Swelling Ratio	

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ABSTRACT

Radiation crosslinking of Carboxymethylcellulose (CMC) with a Degree of Substitution (DS) of 0.76 and 0.9 was the subject of the investigation. This radiation crosslinked CMC can be used as a substitute for conventional hydrogels. CMC was irradiated in solid state and aqueous solutions at various irradiation doses. DS and the concentration of the aqueous solution had a remarkable effect on the crosslinking of CMC. Irradiation of CMC in solid state and low concentrated aqueous solution has low crosslinking whereas 20% CMC gave the highest gel fraction. CMC with a DS of 0.9 caused for higher crosslinking than that with DS of 0.76 with the same concentration.

It was apparent that high DS and high concentration in an aqueous solution were favorable for high crosslinking of CMC. It is assumed that high radiation crosslinking of CMC was induced by the increase mobility of its molecules in water and by the formation of CMC radicals from the abstraction of hydrogen atoms from macromolecules in the intermediate products of water radiolysis.

The effect of various parameters such as concentration of different inorganic salts, pH, swelling temperature, swelling time on the swelling ratio in water were investigated in detail. 0.9 CMC hydrogel swelled by 120g of water per gram of dry gel at 60kGy applied dose and 0.76 by 110g of water per gram of dry gel. Swelling tests of CMC hydrogels in salt concentrations and media of various pHs showed that swelling values decreased with the increase of salt concentration and was high at the neutral pH media. Radiation crosslinked Na-CMC showed good water absorption below 50°C,

whereas it became solution when heated more than 60°C . Equilibrium swelling time of the Na-CMC was also investigated by a kinetic study and the equilibrium swelling was reached after 16 hours.

The effect of the sealing condition on crosslinking of CMC was investigated. Vacuum sealed CMC samples showed higher swelling values and gel fraction than that of the samples sealed by polythene sealer. Irradiation of CMC even in 5%, 10% aqueous solution and solid state resulted in degradation, hence viscosity decreases. More concentrated solution of 20% CMC was taken high viscosity due to the crosslinking by radiation.

FTIR spectra revealed, radiation crosslinking reaction of CMC occurred in side chains of CMC molecules due to the presence of $-\text{OH}$, $-\text{CH}_2$ and $\text{R-O-CH}_2\text{-COO}^-$ whereas radical formed in $-\text{CH-O-CH-}$ of main chain of CMC molecule lead easily to the chain scission. Scanning electron micrographs show highly porous structure of the gel. Therefore large amount of water will absorb to them and retain even under pressure.