Chapter I

Aims And Objectives
AIMS AND OBJECTIVES

1.1 Introduction

Water is a key component in determining the quality of our lives. Although water covers more than 70% of the Earth, only 1% of the Earth’s water is available as a source of drinking. An undesirable and excessive addition of substances to water, air and land which adversely change the natural quality of the environment is termed as pollution. The environment is being polluted everyday. The pollution affects our living as well as non-living environment. In other words, the pollution has serious threat to the biological environment. Industrial units play an important role in water pollution. Waste-water from textile industries poses a threat to the environment. The textile finishing industry has a specific water demand of about $100-500 \text{ L.Kg}^{-1}$ product$^{[1,2]}$. Removal of colour from dye bearing waste-water is a complex problem because of difficulty in treating such wastewaters by conventional treatment method$^{[3]}$.

Malachite Green (MG) is a highly toxic dye ($C_{23}H_{25}ClN_2$), molecular weight 364.911, which is primarily designed to be used as a dye for silk, leather and paper. Malachite Green is traditionally used as a dye. MG is a synthetic triphenylmethane dye$^{[4]}$. Its use has been banned in many countries due to its suspect of carcinogenicity. Millions of kilograms of MG and related triarylmethane dyes are produced annually for this purpose$^{[5]}$. Its use has been banned in United States since 1983 in food related applications. It is banned in the UK also$^{[6]}$. Malachite Green is deadly toxic to all marine and freshwater invertebrates, algae, plant life.

Brilliant Blue G (BBG) is a blue dye (Colour Index No:- 42655, $C_{47}H_{48}N_5O_7S_2Na$) and molecular weight 854.0, that is also known as acid blue 90 and Coomassie BBG. Its ingestion can cause eye, skin and respiratory tract irritation.

1.2 Objectives of the work

The present work aims at the removal of hazardous dyes from water using polymeric hydrogels. Polymeric hydrogels are of special importance in polymeric biomaterials because of their favorable biocompatibility. Hydrogels are crosslinked
macromolecular networks formed by hydrophilic polymers swollen in water or biological fluids. The crosslinks can be formed by either covalent bonds or physical cohesion forces that exist between the polymer segments. Polymeric hydrogels are primarily classified into chemical and physical hydrogels (based on the bonding type of the crosslinks), though they can also be classified in many other ways. Chemical hydrogels can be prepared by copolymerization of a monomer with crosslinker, or by crosslinking of water soluble polymers. Physical hydrogels can be made of natural biopolymers, thermo-sensitive synthetic polymers, amphiphilic triblock copolymers or many other copolymers. Further, polyelectrolyte complexes and polymer cyclodextrin inclusion complexes can likewise form hydrogels. Their biomedical applications are in drug delivery and tissue engineering. Now-a-days hydrogels have become popular carriers for drug delivery applications due to their biocompatibility and resemblance to biological tissues\textsuperscript{[7-12]}.

In the present study, 1:1, 2:1 and 3:1 TTEGDA-, NN MBA- and HDODA-crosslinked AA-NVP copolymeric hydrogels are used. These are prepared by suspension polymerization method. The crosslinking agents having varying degree of rigidity and flexibility, hydrophilic-hydrophobic nature and solubility were used. The conditions for maximum binding were optimized by altering certain factors such as crosslink density, concentration of dye solution, amount of polymer, pH and temperature. Infrared spectroscopy, UV-vis. spectroscopy, NMR spectroscopy and SEM studies were applied for the characterization of unbound polymers and dye bound polymers\textsuperscript{[13-16]}. The study can be outlined under the following heads:

A. **Synthesis of 1:1 TTEGDA-, NN MBA- and HDODA-crosslinked AA-NVP copolymeric hydrogels.**
   (i) Synthesis of the copolymeric hydrogels with varying conditions
   (ii) Characterization of unbound and bound polymers
   (iii) Swelling studies

B. **Synthesis of 2:1 TTEGDA-, NN MBA- and HDODA-crosslinked AA-NVP copolymeric hydrogels**
   (i) Synthesis of the copolymeric hydrogels with varying conditions
   (ii) Characterization of unbound and bound polymers
   (iii) Swelling studies
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C. Synthesis of 3:1 TTEGDA-, NN MBA- and HDODA-crosslinked AA-NVP copolymeric hydrogels
   (i) Synthesis of the copolymeric hydrogels with varying conditions
   (ii) Characterization of unbound and bound polymers
   (iii) Swelling studies

As a background to the present work, a brief survey of the existing literature on the various aspects of water pollution studies related to the binding of selected copolymeric hydrogels on dyes and their applications in various fields are given in the beginning. In the present study, emphasis is given to the binding of dyes with copolymeric hydrogels at varying conditions.

1.3 Organisation of the thesis

The thesis consists of four chapters. Chapter I is an introduction to the work stating its aims and objectives. Chapter II deals with the importance of hazardous dye removal from water by using copolymeric hydrogels. Chapter III describes experimental part of the thesis. It describes the synthesis of 1:1, 2:1 and 3:1 TTEGDA-, NN MBA- and HDODA-crosslinked AA-NVP copolymeric hydrogels. Chapter IV and V discusses the results of varying conditions of MG and BBG dye binding on copolymeric hydrogels. Chapter VI serves as a conclusion. It summarises the work done, the results of investigation of the dye bound polymers and the effect of various factors affecting conditions of dye binding.

1.4 References


2. Kalliala E, Talvenmaa P. Environmental profile of textile wet processing in Filand, J Cleaner Prod; 2000, 8:143-54.


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