CHAPTER I

INTRODUCTION

1.1 Scientific Rationale

Superabsorbent polymers are lightly crosslinked hydrophilic polymers that can absorb, swell and retain aqueous solutions or fluid up to hundreds of times their own weight. Therefore, superabsorbent polymers have great advantages over traditional water absorbing materials such as cotton, pulp or sponge. They are widely used in agriculture, horticulture, sanitary goods, sealing, controlled drug delivery systems, concrete, drilling and so on. The first superabsorbent polymer was reported by the U.S. Department of Agriculture in 1961, and many researchers have attempted to modify these absorbent polymers to enhance their absorbency, gel strength, and absorption rate (1-3).

In recent years, the study of organic-inorganic nanocomposites has become a very important field. Currently, reinforcing polymer with small amounts of smectite clays has attracted increasing interest, because the derived heterostructural materials exhibit impressive mechanical, thermal, optical, and other properties that increase their technological values.

Clays have sandwich types of structure with an octahedral Al sheet and two tetrahedral Si sheets, the so called phyllosillicate. There are many types of philo-silicate: kaolinite, montmorillonite, hectrite, saponite and, synthetic mica, etc. (4). For our purposes, a synthetic mica was chosen for syntheses of acrylamide-itaconic acid superabsorbent polymer nanocomposites. Because of their hydrophilic nature, clays are more suitable for use in water absorbents as additives. The main goals of using these mica particles are increasing swollen gel strength and achieving new materials for personal care applications.

1.2 Objectives of the Research Work

The objectives of this research are as follows:

1.2.1 To synthesize the poly[acrylamide-*co*-(itaconic acid)]/mica composites via solution polymerization. Effects of influential parameters such as mole ratios of acrylamide to itaconic acid, crosslinker concentrations reaction temperature, and mica contents, etc., were studied.

1.2.2 To characterize the chemical and physical properties of the newly synthesized superabsorbent polymers and nanocomposites.

1.2.3 To study the swelling properties of the the resulting superabsorbent polymers and nanocomposites.

1.2.4 To study viscoelastic properties of the swollen gel resulting from the superabsorbent polymers and nanocomposites.

1.3 Expected Benefit Obtainable from the Development of This Research

1.3.1 Obtained poly[acrylamide-*co*-(Itaconic acid)]/mica nanocomposites which can absorb great amounts of water.

1.3.2 Increased swollen gel strength and achieved new materials for personal care applications.

1.3.3 Information about influences of the reaction parameters in order to improve a better synthesis method.

1.4 Scopes and Workplan of Research Work

The acrylamide-itaconic acid/mica superabsorbent composites were prepared by free radical polymerization in aqueous solution of acrylamide (AM) with itaconic acid (IA) as comonomer. Mica is used as inorganic filler in solution polymerization to reinforce the polymer properties. They are polymerized using APS and TEMED as an initiator and co-intiator, respectively, and N-MBA as a crosslinking agent, at the temperature of 50 °C for 30 min. The influences of the reaction parameters on properties of the synthesized copolymer are investigated. The important procedure to achieve a better result is as follows:

1.4.1 Literature survey and in-depth study of this research work.

1.4.2 Synthesis of poly[acrylamide-*co*-(itaconic acid)]/mica superabsorbent composites *via* a solution polymerization by changing the following parameters so as to attain an appropriate reaction condition:

a) The effect of mole percent of monomer ratio (acrylamide/itaconic acid) at 100/0, 99/1, 95/5, 98/2, 97/3, 96/4, 95/5;

b) The effect of reaction temperatures at 40, 50 and 60°C.

c) The effect of crosslinker concentration: *N, N'*-methylenebisacrylamide (N-MBA) at 0.2, 0.5, 0.7, 0.9 % mole;

d) The optimum content of mica between 0-15 %weight on the total monomers.

1.4.3 Characterization of the synthesized polymer by means of:

a) Identification of functional group and structure in the synthesized copolymers by Fourier transform infrared spectroscopy.

b) Surface morphology of the synthesized copolymer by scanning electron microscopy.

e) Characterization of the structure of the synthesized superabsorbent composite by X-ray diffraction analysis and transmission electron microscopy.

f) Thermal properties of the synthesized copolymer by thermogravimetric analysis.

g) The water absorbency of the synthesized copolymer in distilled water and artificial urine.

h) The water absorbency under load of the synthesized copolymer under loads at 0.28 and 0.7 psi.

i) The water absorbency of the synthesized copolymer with various times in distilled water at: 1, 5, 10, 30, 60, 180, 300, and 480 min.

i) The amount of retained mica in the superabsorbent polymer nanocomposites by sinteration.

1.4.4 Viscoelastic properties of the swollen gel of the synthesized copolymers and composites.

1.4.5 Determination of the trace amounts of acrylamide monomer retained in the polymer by gas chromatography.

1.4.6 Summarizing the result and preparing the report.