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SYNTHESIS AND CHARACTERIZATION OF BIODEGRADABLE SUPERABSORBENT HYDROGELS OF POLY SODIUM ACRYLATE-POLYVINYL PYROLIDONE

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Abstract

Hydrogel is a hydrophilic polymer with a cross-linked network structure, able to swell in water, and has a high water diffusion capacity. Polyvinylpyrrolidone (PVP) is the result of the polymerization of 1-vinylpyrrolidone-2-one. In its polymer form, with the molecular formula (C6H9NO) n, its molecular weight ranges from 10,000 to 700,000, appears as a white or yellowish-white powder; has a faint odor or is odorless, is hygroscopic, and is easily soluble in water, ethanol (95%), chloroform; and is practically insoluble in ether (Anonymous, 1979). Research to determine the effect of superabsorbent hydrogel with the addition of poly(vinyl)pyrrolidone (PVP) powder. Research methods include physical examination and testing of gel fractions in hydrogel formulations. In general, the graph provides an overview of the kinetics of the behavior of three different experimental conditions on the variables studied over a certain period of time. The physical appearance of hydrogels with variations in PVP concentrations of 0.5, 1, 1.5 and 2 was obtained in solid and flexible forms, with clear and white colors.

***Keywords**: Hydrogels, Polyvinyl Pyrolidone, Superabsorbent*

1. INTRODUCTION

Hydrogel is a hydrophilic polymer with a cross-linked network structure, capable of swelling in water, and has a high water diffusion capacity. Due to these unique physical properties, hydrogel was initially synthesized for use as a drug release/retention matrix, contact lenses, and for enzyme and cell immobilization[1]. Furthermore, with the advancement of technology and the increasing demand for materials, research and development of hydrogels, particularly for biomedical applications, have been conducted intensively in recent times. One application of hydrogel in the healthcare field is for burn wound dressings. This is based on its physical properties, including its ability to retain water, act as a surface wetting agent, provide a cooling effect on burn wounds, and be biocompatible with the body[2].

Superabsorbent hydrogels are hydrophilic polymers capable of absorbing water hundreds to thousands of times their dry weight, yet they do not dissolve in water due to the three-dimensional cross-linked structure within their polymer network[3]. Hydrogels are one example of polymer materials that can function as substances sensitive to environmental changes[4].

Polyvinylpyrrolidone (PVP) is the result of the polymerization of 1-vinylpyrrolid-2-one. In its polymer form, with the molecular formula (C6H9NO)n, its molecular weight ranges from 10,000 to 700,000, appearing as a white or yellowish-white powder; it has a faint odor or is

odorless, is hygroscopic, and easily soluble in water, ethanol (95%), chloroform; and practically insoluble in ether (Anonim, 1979). Polyvinylpyrrolidone (PVP) is a polymer widely used in the pharmaceutical and healthcare fields, among others, as a tablet binder, suspending agent, and dispersing agent. Additionally, PVP is non-toxic, inexpensive, and readily available[5].

2. METHODOLOGY

2.1 Tools and materials

Acrylic acid (Merck), PVP, NaOH (Merck), NaCl (Merck), Urea (Merck), Aquadest, NW 300 analytical balance, oven (Hereaus Vacuterm Instruments), Co60 irradiator (rubber irradiator), Fourier Transform Infrared Spectrophotometer (Shimadzu Prestige-21), scanning electron microscope (SEM) JSM (Jeol, Japan), magnetic stirrer (Heidolph), stopwatch, shaker (Kottermann Labortechnik, D-3162 type 3047), blender, DTG, and EDS.

2.2 Procedurs

2.2.1 Formulation

Table.1: *Superabsorbent Hydrogel Formulation of Poly Nalium Acrylate - Polyvinylpyrrolidone (PVP) Before Irradiation (PVP Variation)*

Materials	Formulation I	Formulation II	Formulation III	Formulation IV
As.Akrilat (ml)	15	15	15	15
NaOH (g)	4	4	4	4
PVP (g)	0,5	1	1,5	2
Aquadest	Add 100	Add 100	Add 100	Add 100

Preparation of superabsorbent hydrogel poly potassium Acrylate - Polyvinylpyrrolidone (PVP)[6]

- Prepare 15 ml of acrylic acid, Sodium hydroxide, add 40 ml of distilled water, then stir at a speed of 300 rpm until homogeneous. (as mass 1)
- Prepare PVP with each concentration of 0.5g, 1g, 1.5g, and 2g. each is added 40 ml of distilled water then stirred at a speed of 300 rpm until homogeneous. (as mass 2).
- Mix the acrylic acid solution (mass 1) with the PVP solution (mass 2) then stirred at a speed of 300 rpm until homogeneous.
- The solution is packed into a 3X10 cm2 polypropylene (PP) plastic bag. Then irradiated with gamma rays at a dose of 10 kGy.

2.3 Characteristic Test

2.3.1 Physical appearance of hydrogel

Physical appearance tests were carried out organoleptically, including color, hardness and shape of the gel produced[7].

2.3.2 Swelling Ratio In Distilled Water

The swelling rate of the hydrogel was determined gravimetrically. Dry hydrogel (Wo) weighing ± 0.10 gr was put into 100 ml of distilled water (other

types of solutions), at room temperature for minutes at room temperature. After a certain time, the swollen hydrogel was filtered using a tea strainer (± 200 mesh). Then the air filter that came out of the filter was collected in a beaker (± 1 jar). The volume of air collected in the beaker was weighed/measured (Wi). The same thing was done to measure the absorption of distilled air each within 0.3 minutes, 0.6 minutes, 1 minute, 1.3 minutes, 2 minutes, 2.3 minutes, 2.6 minutes, 3 minutes, 5 minutes, 7 minutes, 9 minutes, 11 minutes, 13 minutes, 15 minutes, 20 minutes, 25 minutes and 30 minutes. The test results from each were calculated using the equation[8]: Swelling ratio = Ws / W0

3. RESULTS

3.1 Characteristics Test

3.1.1 Physical Appearance

Visual differences of superabsorbent hydrogels were observed from their physical appearance. The physical forms observed included shape and color. The results of physical observations of polysodium acrylate-PVP superabsorbent hydrogels are as follows.

***Table.2**: Physical appearance of hydrogel with varying PVP concentration at 50% NaOH neutralization after irradiation at 10kGy irradiation dose*

[PVP,%]	[NaOH,%]	Texture	Colour
0,5	50%	Solid and flexible	Clear
1		Solid and flexible	Clear
1,5		Solid and flexible	White
2		Solid and flexible	White

3.1.2 .Effect of PVP Concentration on Superabsorbent Hydrogel

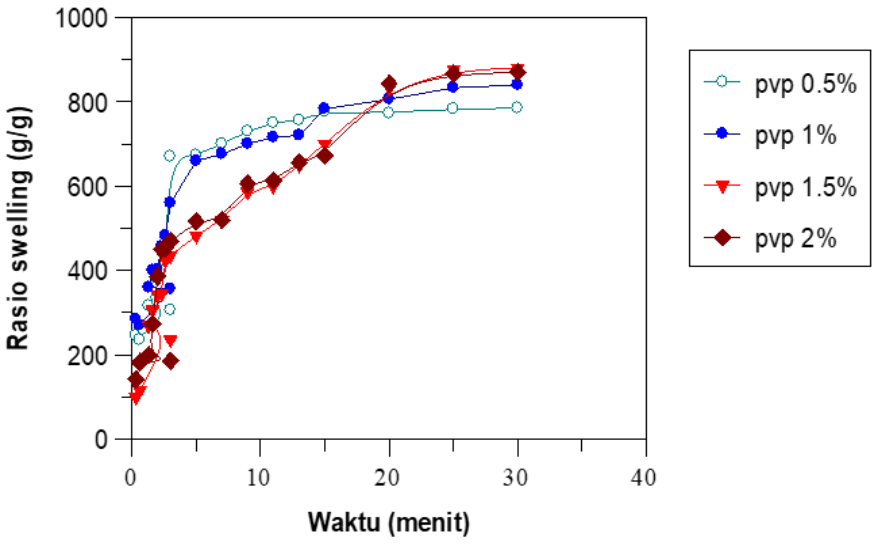

Figure 1. Effect of Soaking Time in Distilled Water on the Swelling Ratio of Superabsorbent Hydrogels with Variations in PVP Concentration and Neutralization of NaOH from Irradiation Results at a Dose of 10 kGy

The graphs shown illustrate the relationship between time (x-axis, in minutes) and a variable that is most likely related to the uptake or release of a substance in the system under test (y-axis). In these graphs, three different data sets are represented by different symbols, namely blue circles, inverted red triangles, and red diamonds, each of which shows the results of a different sample or experimental condition. In each data set, we see a similar pattern: initially, the curves show a rapid increase, indicating a high rate of uptake or release of the substance in the initial phase. However, as time passes, these curves begin to show that the system is reaching a saturation or equilibrium point, where the rate of change of the variable slows down significantly or stops altogether[9].

Although the curves show the same general trend, there are differences in the details. For example, some curves may show a faster or slower initial uptake rate than others, or may take different times to reach a plateau or equilibrium. Overall, these graphs appear to be the result of research exploring how a particular substance is uptake or released by a material (such as a hydrogel) under different conditions. This research can be related to biomedical applications, where understanding the kinetics of substance uptake or release is crucial for the development of efficient and effective materials. For a deeper interpretation, it is important to understand the context behind this experiment, such as the nature of the substance being tested, the materials used, and the purpose of the study. But in general, this graph provides an overview of the kinetics of the behavior of three different experimental conditions against the variables studied over a period of time[9].

4. CONCLUSIONS

Physical appearance of hydrogels with variations in PVP concentration of 0.5, 1, 1.5 and 2 obtained solid and flexible forms, with clear and white colors.

5. ACKNOWLEDGEMENTS

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