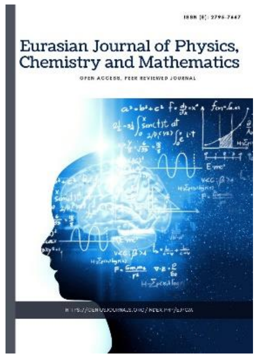

Preparation and Study of Some Properties, True Density, Apparent Porosity and Water Absorption of Polymeric Blend Films [PVA:PVP] Reinforced by $CaCl_2.2H_2O$ Salt.

Rafid M. A. Rustam — Department of Physics, College of Science, University of Diyala, Iraq
rafidmahmood26@gmail.com

Sabah A. Salman — Department of Physics, College of Science, University of Diyala, Iraq
pro.dr_sabahanwer@yahoo.com

Rana S. Mahmood — Department of Physics, College of Science, University of Diyala, Iraq

ABSTRACT

In the present paper, pure polymeric blend films [PVA: PVP] reinforced by $CaCl_2.2H_2O$ salt have been produced with different weight ratios (10,20,30,40,50 wt %) by using the solution casting method. The effect of the weight ratio of the salt upon true density of reinforced polymeric blend films was studied, where the experimental results showed an increase in the true density with increasing weight ratio of added salt. The apparent porosity of reinforced polymeric blend films was determined, and it was found that the apparent porosity decreases as weight ratio of the added salt is increased. The water absorbance of the reinforced polymeric blend films has been investigated as well, and experimental results have revealed that water absorbance decreases with the increase in weight ratio of the added salts.

Keywords: polymeric blend [PVA:PVP], $CaCl_2.2H_2O$ salt, True density, Apparent Porosity, Water Absorption.

Introduction

The history of polymers is linked to human development, as they were used in the clothing industry and the manufacture of dyes and glues, and were later used in water prevention, as in the asphalt used in boating [1]. The beginnings of laboratory studies of polymers, it dates back to the beginning of the twentieth century, specifically to the studies of the scientist (Staudinger) (1920) who pioneered the study of long molecular chains involved in the structure of the polymer to be the cornerstone in building of the polymers science [2].The topic of polymerization and polymers has received the attention of the scientific and industrial community, where many researchers have diagnosed polymers and the means to study their properties and manufacture them, which has led to their improvement and increase in use in various aspects of life. Polymers have entered into the production of most industrial materials, from toys, car structures, and aircraft. The use of polymers has also emerged in the manufacture of solar cells and chemical cells, and a number of polymers have been classified as insulators, as they have been used in the field of electronic industries to produce useful materials such as electronic circuit boards, electrical insulation materials, electrical wire wrapping and electrical connections, which are uses that fit the insulating nature of most polymers. Polymers have become an alternative to many traditional building metals, due to the high temperatures and stress that a number of polymers are characterized by, while the use of reinforced polymers has emerged in prefabricated construction, good thermal and sound insulation, and resistance to weather conditions [3].

Materials Used

1-The basic material

A- Polyvinyl alcohol (PVA): It is in the form of grains of a white color and is quick to dissolve in distilled water. It is a product of the Indian company HIMEDIA, and its molecular weight average is (13000–23000) g/mol.

B- Polyvinyl pyrrolidone (PVP): It is in the form of a white, slightly yellowish powder that dissolves quickly in distilled water. It is a product of the Indian company HIMEDIA, and its molecular weight is about (40000 g/mol). Figure (1) shows the structural formula of the above polymers [4].

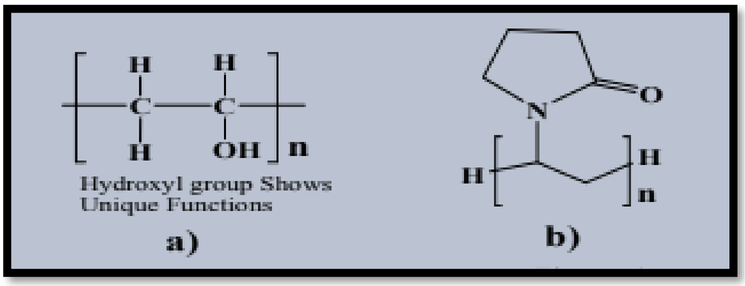

Figure 1: Structural Formula of Polymers
(a) Polyvinyl alcohol polymer (PVA). b) Polyvinyl pyrrolidone polymer (PVP)

2 – The reinforcement material

A- Hydrated calcium chloride: It is white crystalline material, soluble in water at (30 ^oC), and has the chemical formula $CaCl_2.2H_2O$. The most prominent properties are its molar mass (110.98g/mol), its density (2.15g/cm3) and its melting point (772^{o}C).

Preparation of Composites

The [PVA:PVP] polymeric blend is prepared using the casting method, a certain weight ratio of PVA was mixed with a certain weight ratio of PVP, and distilled water was added to them at an amount of 15 ml by using a magnetic sterrier for 1 hour at a temperature of 60 oC for the purpose of obtaining a homogeneous solution. The solution is cast afterwards into special glass mold that is placed on flat surface and left the solvent evaporates and we get the required sample. As for preparing a polymeric blend [PVA: PVP] reinforced by $CaCl_2.2H_2O$ salt using the casting method, Certain weight ratios of PVA polymer were mixed with certain weight ratios of PVP polymer and certain weight ratios of $CaCl_2.2H_2O$ salt (10,20,30,40,50 wt%), and then distilled water was added to them in an amount of (15 ml) using a magnetic sterrier for 1 hour at a temperature of (60^{o}C) to obtain a homogeneous solution, after which the solutions are cast in special glass molds that are placed upon flat surface and left to the point where the solvent evaporates and required samples are obtained.

Devices of Measurements

Sartoius balance

In order to test the true density, apparent porosity, and water absorption of the pure polymeric blend film [PVA:PVP] and polymeric blend films reinforced by $CaCl_2.2H_2O$ salt, a device of the type (Sartoius) of German origin was used.

Results and discussion

True density

The true density of the pure polymeric blend film [PVA: PVP] and polymeric blend films reinforced by $CaCl_2.2H_2O$ salt were calculated with different weight ratios, as shown in Figure (2). As we note from the figure that the value of the true density of the pure polymeric blend film [PVA: PVP] is (213.5 Kg/m^3), and when reinforced with $CaCl_2.2H_2O$ salt with different weight ratios, we notice that the apparent density increases with the increase in the concentration of $CaCl_2.2H_2O$ salt due to the chemical composition of the salt, where it has an effect on the density at a certain temperature, which causes the increase in the density. Also, the method of immersing the sample in water is important to increasing the convergence of the granular components of the sample, which leads to an increase in the amount of accumulated granules per unit sample volume, which leads to a higher density of the sample when immersed in water, and this does not mean reaching materials at their full density. The increasing density leads to an increase in the temperature, because the number of pores in the sample decreases, and thus the density increases [5]. Table (1) shows the true density values of all polymeric blend films.

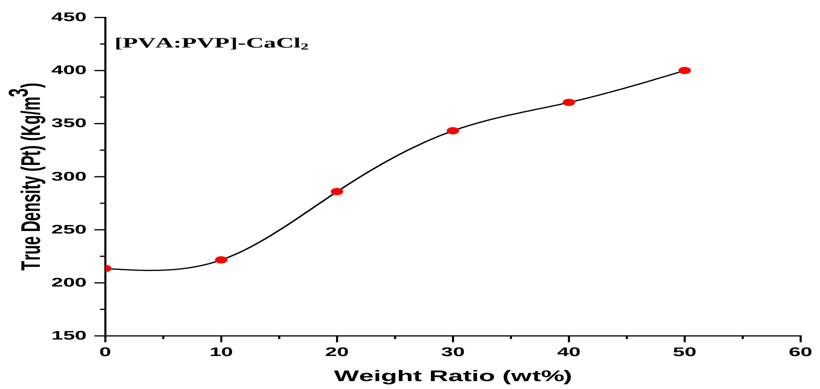

Figure 2: True Density of the [PVA:PVP]- $CaCl_2$ composite films as function of the weight ratio of $CaCl_2.2H_2O$ salt.

Table1: True Density value of [PVA:PVP]- $CaCl_2$ composite films with weight ratio of $CaCl_2.2H_2O$ salt.

Weight Ratio wt (%) of Salt	(Pt) [PVA:PVP]-$CaCl_2$ TrueDensity (Kg/m³)
Pure [PVA:PVP] Blend	213.5
10	221.6
20	285.9
30	343.2
40	370
50	400

Apparent Porosity

The apparent porosity of the film of the pure polymeric blend film [PVA: PVP] and polymeric blend films reinforced by $CaCl_2.2H_2O$ salt were calculated with different weight ratios, as shown in Figure (3). As we note from the figure, the apparent porosity value of the pure polymeric blend film [PVA:PVP] is 0.8422%, and when reinforced by $CaCl_2.2H_2O$ salt in different weight ratios, we notice that the apparent porosity decreases with the increase in the concentration of $CaCl_2.2H_2O$ salt. This is due to the convergence and granulation of the particles together and the closure of the porosity, and thus the apparent porosity of these films decreases. The apparent porosity depends on three important factors: temperature, porosity formation (open pores) and the holes within the films due to the release of gases, and the effect of these factors is reversed. [6] Porosity is affected by the raw materials used in the preparation, as it is affected by the size and distribution of particles, as well as by pressure during the process of immersion of samples in water [7]. Table (2) shows the values of the apparent porosity of all polymeric blend films.

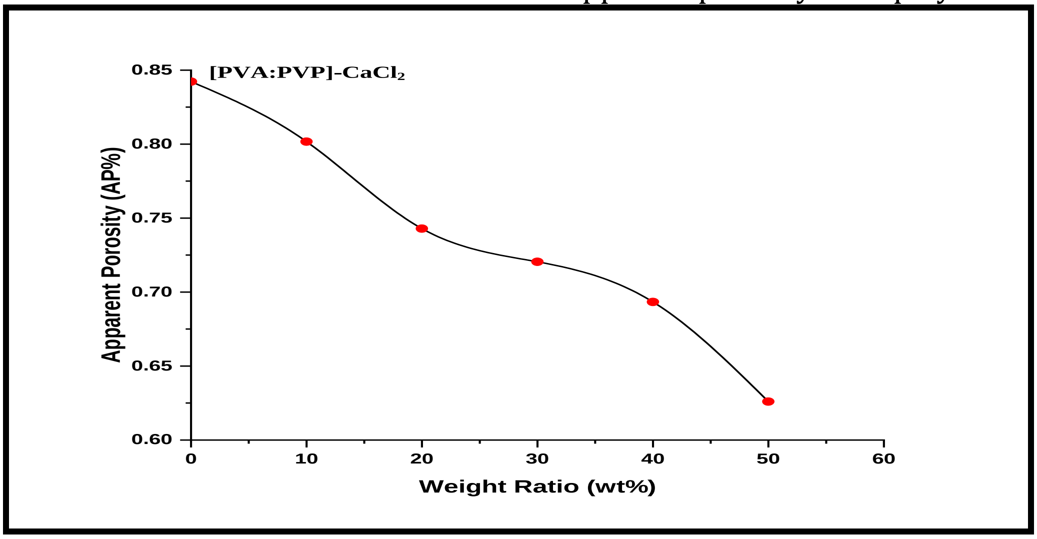

Figure 3: Apparent Porosity of the [PVA:PVP]- $CaCl_2$ composite films as function of the weight ratio of $CaCl_2.2H_2O$ salt.

Table 2: Apparent Porosity value of [PVA:PVP]- $CaCl_2$ composite films with weight ratio of $CaCl_2.2H_2O$ salt.

Weight Ratio wt (%) of Salt	[PVA:PVP]-$CaCl_2$ Apparent Porosity (AP%)
Pure [PVA:PVP] Blend	0.8422
10	0.8017
20	0.7429
30	0.7205
40	0.6933
50	0.6260

Water Absorption

The water absorbance was calculated for the pure polymeric blend film [PVA: PVP] and polymeric blend films reinforced by $CaCl_2.2H_2O$ salt with different weight ratios, as shown in Figure (4), where we note from the figure that the value of the water absorbance of the pure polymeric blend film [PVA: PVP] is 3.8721%, and when reinforced by $CaCl_2.2H_2O$ salt with different weight ratios, we notice that the water absorbance decreases with the increase in concentration of added $CaCl_2.2H_2O$ salt. Such behavior is due to the increase of the liquid phase resulting from the interaction of the solid phase with the components of the film, where there is a phase relationship between water absorption and apparent porosity [7,8]. Table

(3) shows the values of water absorbance of all polymeric blend films.

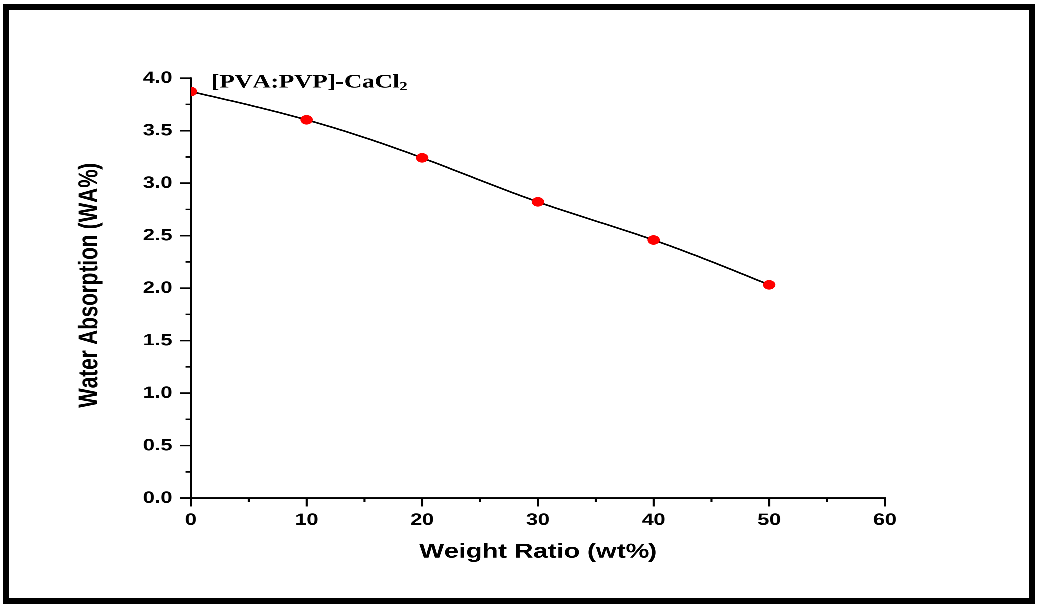

Figure 4: Water Absorption of the [PVA:PVP]- $CaCl_2$ composite films as function of the weight ratio of $CaCl_2.2H_2O$ salt.

Table 3: Water Absorption value of [PVA:PVP]- $CaCl_2$ composite films with weight ratio of $CaCl_2.2H_2O$ salt.

Weight Ratio wt (%) of Salt	Water [PVA:PVP]-$CaCl_2$ Absorption (WA%)
Pure [PVA:PVP] Blend	3.8721
10	3.6031
20	3.2404
30	2.8215
40	2.4575
50	2.0309

Conclusions

After conducting the study and research on the films of the pure polymeric blend films [PVA: PVP] and reinforced by $CaCl_2.2H_2O$ salt with different weight ratios (10,20,30,40,50) wt % , The study showed that the true density increases with the increases of weight ratio of added $CaCl_2.2H_2O$ salt. While the apparent porosity and water absorbency reduce with the increases of weight ratio of added $CaCl_2.2H_2O$ salt.

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