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Rheological and Electrical Properties of Industrial Polymers

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Abstract

The main purpose of the preparation of the polymeric mixtures here is to obtain these new properties and properties (super properties), which cannot be found and reached in individual polymers alone. To do so, a range of methods are utilized, including Solid State and Liquid state. On those polymeric materials that possess those good mechanical and electrical properties. The current polymer-based PVA-CMC-PEG is methylcellulose (CMC) reinforced with both polyvinyl (PVA) and polyethylene glycol (PEG) and in different concentrations (g / mL3). (2, 3, 9, 3, 4, 4, 2. 6,202). Some of these rheological properties have relative density and reduce viscosity. For these electrical properties, electrical conductivity measurements are then included in the calculation and molar analysis. The results indicated that all properties increase linearly with increasing concentration of components and properties except low viscosity, molar conductivity, and degree of dissociation of samples.

Keywords: Rheological properties, electrical properties, industrial polymers, polymer-based material, polymeric mixtures.

INTRODUCTION

It is tough to conceive today's fast-paced world without polymeric materials. Nowadays, those materials have grown a major part of our lives and are utilized to construct different objects, from living tools to accurate and complicated medical and scientific means. The word polymerase comes from the Greek word (Poly), meaning multiple and (Meros), meaning unit with part [1,2].

In the meantime, the polymer's structure with very long molecules of species chains totally differs from the entire metal structure. The long molecules consist of thousands of small molecular units commonly named monomers. Natural materials, including bitumen, silk, lacquer, nail polish remover, and cellulose, possess similar structures [3,4].

Major industrial polymers are chemical compounds used in the manufacture of synthetic industrial materials. They are classified according to composition. In general, Industrial polymers are either carbon-chain polymers (also called vinyl) or heterochain polymers (also called noncarbon-chain or nonvinyls). Polymers are one of the most important industrial and chemical products alike, as they have been introduced into most of the daily life of both the individual and society as a whole and have replaced many of these traditional materials used in the past. [5].

The different needs in polymers industrial and synthesized varieties, where the increased need for polymers with high-quality efficiency and the required accomplishment, have changed these modern and advanced studies in polymer science in terms of development [6].

The new homogeneous polymers to this development in these new polymeric mixtures where polymer blends science has become the most important science in recent years, especially in economic, commercial, and industrial [7].

The polymeric here is defined as that mixture of two or more polymers, and the reactive process is prepared here by the mixture of polymers in both liquid or stable states or in the molten phase. This mixture is called either Binary, Ternary, or Quaternary depending on the number of polymers [7,8].

METHODS

To investigate the rheological and electrical properties of industrial polymers, different methods in the preparation of polymeric mixtures are applied as follows:

(1) Solid-State: It is the one that mixes the first polymer in the solid-state (powder) with the second polymer, which is in the form of white powder, and then dissolved here together in the appropriate solvent where this method is the most used methods in the industry.

(2) Liquid-state: It is by the reaction so that the first polymer is mixed with a second polymer in the liquid phase as the second polymer is polymerized through the first polymer after mixing them [8-10].

RESULTS AND DISCUSSION

Rheological Properties

Viscosity here is one of the important phenomena in the materials used and manufactured in general, including those polymeric materials. Extension of polymeric molecules by researching the space of that solution [11,12].

The polymeric solutions are uniquely different from the solutions of various other substances by being more viscous.

Shear Viscosity is one of the liquid properties and expresses the resistance of liquid molecules in motion [13].

The viscosity of the polymeric solutions as a result of the friction of these polymeric molecules is explained by the solvent molecules when they move them together with the solution.

This relative wife (ηrel) is also defined as the ratio between the wife's polymeric solution to the wife's pure solvent as in the following equation [14]:

$$\eta_{rel} = \frac{\eta_s}{\eta_0} \quad (1)$$

It is the ratio between the amount of increase in the viscosity of the solution as a result of its polymer solubility and the viscosity of the pure solvent so that the result is given by:

$$\eta_{sp} = \frac{\eta_s - \eta_0}{\eta_0} \quad (2)$$

The ratio between the specific viscosity and the concentration of the solution (C) is called the reduction viscosity (ηred) Reduced Viscosity.

The equation [9] shows:

$$\eta_{red} = \frac{\eta_{sp}}{c} \quad (3)$$

Electrical Properties

Electrical conductivity is defined as the process in which the transfer of electrical charges from one location to another in that medium is under the influence of that electric field and here is the ionic conduction in those polymers due to the free movement between the ions and those impurities where the chemical composition of the polymer is here. The specific effect in ionic motion where the greater the conductivity of polymers, the higher the temperature depending on the equation [11,12]:

$$\sigma = \Psi e^{-\Delta u / RT} \quad (4)$$

Practical Part

Materials used in the experiment: The base material used herein A- Matrix Material: The base material used is carboxymethyl smimoz (Carboxymethyl Cellulose) Carboxymethyl cellulose is a high viscosity of ionic linear polymers and is characterized by dissolving in water and has a degree of fusion (CMC High viscosity) (227 ºC) and is in the form of a white powder with a moderate smell Non-toxic.

B - reinforcing materials of the mixture: (PVA) Polyvinyl alcohol is characterized because it contains granules with the ability to dissolve B water in addition to its resistance to do solvents such as oils experiment whit Non-toxic melting point equivalent. (230ºC)

Preparation of Polymer Blends Preparation of Polymer blends Prepared several mixtures of polymers (PVA - (CMC - PEG) by dissolving those specific weights of them in the volume chosen for the experiment (250 ml) of that distilled water as a kind of good solvent for these polymers. The magnetic stirrer was used in the mixing process of the components used in order to obtain the most homogeneous mixture at a temperature of 50 °C for a minimum duration of 45 min. / mL0 .44.0 .38, 0 .34, 0 .3, 0. 26, 0).

Then the cooling process of the mixtures to reach the temperature in the room has been carried out here some rheological and electrical measurements and calculated the concentrations of these mixtures[13,14]:

Measurements

The density of the mixture used for all of the concentrations was measured using a bottle of density and a capacity of 26 ml in addition to an electronic scale manufactured by the company (Mettler Switzerland) with a sensitivity of (+0.01).

The viscosity ratio of all concentrations used in the experiment was measured using the German-made Rheocalc viscometer. The electrical connections were also measured using a British origin DDS - 307W conductivity meter.

Rheological calculations

Fig. (1) shows that there is a linear increase in the density value with increasing concentration of PVA- CMC-PEG mixture. Polymer and this increase is consistent with what the researcher obtained [2]. Shear viscosity values and different concentrations of the PVA-CMC-PEG mixture were found. Figure (2) shows the extent of change in shear viscosity ratios with these concentrations. Therefore, the increase in the concentration of the polymer in the mixture used and thus results in high friction forces rotational and transition between those polymeric molecules and the solvent on the other hand [6]. Those other types used for viscosity, such as pouring and specificity, behave behavior of sternal viscosity in the same form, through behavior or changes because they are derived from that sternal viscosity as part of it. The relative and specific viscosity values were obtained using these equations (1) and (2), respectively. The results are shown in Figures (3) and (4). The reduced viscosity of PVA - CMC - PEG mixture was calculated using equation (3) and Fig. (5) [4].

Electrical-Calculations

The electrical conductivity and the different concentrations of the mixture used (PVA- CMC - PEG) were measured by Figure (6) where it is noted that the conductivity increases with increasing concentration and due to the increase in concentration, resulting in an increase in the number of ions and free electrons regularly and resulting Increased electrode polarization within the solution and thus increased conductivity [7].

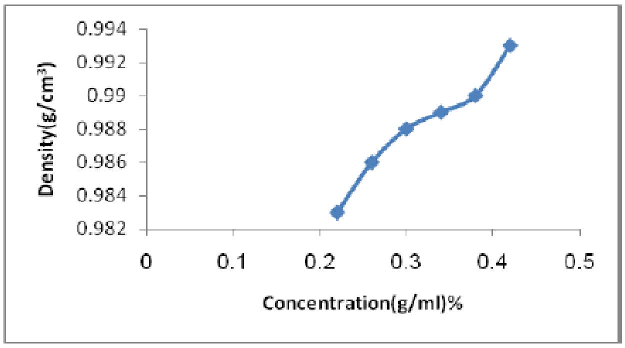

Figure 1. Density change concentration with PVA-CMC-PEG mixture:

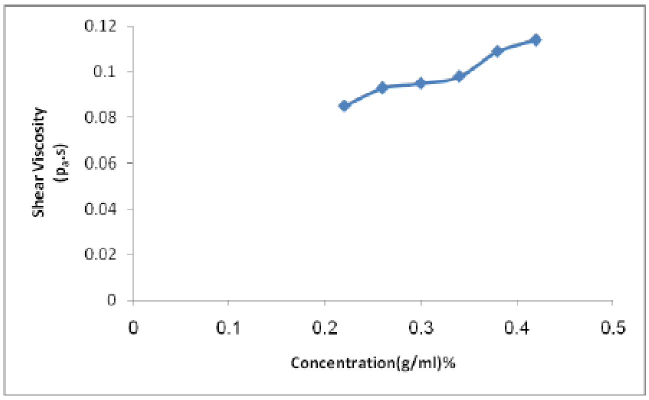

Figure 2. Shear viscosity change with concentration of PVA-CMC-PEG:

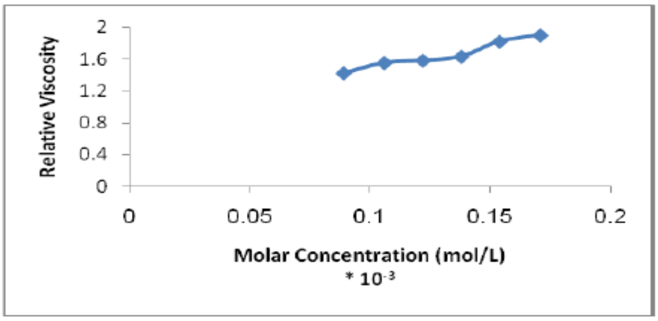

Figure 3. Relative viscosity change with concentration:

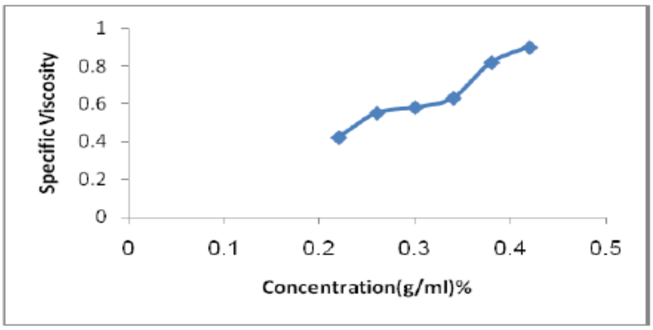

Figure 4. Specific viscosity change:

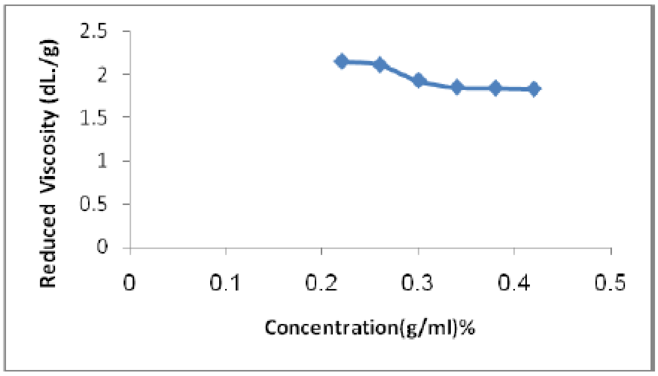

Figure 5. Specific viscosity ratios:

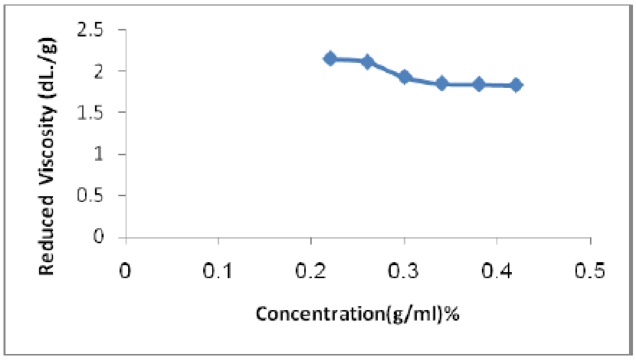

Figure 6. Change of electrical conductivity:

CONCLUSIONS

In the light of the results of this research, it can be concluded that:

1. These polymers result in continuous changes in their rheological and electrical properties as a result of the addition of PVA-PEG to CMC, which can be utilized in many different industrial applications at present.
2. When adding (PVA - PEG) the ratio of viscosity to the substance (CMC) and through this we can get different degrees of viscosity for each change in the concentration of the reactant (PVA - PEG). This means obtaining new industrial applications and products for the polymer industry (CMC).
3. When we add (PVA - PEG) to (CMC) resulted in high electrical conductivity of the mixture, and through this can increase the rates of electrical conductivity by increasing the volume of concentration added to the reaction.

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