

RESEARCH PAPER

Synthesis of Polysaccharide Polymer Kappa Carginate Nanoparticles Using Cocoamide Monoethanolamine and Their Applications in the Removal Zn^{2+} , Pb^{2+} , Co^{2+} From the Solution

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ABSTRACT

In this study, cocoamide monoethanolamine was used to create the Kappa Carginate nanopolymer. After that, it was ground with hard balls to produce nanoscales. (24.56 ,26.80 ,49.13) nm. FTIR, scanning electron microscope, and an X-ray diffraction tool were used to studies. The polymer's ability to absorb substances was tested at various pH, with pH 7 having the best absorption capacity (50). The effect of time on absorption capacity was also investigated, with the more time the polymer was exposed to, the greater the absorption. The role of heat in deciding the usage of polymer in ion treatment (Zn^{2+} , Pb^{2+} , and Co^{2+}) in solutions was investigated, and the influence of heat on the neutral pH capacity for absorption was demonstrated.

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INTRODUCTION

The difficulty of getting rid of polymers, which generate environmental contamination due to their difficulty in degrading, is one of the most important issues affecting the environment at the moment [1,2]. Consequently, focus shifted to solving this issue [3,4]. Because natural polymers contain sugar groups, which naturally disintegrate by these groups, they were created and used in the environment instead of artificial polymers [5,6]. Carginate, linear sugars with a sulfate group taken from red algae, are one of these polymers that have been examined. A copolymer [7,8] Unsaturated cascade made up of two different kinds of sugar monomers. Since this classification was developed based on solubility in potassium

chloride, there are multiple forms of Carginate (η , ϵ , ι , κ , λ) all of which contain a percentage of 22-35% sulfates [9,10]. carrageenan differ depending on the quantity of sulfur groups they contain and how they are thermoformed, which affects their physical, chemical, and viscous properties [11,12]. There are three primary forms of Carginate, although Lamda, which is amorphous, and kappa, which is strong crystalline and weakly amorphous, are the two that are more prevalent [13][14]. The most utilized type is kappa, which produces a highly potent gel when mixed with potassium salts and contain between 25 and 30 percent sulfur aggregates [15]. When we cool the solution after this polymer dissolves in water [16].

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MATERIALS AND METHODS

Synthesis of the natural polymer kappa Carginate nanoparticles using the cocoamide monoethanolamine

The baker is placed in a water bath at 60 ° C and strongly mechanically stirred for 30 minutes after 1 gram of kappa Carginate has been dissolved in 100 ml of ionic water. For a thorough dissolution, we add triethylendiamine (0.06) g and potassium sulfate (0.05) g and the mixture slowly for 30 minutes. The pH is then raised to 7 by dissolving 6 g of acrylic acid in cold water and neutralizing it with ammonia hydroxide. 20 ml of ionic water should be used to dissolve 6 g of acrylamide, along with 0.05 g of PS acrylamide. We drain the combination from the monomer solution, cool it to 40 ° C, and then add 1 g of cocoamide monoethanolamine to the final mixture while strongly mechanically stirring for thirty minutes for thorough mixing of the ingredients. For complete polymerization, we put this mixture in a watch glass and microwave it at 950 watts for 15 minutes [3,16,2]. We take the produced polymer and methanol-wash it.

After that, we wash the ethanol for 24 hours to superficially remove any non-reactive materials, including the active ingredient. After crushing it with a heavy ball technology for six hours to produce nanopowder, we keep it in a particular container away from moisture after having dried it completely in a dryer at 60 ° C for 24 hours [5,17].

Measuring the absorption capacity of the polymer prepared at solutions different PH

Take 0.1 g of polymer and soaking it for 24 hours in 500 ml of different pH solutions. After that, the expanded polymer is filtered and weighed [7].

Study of the effect of time on the absorption capacity of PH (3, 7, 14)

Weights of 0.1 g of polymer were used, and 500 ml of solutions that had different PH were added for different times [11,18].

Study the effect of different temperatures at PH = 7

To completely finish the absorption process, 0.2g of polymer was taken and soaked in 500 ml

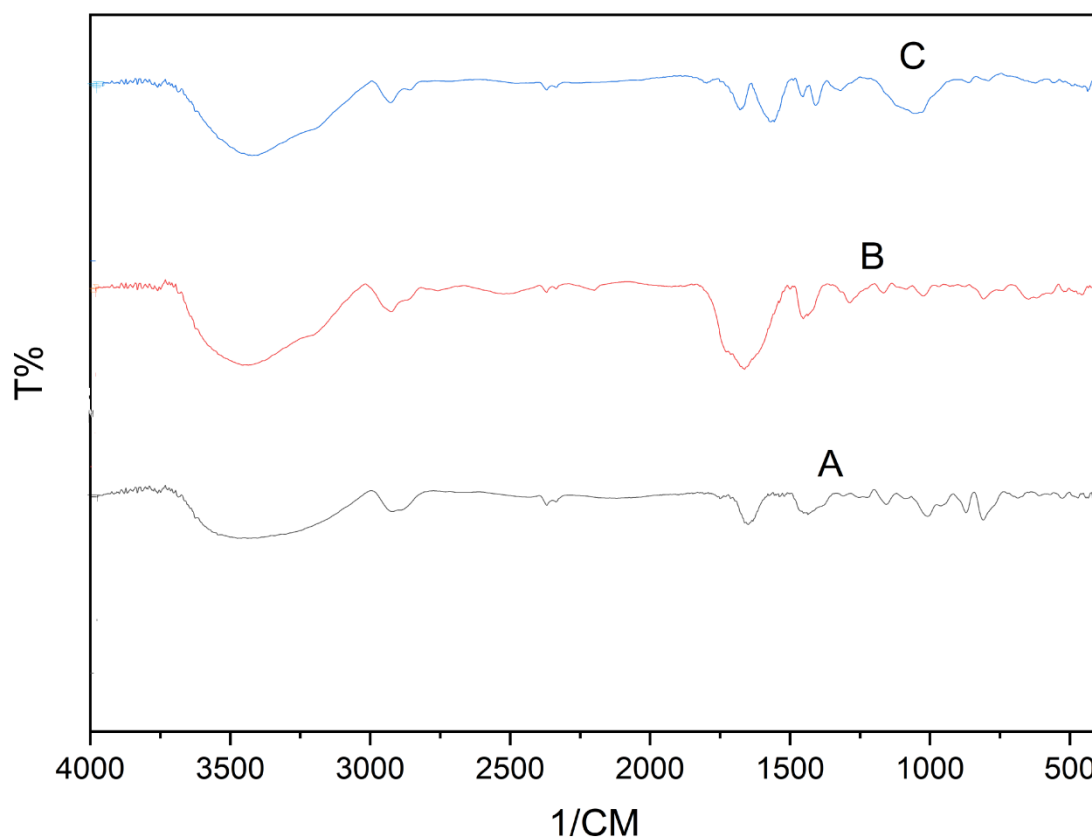


Fig. 1. FTIR spectrum of polymers.

of neutral pH water for 24 hours. The inflated polymer was then created and submerged for a complete hour in hot water at various temperatures (50, 60, 70, 80, 90, and 100 °C). We can now gauge the amount to which heat has an impact on absorption capacity after the polymer was weighed and the weight loss that happened was seen through the decrease [15].

Study of adsorption of elements (Zn²⁺, Co²⁺, Pb²⁺) on the surface of the polymer

Different concentrations of zinc nitrate, lead nitrate, and cobalt nitrate (10, 20, 30, 40, 50, 60, 70, 80, 90, and 100 ppm) were prepared. For 24 hours, 0.1 polymers were dissolved in 10 ml of pH-neutral liquids. After filtering them, the atomic absorption apparatus's absorption capability was determined [19,20].

RESULTS AND DISCUSSION

The prepared polymer's infrared spectrum reveals the presence of the active substance on the surface, and when compared to the kappa Carginate polymer, it demonstrates a distinct difference in the basic peaks that make up each peak, where bundles appear in the region of (3454

- 3435 - 3425) cm⁻¹, which indicates the formation of stretch bundles containing the hydroxyl group. (OH). In contrast, the prepared polymer exhibits fortunes in the wavelength of (3531-3458-3421-3400) cm⁻¹, which indicates the emergence of the hydroxyl beam as a result of the formation of hydrogen bonds as a result of the overlap of the second polymer chain produced up of Acryl amide and acrylic acid. The stretching of the methyl group (CH) caused a peak to arise in the region of (2926) cm⁻¹ in the spectrum of kappa Carginate, whereas the same peak appeared in the same region in the produced polymer. Nevertheless, bundles appeared in the region of (3234-3223) cm⁻¹ due to the symmetrical stretching of the acryl amide (NH) group and appeared in the region of (1575) cm⁻¹ due to the curvature of the acryl amide (NH) group, indicating that the polymerization occurs entirely with kappa carrageenan. Additionally, bundles that are a part of the Carginate carbonyl has increased by about 1651 cm⁻¹ (Fig. 1).

Fig. 2 demonstrates the prepared polymer's variable intensity, which indicates the presence of monomers and non-reactive polymers between the polymeric chains. This polymer was prepared before to the addition of the material that was

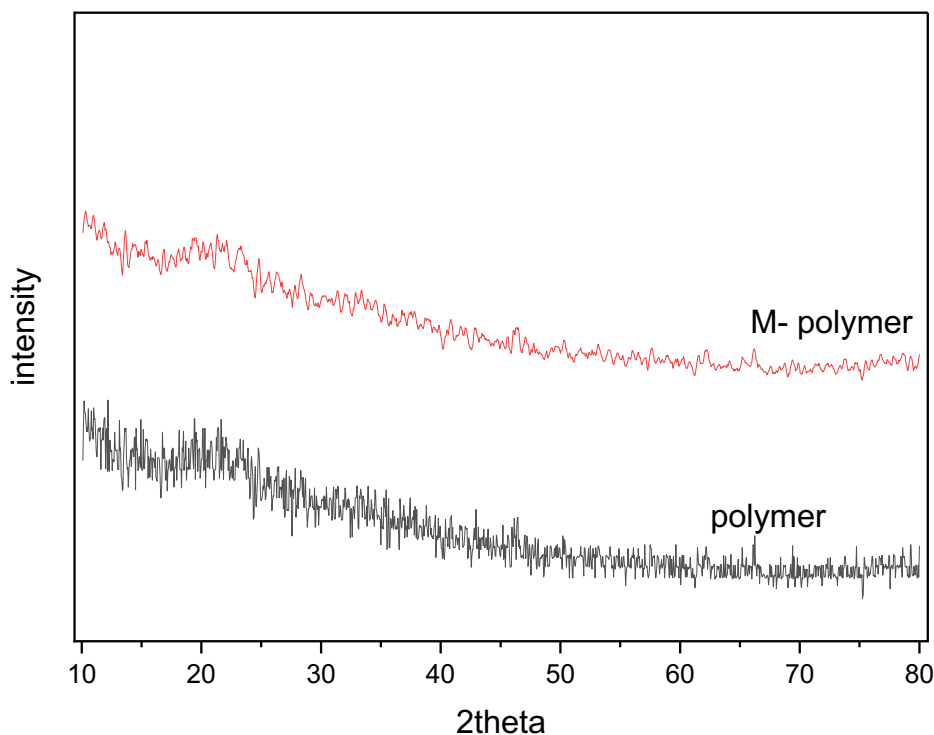


Fig. 2. The difference between the polymer and M-polymer.

attached.

SEM images of samples was presented in Fig. 3. It should be noted that the polymer bearing the symbol (B) that does not contain the active substance superficially and at a dimension of notice the irregularity of the surface and the

appearance of unorganized peaks at the size 200 nm. It was discovered through the measurement of scanning electron microscopy that the active substance has a significant role in smoothing the surface and giving it a wide area, which makes it easy to crush easily. We see that there were

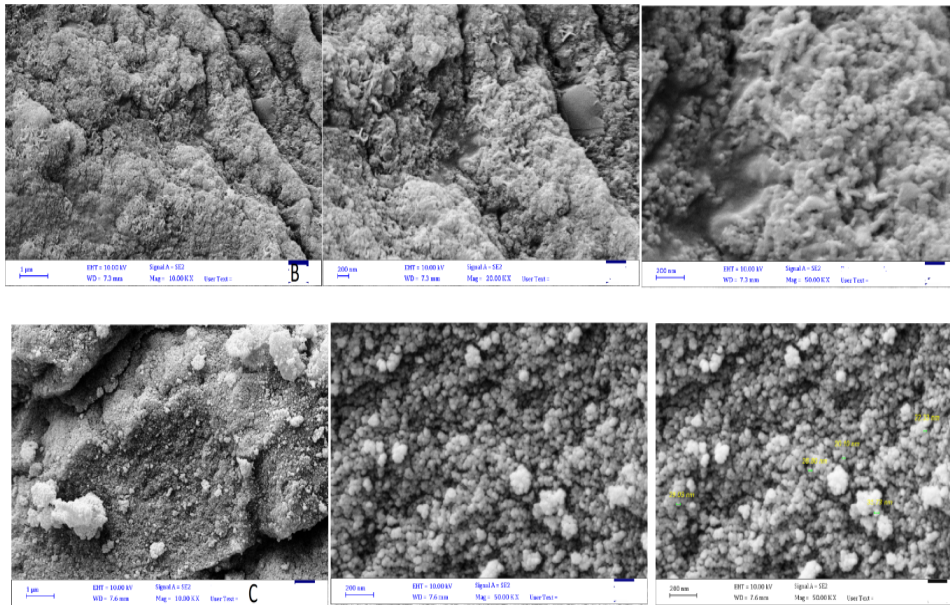


Fig. 3. The SEM images of the polymer (B) and Polymer (C) .

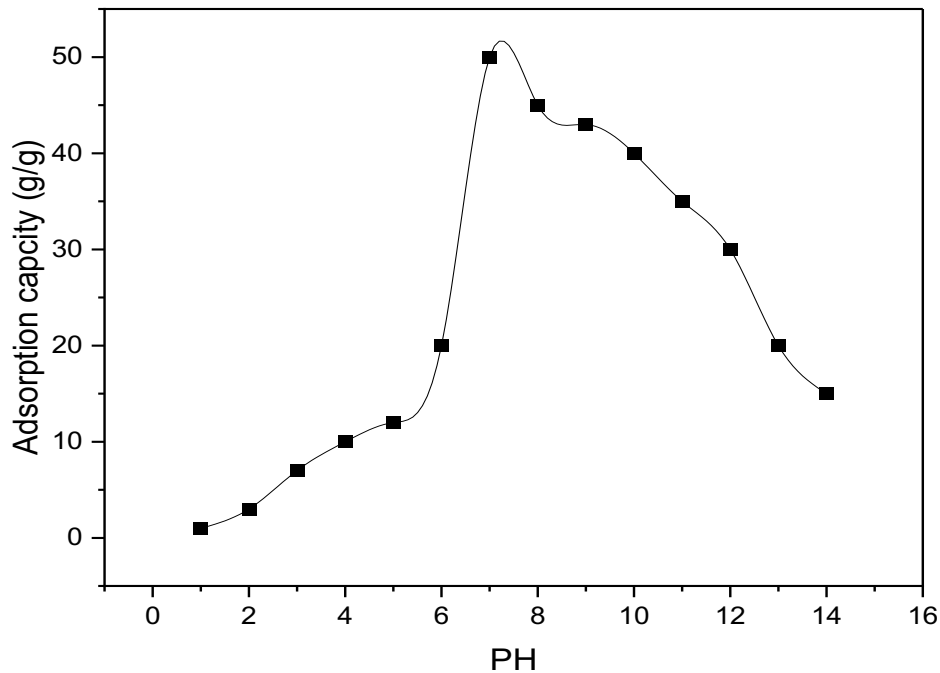


Fig. 4. The relation between pH and absorption capacity.

more increases that appeared to be unregulated. On the surface, we see that the polymer has the symbol (C) and contains the active ingredient. There are no discernible aberrations in the size of 1 micrometer, and this was seen through the dimension of 200 nm.

As shown in Fig. 4, at low pH, water absorption

is unavailable due to the insufficient brittleness of polar groups, which results in the lack of hydrogen bonds and, as a result, causes the contraction of polymer chains between them. This was observed when the absorption capacity of the polymer treated with the micelle material that was prepared at different PH levels was measured,

Table 1. Adsorption Capacity at Different PH.

Adsorption capacity (g/g)	pH
1	1
3	2
7	3
10	4
12	5
20	6
50	7
45	8
43	9
40	10
35	11
30	12
20	13
15	14

Table 2. The effect of the pH on the adsorption capacity at different times.

Time (m)	PH = 3	PH = 7	PH = 14
10	0.1	4	3
20	0.3	8.1	3.1
30	0.5	10	3.2
40	0.9	13	3.3
60	1	14	3.6
70	1.2	15	4
80	1.4	16	3.9
90	1.8	17	3.7
100	2.1	20	3.5

Table 3. The effect of temperature on adsorption capacity.

Adsorption capacity (g/g)	Temperature(°C)
45	50
43	60
35	70
30	80
20	90
11	100

receives some absorbed as a result of the polar groups in water being used again to form granules. This expansion of polymeric chains causes high absorption. Contrarily, because to the absence of

proteinization of polar groups granulating water, water absorption is high PH, and as a result, there is absorption, as shown in Table 1.

The impact of time changes on absorption

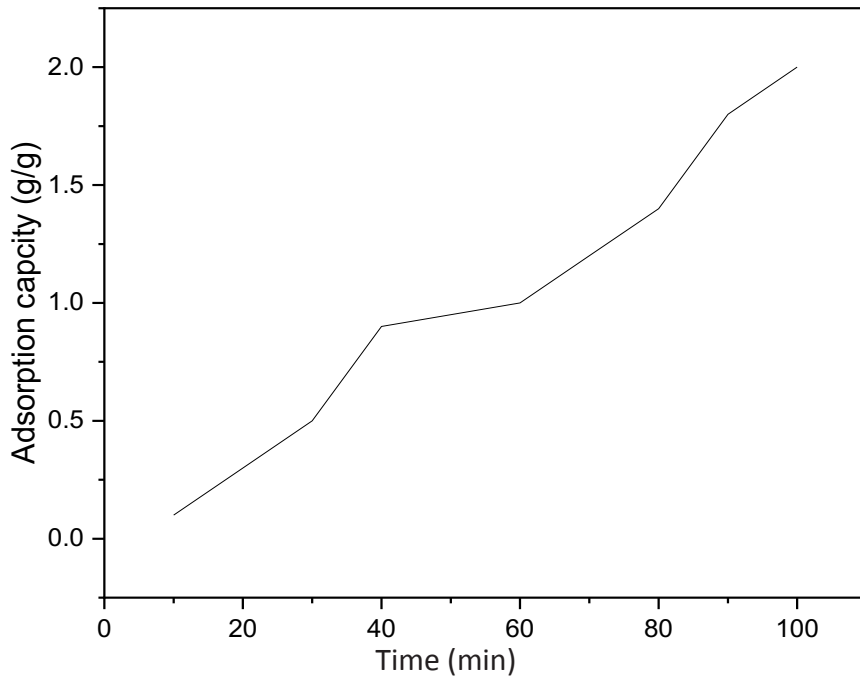


Fig. 5. The effect of time on the absorption capacity at pH = 2 .

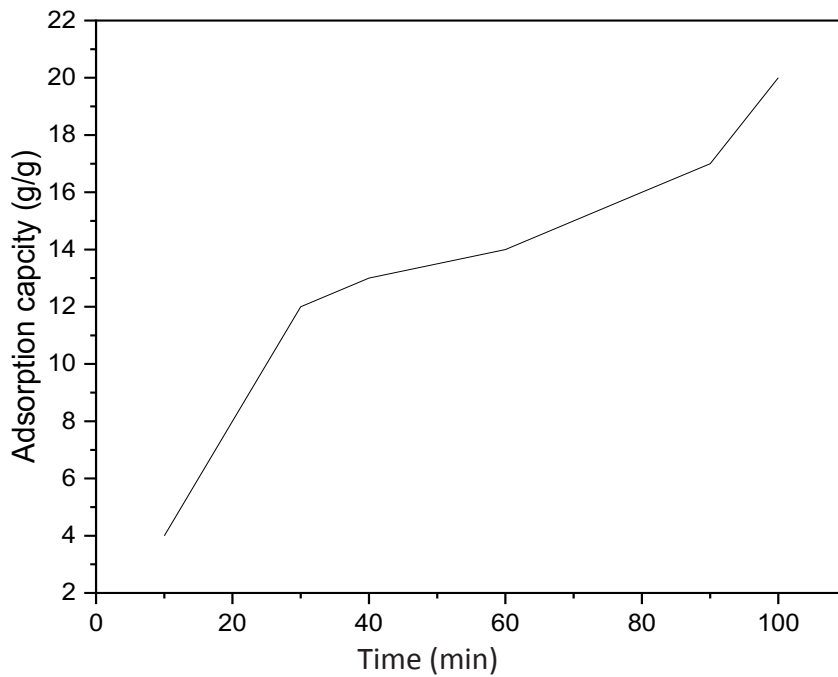


Fig. 6. The effect of time on the absorption capacity at pH 7.

capacity of the polymer synthesized with different PH (2,7,14) was investigated, and the results are

shown in Figs. 5, 6, 7, and Table 2.

It was discovered through Table 3 and Fig.

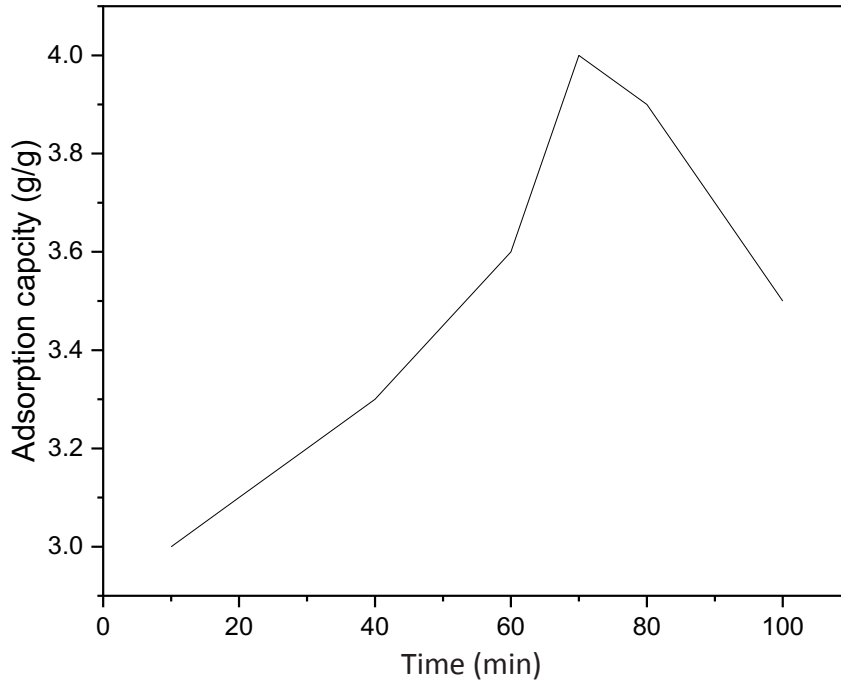


Fig. 7. Effect of time on absorption capacity at pH 14.

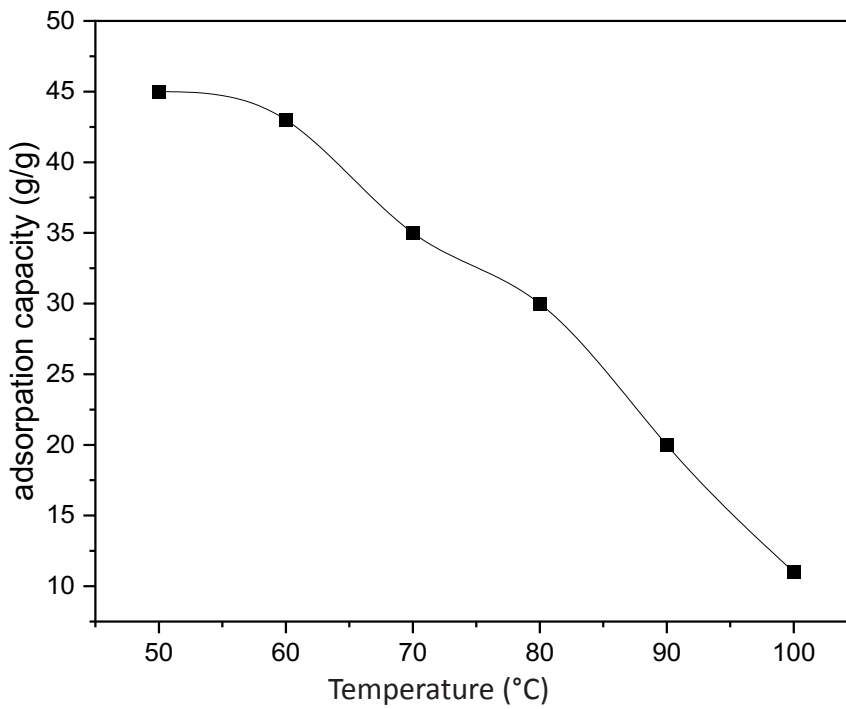


Fig. 8. Effect of temperature change on the absorption capacity of the polymer.

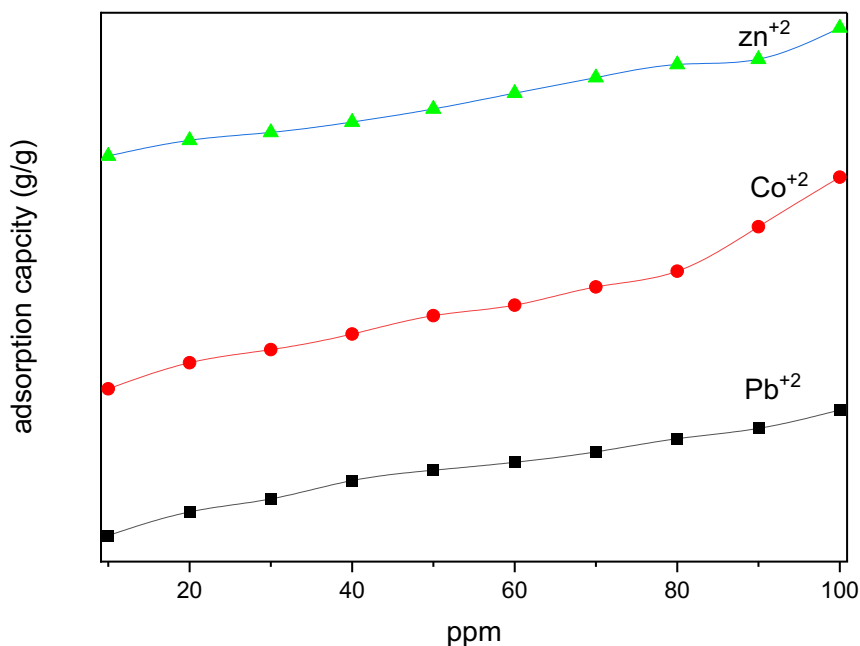


Fig. 9. The effect of concentration of elements on the absorption capacity of the polymer.

Table 4. The effect of salt concentration on absorption capacity.

ppm	Adsorption capacity (g/g)		
	Co ²⁺	Pb ²⁺	Zn ²⁺
10	2.1	1	5
20	2.7	2	5.9
30	3	2.5	6.4
40	3.4	3.1	7.1
50	3.9	3.8	7.5
60	4.5	4.2	7.8
70	5.1	4.9	8.2
80	5.6	5.5	8.7
90	5.8	7.2	9.1
100	7	9.1	9.8

8 that the higher the temperature, the lower the absorption capacity in a shaved manner because the heat leads to the weakness of the polymeric network, which leads to the expansion of channels which then leads to the dimensions of the influential group. The effect of heat on the absorption capacity of the prepared polymer at different temperatures and the pH seven was studied because it is the best acidic function at which absorption may happen.

Measured solutions of zinc nitrate, lead nitrate, and cobalt nitrate were prepared, and concentrations of 10, 20, 30, 40, 50, 60, 70, 80, 90, and 100 ppm were measured in the atomic absorption. The results are shown in Tables 4 and

Fig. 9, where it is noted that the large surface area of the prepared nanopolymer results in an increase in absorption as the concentration increases. The Table 4 exhibits the relationship between the synthesized polymer's concentration and absorption capacity.

CONCLUSION

1- The absorption and adsorption are inversely correlated with the produced polymer's surface area and nanoparticles.

2- It gets less absorbent as the temperature increases.

3- The produced polymer's absorbability increases with the number of efficient particles



present. The physical connects between the polymeric chains become weaker as a result of the active substance's use, which increases the pores in the polymer.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interests regarding the publication of this manuscript.

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