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Box(190)

www.Edu_girl.Kuiraq.com

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Acetamiprid Pesticide Removal in Aqueous Solutions Using Activated Carbon from Cherry Seeds

Rasha Faris Hadi ^{1, a)} and Lekaa Hussein Khdaim ^{2, b)}

¹ Chemistry Department, College of Education for Women, Kufa University, Al-Najaf Al-Ashraf, Iraq.

² Chemistry Department, College of Education for Women, Kufa University, Al-Najaf Al-Ashraf, Iraq.

^{a)} Corresponding author: rashafarishadi@gmail.com

^{b)} liqaa.aljailawi@uokufa.edu.iq

Abstract. In this research, activated charcoal derived from cherry nuclei, which was activated with citric acid at a concentration of 0.6M, was used to adsorb estamperid from its aqueous solution, and the results showed the adsorption efficiency of R (76%), to study the kinetics of the adsorption of the activated charcoal of the pesticide. The adsorption process is subject to the rate of false second order, the thermodynamic processes were studied to find the value of the enthalpy in different degrees of temperature, and the adsorption process was automatic and endothermic, and the contact time for the adsorption of the pesticide on activated charcoal was also studied, and the best time was at half an hour and the best weight was (0.05gm). Six isotherm models were selected, and the results showed that the Frendelsh model applied to the adsorption process in this study supports the Tamkeen and Dubin model through the value of the constants. The results indicate that the ZPCpH value of the surface of carbonated coal derived from the cherry cores is within (10), meaning that the surface charge is positive within the value of this $p=10$. And the results showed an increase in the amount of adsorbed with the increase in the initial concentration, the kinetic adsorption results it is subject to a pseudo-second-order kinetic equation. The study included the choice of applying isothermate models (Langmuir, Freundlich, Temkin, Harkins-jura, Eiovich, and Doben).

KEYWORDS: Acetamiprid; Pesticide; Activated Carbon; Cherry Seeds; Removal

1. INTRODUCTION

Water pollution appears in multiple forms, such as poisoning with inorganic wastes, pesticides or detergents, or pollution resulting from food impact, thermal pollution, oil pollution, or pollution resulting from dyeing factories [1], where river water is polluted with surplus dyes that are thrown by factories, including textile factories and other various pollutants. Water pollution is a form of pollution caused by the improper use of pesticides. This simply means that unsuitable substances are present in the water, which changes its properties, making it contaminated and unsuitable for use. This occurs when pesticides are used in wilderness areas that are used to grow crops away from wind and rain in bodies of water. As a result, it changes the state of these water bodies by altering their physical, chemical and biological conditions, making them toxic, polluted and unsuitable for use. And when the water is contaminated with pesticides, this water becomes harmful to the organisms that consume it or come into contact with it. Water pollution is a very bad thing and has devastating effects on the environment. It creates negative impacts on the environment [2].

Acetamiprid is an organic compound with the chemical formula C₁₀H₁₁ClN₄ as shown in figure 1. It is an odorless neonicotinoid insecticide produced under the brand names Assail and Chipco by Aventis CropSciences. It is produced systematically and aims to control sucking insects (Thysanoptera, Hemiptera, mainly aphids) on crops such as leafy vegetables, citrus fruits, pome fruits, grapes, cotton, cola crops and ornamental plants. It is also a major pesticide in commercial cherry cultivation due to its effectiveness against cherry fruit fly larvae [3]

Acetamiprid has a high bioaccumulation potential and is highly toxic to birds and moderately toxic to aquatic organisms [4]. Excessive use of pesticides can pose a threat to bird populations and other parts of the food chain. On the other hand, the metabolites produced after absorption of acetamiprid in honey bees are less toxic than those found in other nicotinoid. Also, the half-life of acetamiprid is rather short, around 25-30 minutes, while the half-life of other neonicotinoids can be 4-5 hours. However, some metabolites were still present in honey bees after 72 hours. This could be a toxic hazard to honey bees, as chronic exposure can increase the toxicity of some compounds. The Environmental Protection Agency considers it a "moderate only toxic" to bees. However, some media sources and the recent documentary *Vanishing of the Bees* have blamed neonicotinoid pesticides such as acetambride for colony collapse disorder [5].

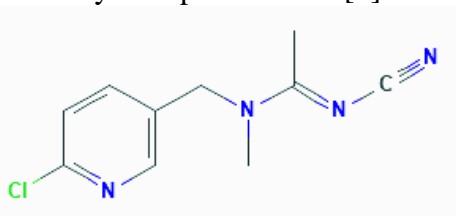


Figure 1. the chemical formula for chemical formula.

Adsorption is considered one of the effective techniques used in the purification and separation processes. The application of adsorption has expanded in a way that aroused the interest of many researchers for its effective role in accomplishing many purification processes, so that hardly any industry today is devoid of adsorption processes. It is considered one of the means that work to remove organic or inorganic substances or pollutants from their aqueous or alcoholic solutions or a mixture thereof and at low concentrations or concentrations that cannot be removed by traditional chemical or biological methods, as it opened new horizons in various sciences and areas of life and is in continuous progress. Where the adsorption method was used as one of the successful solutions in treating water pollution problems resulting from industrial water wastes, especially the waste of industrial and textile factories. Despite the large number of researches published in this field, most of them are directed to the use of the same adsorption surfaces, from the beginning of the surface of activated carbon [6] and its extensive uses to the surfaces of porous clays [7] that have become associated with most adsorption processes. With the development of natural analyzes and methods of studying adsorption and the different application needs and expansion, the urgent and important need appeared to study other hard, porous surfaces that are no less important than the previous ones, especially if these surfaces are natural and cheap, such as wood, zeolite, aluminum oxide and animal charcoal (char) [8], coal and silica gel [9], [10], silica gel does not give a high adsorption capacity when working as adsorption surfaces. Therefore, it became necessary to develop and go deeper to obtain surfaces or materials with high adsorption capacity, low economic cost, and easy use, as recent studies have indicated that used some types of manufactured polymers such as natural acrylic tissues, including cellulose. Cotton that has shown high efficiency as adsorbents in adsorption processes [11].

Activated carbon is a porous substance that suffers during its production a defect in its crystalline structure, which leads to the emergence of unstable pores or holes in terms of its energy content,

which underlie the high capacity of activated carbon to adsorb [12]. The presence of these pores in an abnormal way resulted in activated carbon having a surface area ranging between (2000-300) m²/g and up to 5000 m²/g [13]. Tang et al. [14], investigate Equilibrium, kinetic, and thermodynamic trials of the removal of methylene blue from aqueous solutions utilizing industrial waste walnut shell. Methylene blue (MB) was removed from aqueous solutions using walnut shell (WS), a cost-effective and environmentally safe adsorbent. On MB removal, the results of WS particle size, amount, contact duration, solution pH, adsorbent dose, contact duration, and amount were studied. The removing percentages will reach 97.1 percent under optimal conditions (contact period 2 h, pH 6, particle size 80 mesh, dye amount 20 mg/L, and 1.25 g/L adsorbent), meaning that WS is a good adsorbent for removing MB. To better grasp the adsorption processes, additional experiments including Brunauer-Emmett-Teller (BET), dynamic light scattering (DLS), Fourier transform infrared spectroscopy (FTIR) and the process were used. The active adsorption of MB on WS particle was verified by FTIR using the functional groups of WS. The correlations between dyes and WS particles under different pH have been studied using the DLS system, which can be attributed to electrostatic forces. The pseudo-second-order model suits the kinetic data well, suggesting chemical adsorption. Both the Langmuir and Freundlich models accurately represented the adsorption isotherms. Also, the Dubinin-Radushkevich model revealed that the adsorption was chemical in nature. At room temp, the adsorption has been random, exothermic, and favorable, according to thermodynamic results.

Upon reviewing the literature, it was found that there are many researches and studies that relied on different raw materials and methods of preparation and activation. In the past, commercial activated carbon was prepared from sawdust, peat, coal, or cellulosic waste [15], petroleum coal and some spent resins. Used in ion exchange such as styrene polymers and diphenyl benzene [16], phenol-formaldehyde resins [17] and spent car tires [18], as well as prepared from many of the aforementioned with the addition of binders such as heavy oils and others [19]. Carbon prepared using temperatures between (1000-800) m in an atmosphere of nitrogen or water vapor or carbon dioxide [20].

Vohler, et al., [22] were able to prepare activated carbon from sawdust and they obtained good quality when measuring the adsorptive and mechanical properties of the prepared samples. The product has a high surface area and porosity [15], and Metcalfe, et al., [23] were able to prepare activated carbon from coconut husks after mixing it with wood rich in quinine. The results showed that the activated carbon has different porous sizes and has a high ability to adsorb organic molecules. From preparing activated carbon from tooth wood using an increase of potassium hydroxide at a temperature of (550) m for a period of 3 hours. Hamdoon, et al., [24] were able to prepare activated carbon from the oxidation of bituminous residues using different concentrations of phosphoric acid (20,15,10,5,0%), then carbonization of the product using sodium hydroxide and it was found that the product has good adsorption characteristics. Preparation of activated carbon from bituminous materials with different proportions of polyethylene as a binder, as the process of aerobic oxidation was carried out at a temperature of (350) C. Then the carbonization process was completed using sodium hydroxide at a temperature of (550) C and the product was of excellent specifications, quantity and quality [25]. Ramadan and his group attended activated carbon from tartar materials left over from crude oil refineries from the northern region refineries through oxidation using (V₂O₅) and a stream of air at (350) m for 3 hours, followed by a carbonization process using an increase of 550 NaOH. M for 3 hours [26], and then it has been prepared activated carbon from tartar materials for the refineries of the northern region using different proportions of NaIO₄ with a stream of oxygen passing for 3 hours at (350) m, and then performing the activation process using an increase of NaOH. At (550) m for 3 hours [27].

The main objective of this study is to remove pollutants from water, as an important biosorbent for acetamiprid pesticide removal from aqueous media, porous activated carbon from Cherry seed waste was introduced in the current research. For the chemical activation of these agricultural wastes, the acidic solution HNO₃ and the basic NaOH have been utilized. Various variables, including various mass, pH, initial acetamiprid pesticide concentration, and contact duration, have been utilized in this research via batch adsorption. The removal ability has been analyzed by matching isothermal, kinetic, and thermodynamic adsorption results.

2. METHODOLOGY

2.1. Prepare the adsorbent surface

The charcoal derived from the cherry kernels was prepared by washing the seeds with distilled water several times and leaving them to dry at a temperature of (100) Celsius, then put them in an oxygen-free oven for two hours at a temperature of (500 degrees Celsius).) In order to obtain carbonated charcoal (CRH) and then the charcoal is finely crushed. Sift with a sieve with a diameter of (0.1 μm), then wash several times with distilled water and dry for two hours at a temperature of (50 ° C). We take 100 g of charcoal CRH and immerse it in 200 ml of 0.6M citric acid [28] for two hours under a temperature of 20 ° C and are dried under a temperature of 50 m for the next day and then dried again under a temperature of 120 m, the charcoal is washed with distilled water 5 times, and finally the charcoal is dried under a temperature of 100 m for the next day to obtain the activated surface (ARH) as shown in **Figure 2**.



FIGURE 2. Cherry seeds converting into carbonated charcoal (CRH).

2.2. Preparation of standard solutions and calibration curve

The standard stock solution of the pesticide acetamiprid was prepared at a concentration of (200 ppm), by dissolving a weight of (0.1gm) in (500 ml) of distilled water. After that different concentrations were prepared ranging from (10 to 100 ppm) as shown in Figure 3. The wavelength λ_{max} has measured to get the greatest absorption of the pesticide using distilled water (Reference) (Blank). Then, the absorbance was measured for each of the ten samples by UV-visible spectrophotometer (as shown in figure 4) to determine the calibration curve of the pesticide. The acetamide pesticide solution was measured using a UV-Vis spectrophotometer and the value of

λ_{max} (243nm) was based on this wavelength. The calibration curve was drawn for the dilute solutions, and the straightness of the calibration curve is a good indication that the calibration curve is subject to Beer's law. (Beer-Lambert) as shown in **figure 5**.

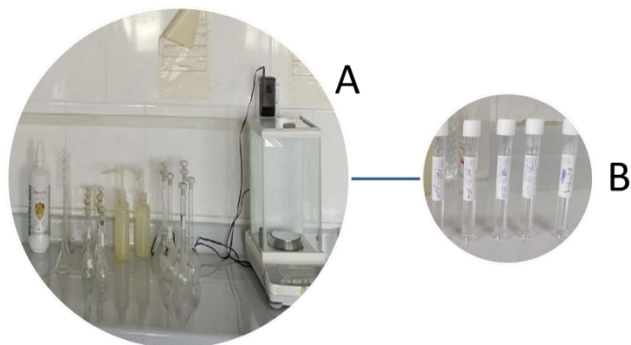


FIGURE 3. Preparing of pesticide acetamiprid in different concentrations.

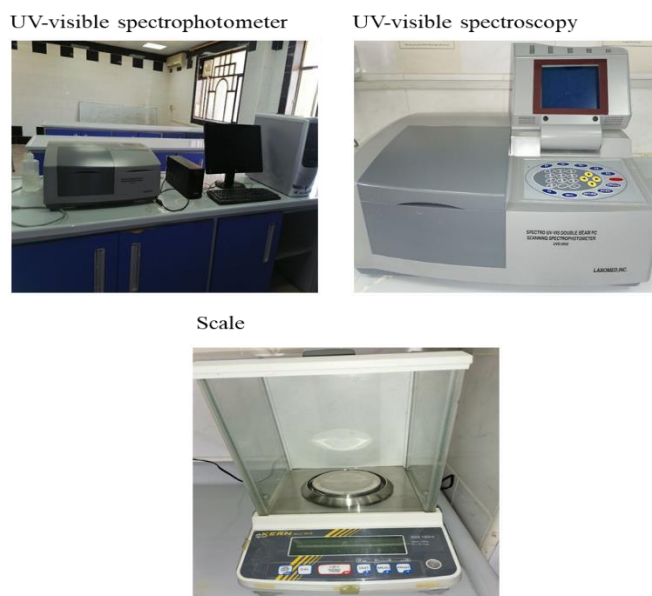


FIGURE 4. UV-visible spectrophotometer and UV-visible spectroscopy devices.

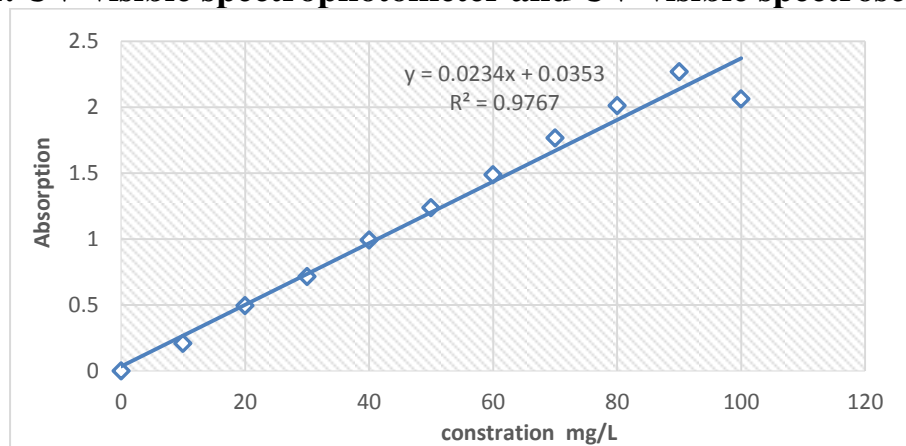


FIGURE 5. Titration curve for the adsorption of Acetamiprid at 301k and pH = 7.

2.3. Effect of contact time

This experiment was conducted at a temperature of (301 k) and (PH = 7) to discover the equilibrium time between activated charcoal and the pesticide acetamiprid. The volume of all samples was (15 ml) with a concentration (100 ppm) and the weight of activated charcoal (0.2 g) and at different times (0.5, 1, 1.5, 2, 2.5, 3 h) after application. The samples were in the vibrating water bath, after which the samples were filtered with filter paper and the filter absorbance was measured by UV-visible spectroscopy, **figure 4**.

Figure 6 demonstrates the relationship between the time (h) and the amount of adsorbent (mg/g), where the relationship between those two variables was positive increasing one of them lead to increasing the another one. The adsorption is rapid in the beginning, which is the stage of adsorption of the outer surface, then it begins to slow down gradually until it reaches a constant value due to the adsorption of the inner surface, so the adsorption surface cannot remove the pesticides from the solution at this stage. It can be interpreted that the active sites on the adsorbent surface are not empty and can be reached by the adsorbent materials. When all these sites are occupied, it becomes difficult to remove the remaining pollutants from the solution due to the repulsive forces between the particles adsorbed on the surface and the particles in the solution [34], [35].

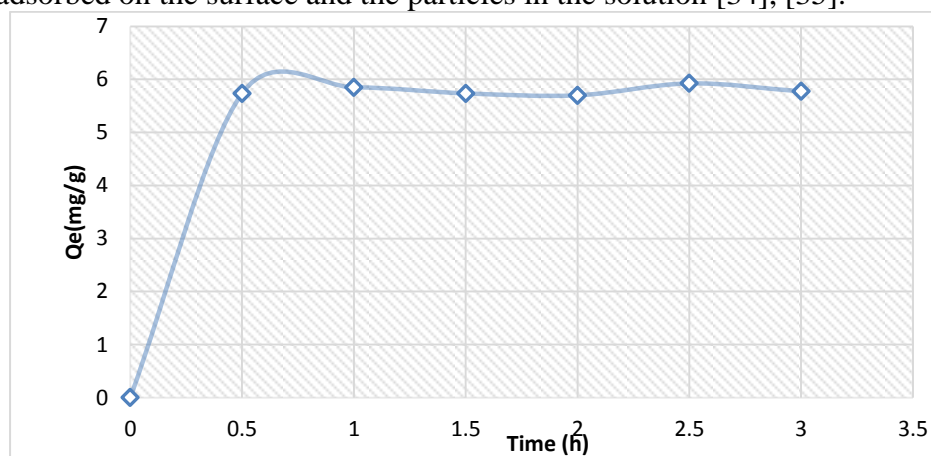


FIGURE 6. Effect of contact time for adsorption of 15 mg / L of Acetamiprid on the surface of carbonated charcoal derived from cherry nuclei at 301k and pH =7

2.4. Effect of adsorbent dosage

Under constant conditions and temperature (301 K) and PH = 7, the experiment was conducted with weights (0.05, 0.1, 0.15, 0.2, 0.25, 0.3 g) and volume (15 ml) at a concentration (100 ppm) and the time was (2.5) hour, samples were placed in a vibrating water bath and then filtered with filter paper. Filter absorbance was measured with a UV visible spectrophotometer.

2.5. Effect of pH

The effect of the pH was studied by preparing six samples of the solution with a volume of (15 ml) of concentration (100 ppm). The pH of the six samples (2, 4, 6, 8, 10, 12) was modified by using an acidic solution. HNO₃ and NaOH were basic at a concentration of (0.1 M), respectively, using the PH device. Then the absorbance was measured for the six samples before the adsorption process, after which the activated charcoal with a weight (0.05 g) was placed in the samples and placed in a vibrating water bath for two and a half hours at room temperature. Then the samples were filtered

with filter paper and the filter's absorbance was measured with a visible ultraviolet spectrophotometer.

2.6. Adsorption isotherms

Seven samples were prepared from dilute solutions of the pesticide Acetamiprid ranging from (30-100 ppm) and withdrawn (15 ml) from each sample, after which a weight of (0.05 g) activated charcoal was applied. Then the samples were placed in a temperature-controlled water bath, where they were measured at temperatures (301,311,321,331K). The samples were placed in a vibrating water bath with a vibration speed (185 rpm) for a period of (2.5 hours). Then, the samples were filtered with filter paper and the filter absorption was measured with a UV-visible spectrophotometer at the maximum wavelength of the pesticide. After determining the absorbance values, the concentration at equilibrium C_e (mg / L) was determined from the titration curve. Then the quantity of adsorbent q_e (mg / g) can be calculated by the following equation:

$$q_e = \frac{(c^{\circ}-ce)V_{sol}}{m} \quad (1)$$

q_e : The amount of adsorbent (mg/m)

c° : The initial concentration of the pesticide (mg/L)

ce : Concentration at equilibrium for the pesticide (mg/L)

V_{sol} : The total volume of the adsorbent (l)

m : The weight of the adsorbent (g).

In this study applied freundlich and langmuir samples on experimental results for adsorption where determine the value of constant a and b from relationship between C_e/Q_e vs. C_e according to following equation [29]:

$$\frac{C_e}{Q_e} = \left(\frac{1}{a}\right) + \left(\frac{b}{a}\right) C_e \quad (3)$$

Where:

C_e : concentration of material before adsorption (mg\lit).

Q_e : amount of adsorbent material (mg\g).

Also determine the freundlich constant K_f and n from relationship between $\ln Q_e$ vs. $\ln C_e$ according to following equation [30]:

$$\ln Q_e = \ln k_f + \frac{1}{n} \ln C_e \quad (4)$$

Temkin Isotherm includes a factor that takes adsorbent-adsorbate interactions explicitly into consideration. The model assumes that the heat of adsorption (temperature function) of all molecules in the layer will drop dramatically rather than logarithmic with coverage, by ignoring the extreme low and high values of concentrations [31]. Its derivation, as indicated in the equation, is defined by a standardized distribution of binding energies (up to some limit binding energy) by plotting the sum of sorbed q_e against $\ln C_e$ and calculating the constant from the slope and intercept. The formula 8 [31] provides the model:

$$q_e = \frac{RT}{b} \ln(A_T C_e) \quad \text{And} \quad q_e = \frac{RT}{b_T} \ln A_T + \left(\frac{RT}{b}\right) \ln C_e$$

$$B = \frac{RT}{b_T} \quad \text{And} \quad q_e = B \ln A_T + B \ln C_e \quad (5)$$

2.7. Kinetic of Adsorption

In this study used equation for pseudo first order to describe adsorption kinetic for liquid – solid system [32]:

$$\ln(q_e - q_t) = \ln q_e - (K_1 - K_{-1})t \quad (6)$$

Where q_t = quantity of adsorbent material at several time, K_1 = constant of frontal interaction velocity (min⁻¹), K_{-1} = constant of reverse interaction velocity (min⁻¹). When draw $\ln(q_e - q_t)$ vs. t get on straight line with slope equal to $(K_1 + K_{-1})$ and its cross with y-axis equal to $\ln q_e$. To describe pseudo second order from following equation [33]:

$$\frac{t}{q_t} = \frac{1}{K_2 q_e^2} + \frac{1}{q_e} t \quad (7)$$

Where K_2 = constant of adsorption velocity for pseudo second order (g.mg⁻¹ .min⁻¹) and from draw t/q_t vs. t get K_2 , q_e by following equations:

$$K_2 = \frac{\text{Slop}^2}{\text{intercept}} \quad (8)$$

$$q_e = \frac{1}{\text{slope}} \quad (9)$$

3. RESULTS AND DISCUSSION

Activated carbon is a porous, solid, black substance with no taste and odor, and can be distinguished from ordinary carbon by its ability to remove impurities and purify water through the adsorption process. Activated carbon is produced from a large group of diverse sources and in different ways. Researchers have divided it according to the standard specifications of activated carbon into several types, including animal charcoal to black carbon to furnace charcoal to polymerized types of them. And it has been produced from plant sources, especially those in which it is abundant. Lignin, i.e. hardwoods, nuts husks, etc., and in this study, one of the hardwoods, sandalwood, which is characterized by extreme hardness and high laconic content, was adopted to produce activated carbon by means of hydrogen removal by smelting with alkaline bases [13].

3.1. The effect of Surface Weight on adsorption Acetamidrid

Figure (7) demonstrates the relationship between the surface weight of adsorption and the amount of adsorbent (mg/g) at (301 k) and an acidic function $\text{pH} = 7$, where the relationship between those two variables was fluctuated. We notice a decrease in the amount of adsorption with an increase in the adsorption surface, thus this decrease may occur as a result of the accumulation of the adsorbent material, followed by a decrease in the available adsorption sites. Cherry seed coal surfaces have a standard structure are 10-30 μm in size and pores shape on the surface inside these pores in a similar manner. These pores are oval or elliptic and are about 0.5 and 1.5 μm in diameter. These pores that form concentrically, are dissociated by pore walls from each other [38].

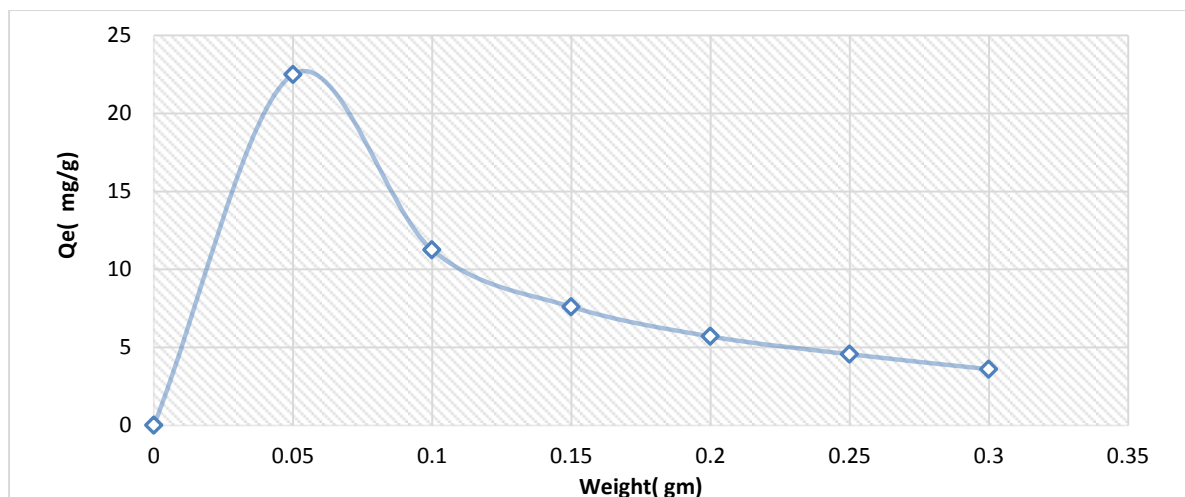


FIGURE 7. The effect of surface weight for adsorption of 15mg / L of Acetamiprid pesticide with different weights at a temperature of (301 k) and an acidic function pH = 7.

3.2. Temperature Effect

Figure (8) shows the temperature effect of the absorption of 15 mg / L of acetamiprid with 0.05 g of surface coal derived from cherry cores at an acidic function pH = 7 with different temperatures (301, 311, 321 and 331) K. Line graphs fluctuate with all concentration at pesticide equilibrium (mg / L). We observe the effect of temperature leading to increased absorption in this experiment where three temperatures (301, 311, 321, 331 K) were taken to find out the effect of temperature on the adsorption of activated charcoal derived from cherry seeds on the adsorption of the pesticide. Through the thermodynamic results, we note that the ions need energy to bind to the surface, and this is evidenced by the positive value (H). Increasing the temperature The percentage of increased absorption can be explained by increasing the temperature to an increase in the movement of particles to the absorbent material, which increases its mobility and reduces the viscosity of the solution. This indicates that the process is endothermic. [39]

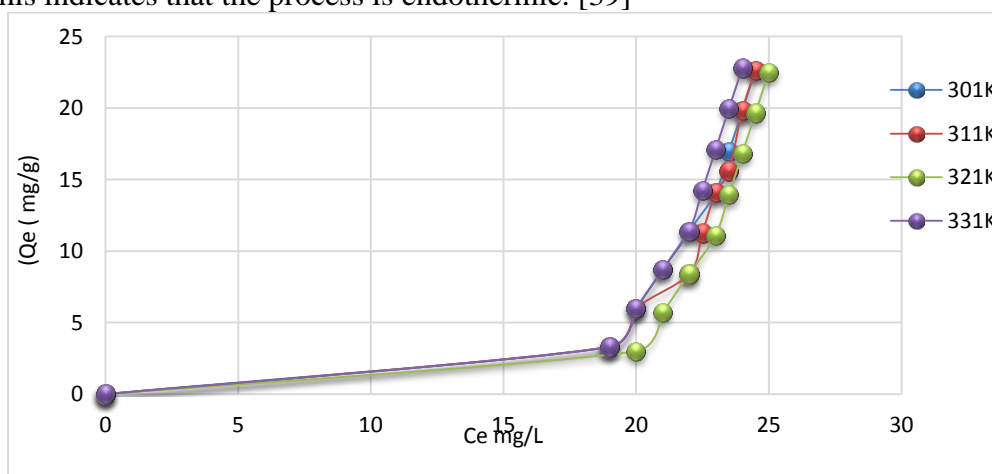


FIGURE 8. Effect of temperature for adsorption of 15 mg / L of Acetamiprid pesticide at temperature (331, 321, 311, 301) k.

3.3. Thermodynamic Parameters

Figure (9) shows the thermodynamic study that is the relationship between temperature inversion and equilibrium constant for absorption of 15 mg / l of acetamiprid with 0.05 g of activated carbonic coal surface derived from cherry seeds at 301 K and an acidic function pH = 7. Relationship between two variables (1 / T and Ln Kqe) are negative, as 1 / T increase leads to a decrease in Ln Kqe. Where the results showed that a negative value for ΔG is (endothermic) reaction [36], as shown in Table 1.

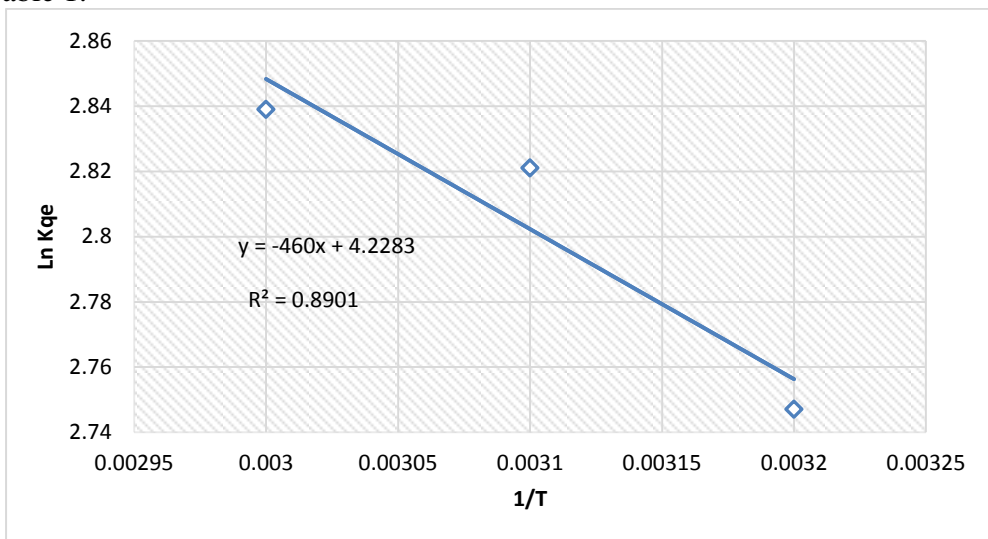


FIGURE 9. The relationship between the temperature inversion and the equilibrium constant for the adsorption of 15mg / L of Acetamiprid with 0.05 gm of the surface of carbonated coal derived from cherry nuclei at 301k degree and an acidic function pH = 7.

TABLE 1. Values of thermodynamic functions for adsorption Acetamiprid pesticide

$\Delta G/J.mol^{-1}$	$\Delta H/J.mol^{-1}$	$\Delta S/J.mol^{-1}$
-6.7712	3.824	0.0352

3.4. Kinetic of Adsorption

Figure (10) To study the reaction kinetics for adsorption of the ectamiprid pesticide at constant experimental conditions, models of the pseudo-first order and the second pseudo- order were taken, and through the values of R², we note that the adsorption process is subject to the pseudo-second rate [37] as shown in Table (2)

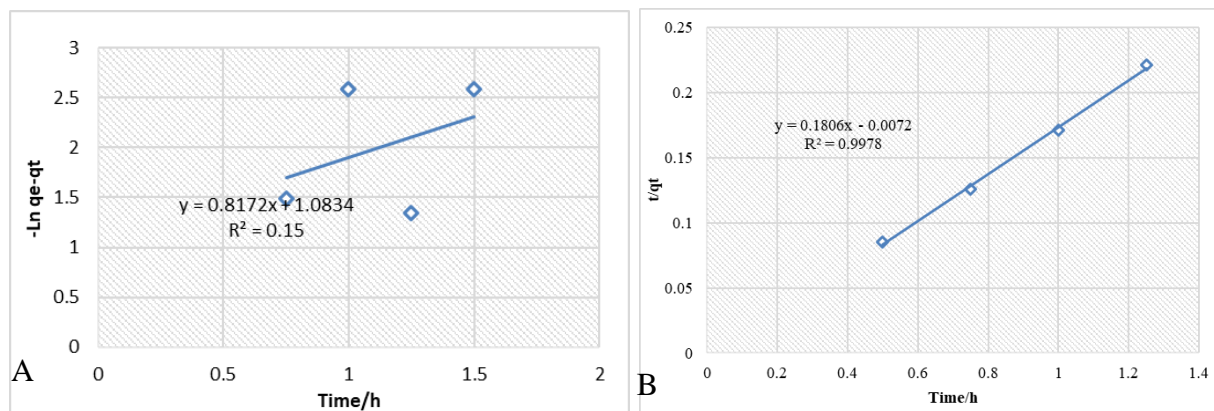


FIGURE 10. Linear relationship of (A) pseudo-first equation (B) the pseudo-second equation for adsorption of 15mg / L of Acitamiprid with 0.05 gm of carbonized coal surface derived from cherry nuclei at 301k degree and pH = 7.

TABLE 2. kinetic parameters for the adoption of Acetamiprid with 0.05 gm of the surface of carbonated coal derived from cherry nuclei at 301k degree and an acidic function pH = 7

Kinetic model	Parameter		
Pseudo-first -order	$R^2 = 0.15$	K1	0.8172
Pseudo-second-order	$R^2 = 0.9978$	K2	0.220

3.5. Adsorption Equilibrium and Adsorption Isotherms Models

Figure (11) demonstrates Langmuir isotherm to adsorb 15mg / L of Acetamiprid with 0.05 gm of carbonized coal surface derived from cherry seed at 301k and pH = 7 pH. The relationship between two variables (C_e/q_e and C_e) is negative, where increase C_e (mg/L) lead to decrease C_e/q_e (L/g).

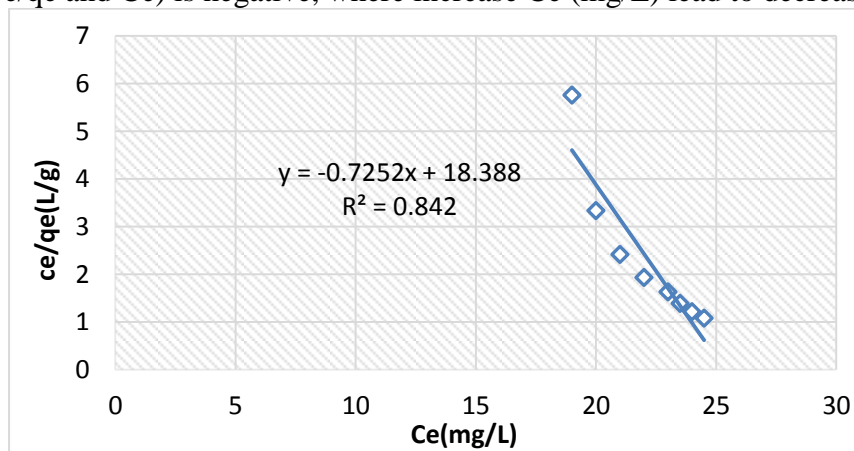


FIGURE 11. The langmuir isotherm for adsorption of 15mg / L of Actamiprid with 0.05gm of carbonized surface charcoal derived from cherry nuclei at 301k and pH = 7

Figure (12) demonstrates that Freundlich isotherm to adsorb 15mg / L of Acetamiprid with 0.05gm of carbonized coal surface derived from cherry seed at 301k and pH = 7 pH. The relationship

between two variables (Log q_e and Log C_e) is positive, where increase Log C_e (mg/L) lead to increase Log Q_e (mg/g), Table 3 shows values for all isotherms applied to the pesticide under study.

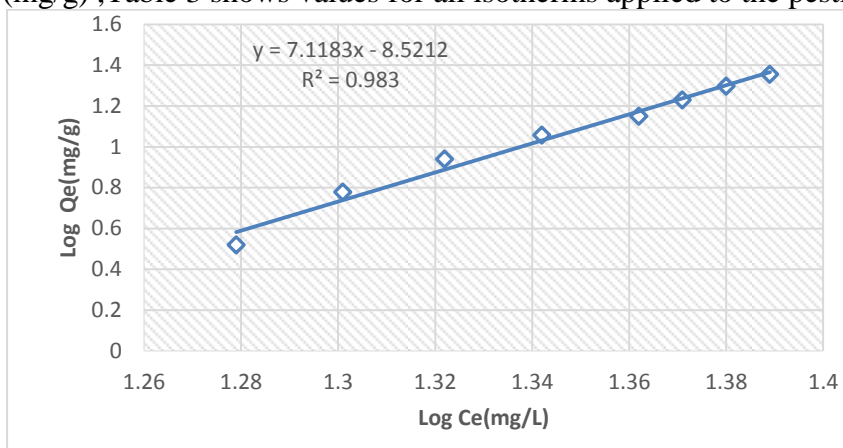


FIGURE 12. a FRENDLICH isotherm for adsorption of 15mg / L of Acitamidrid with 0.05gm of carbonized surface charcoal derived from cherry nuclei at 301k degree and an acidic function pH = 7

Figure (13) The particles adsorbed on the heterogeneous surface may interact indirectly with each other. Because of this reaction, the adsorption temperature of all particles in the sample subjected to adsorption will be linearly reduced by the amount of surface area [38]. While Figure 14 demonstrates Harkin-Jura and Dupin straight-line adsorption of 15mg / L of Acitamidrid with 0.05gm of carbonized surface charcoal derived from cherry seed at 301k and an acidic function pH = 7.

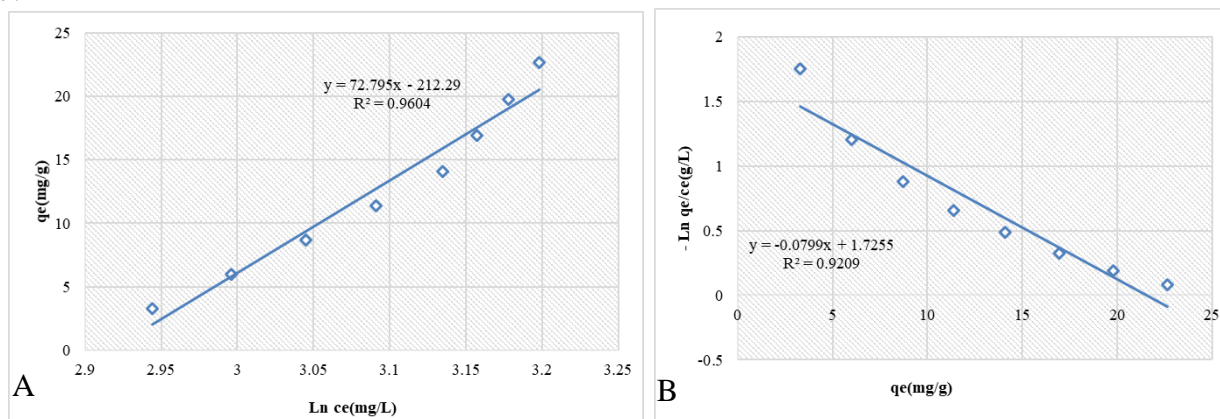


FIGURE 13. A) Temkin Isotherm (B) Elovitch straight adsorption of 15mg / L of Acitamidrid pesticide with 0.05gm of carbonized coal surface derived from cherry nuclei at 301k degree and acidic function pH = 7.

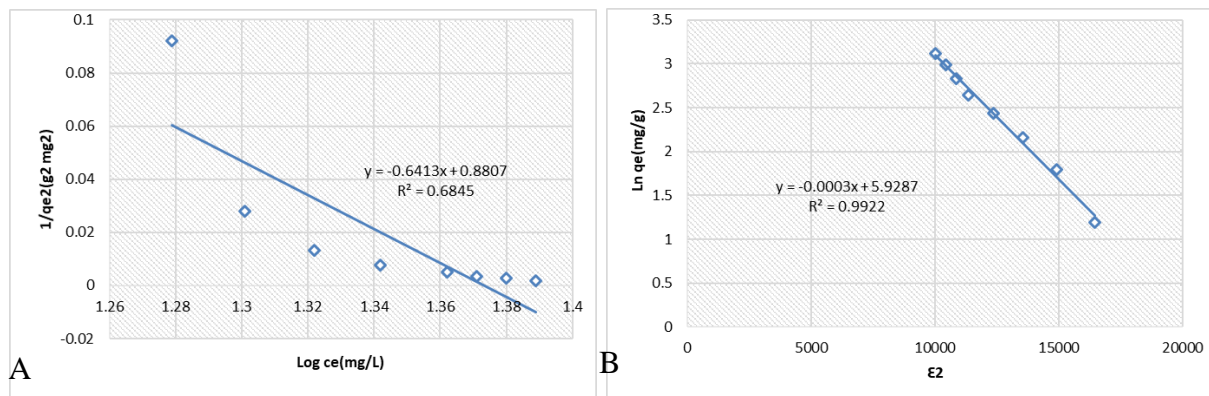


FIGURE 14. A) Harkin-Jura and (B) Dupin straight-line adsorption of 15mg / L of Acitamidrid with 0.05gm of carbonized surface charcoal derived from cherry seed at 301k and an acidic function pH = 7.

TABLE 3. Parameters of isothermal models for the adsorption of acetamidrid on a surface carbonated coal derived from cherry seeds at 301k and an acidic function pH = 7

Adsorption	R ²	Constant
Langmuir	0.842	K _L = 25.363
Freundlich	0.983	K _f = 3.011x10 ⁻⁹
Temkin	0.9604	$\beta = 72.795$ K= 0.990
Elovitch	0.9209	K= 0.871
Harkin-Jura	0.6845	A=1.559 $\beta = 0.565$
Dupin	0.9922	$\beta = 0.0003$

3.6. Effect of pH

In the absence of an accurate absorption, by calculating the relative charge of the surface as a feature of the ion concentration determining the charge at different concentrations of the indifferent electrolyte, the results indicate that the surface charge (10) This was confirmed by the results of the effect of the acidic function on the adsorption of the pesticide, as in Figure (15) [39].

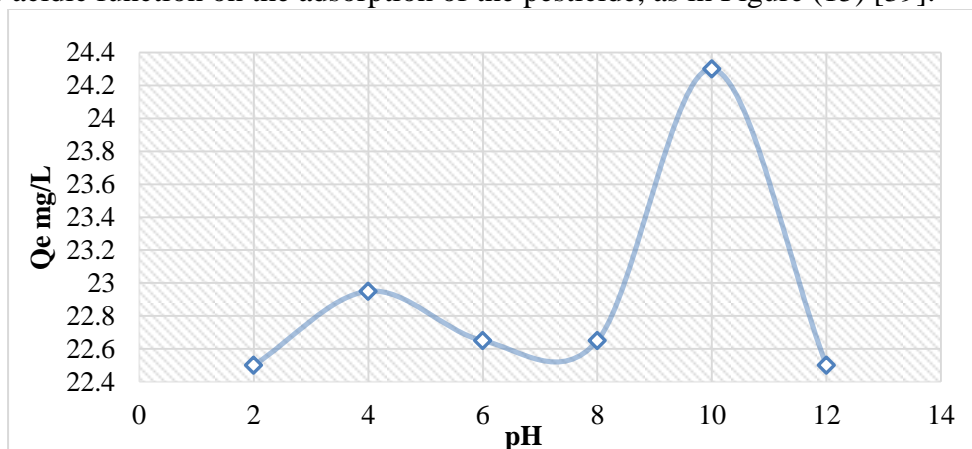


FIGURE 15. The effect of the acidic function of adsorption of 15mg / L of Acetamiprid pesticide with 0.05gm of carbonized coal surface derived from cherry seed at 301k degree.

3.9 SEM Study

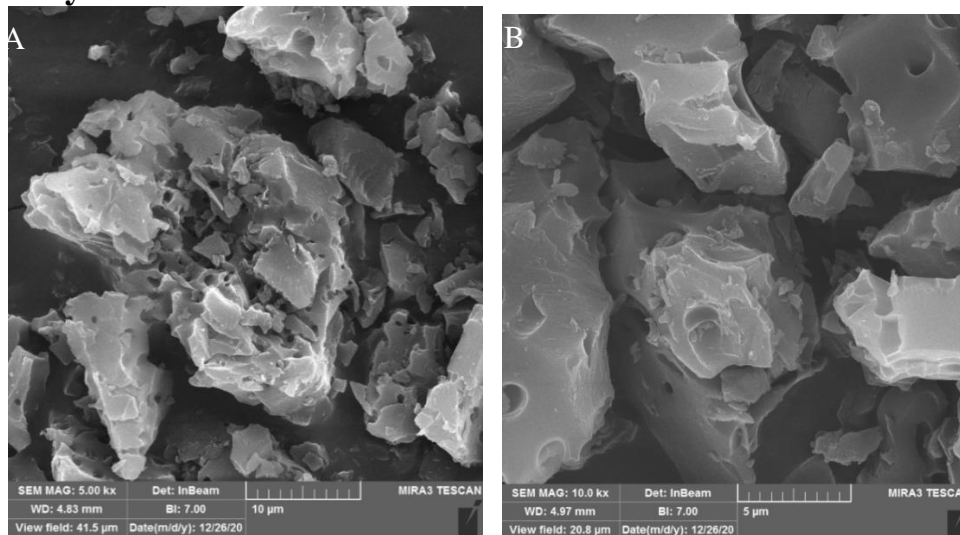


Figure 16. SEM images for a) normal charcoal and b) activated charcoal

The usage of a scanning electron microscope (SEM) to examine the surface structure of an adsorbent is a valuable examination. Figure 16, shows SEM photographs of charry seeds (without and with activated carbon) before the adsorption phase, 16 (a) and (b) are the two options. The adsorbent surface is heterogeneous, as seen in figure 16. A heterogeneous surface provided more accessible active sites, making the adsorption process more effective. The Acetamiprid pesticide relies heavily on this house. The internal structure changes for both adsorbents after the adsorption step, as determined by SEM review, are seen in Figures 16(a) and 4(b). Bio-adsorbents, on the other hand, have a relatively low surface area but multiple usable categories in their architectures. Because of the high porosity of the carbon surface and the high specific surface region, blending with activated carbon will change the adsorption potential and removing percentage [40], [41].

CONCLUSION

From the experiment results, the important findings are summarized:

- The results showed that the general behavior of the pesticide adsorption process follows the multilayer Freundlich isotherm. The values of the thermodynamic functions (Free energy ΔG , enthalpy ΔH , entropy ΔS) were also calculated based on the calculation of the values of the equilibrium constant K_{eq} .
- The results showed that the adsorption process through the positive enthalpy ΔH value was (Endothermic), and positive values for entropy mean the randomness of the system due to an increase temperature.
- A negative value for ΔG indicates that the adsorption process is automatic within Experimental conditions. The resultant heat of adsorption is comparable in value to physical adsorption.

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