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FOR THE ADSORPTION OF ORGANIC MUREXIDE DYE ON THE SURFACE OF ANTIMONY TRIOXIDE, THE HARKEN JURA ISOTHERM AND THE INTERMOLECULAR DIFFUSION EQUATION WERE INVESTIGATED.

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Abstract:

The adsorption of Murexide dye, which is utilized as a guide in analytical chemistry, is the subject of this research. As a result, a variety of processes must now be used to remove it from wastewater before it is deposited into rivers. Adsorption on porous solid surfaces is a useful approach for a variety of concentrations. The surface of the adsorbent for this dye was chosen from tri-antimony oxide, a commonly available industrial waste. The study used UV visible spectroscopy to test the Harken-Jura isotherm model's applicability to the dye's process adsorption data in the heat range of 303 K to 313 K. The research included the application of the intermolecular diffusion order equation to adsorption kinetics on surfaces.

Keyword: UV-visible spectroscopy, Harken Jura isotherm, Murexide, antimony trioxide

Introduction:

(the introduction of solid or gaseous energy, or any form of energy, such as heat, sound, or radioactivity, into an environment that is safe to live in; to exceed the rates that the environment can withstand, decomposition or conversion of harmless substances) and these pollutants are defined as (the introduction of solid or gaseous energy, or any form of energy, such as heat, sound, or radioactivity, into an environment that is safe to live in; to exceed the rates that the environment can withstand, decom Hazardous or natural materials may be involved. Environmental pollution is the most important issue confronting the globe today, and it necessitates making every effort to safeguard and combat all types of ecological habitats from the persistent presence of humans and other living creatures. [1,2]

Environmental pollution is a global concern since it has an impact on many elements of life and creates a variety of health and life-related problems [3]. Pollution has negative consequences for the ecosystem and biodiversity because all species, large and small, rely on readily available components in the environment, and any pollution flaw causes harm and risks to the lives of living organisms, with cities being more affected than the countryside [4]. Renewable energy must be employed, natural and organic fertilizers must be lowered, green spaces must be expanded,

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pollution controls and legislation must be put in place, and fossil fuels must be phased out. Heinrich Kaiser, a German physicist, coined the term "adsorption" in 1881. Kaiser [5-7].

Adsorption is a surface phenomenon in which molecules stick to the top layer of a material's surface [8].

Energy-producing forces bond molecules above the surface of the adsorbent with adsorbent molecules, macromolecules, and ions, causing adsorption [9].

Adsorption occurs in a wide range of physical, biological, and chemical systems, and it can be used in a wide range of applications. The adsorption process is triggered by the existence of imbalanced pressures on the absorbent material's surface [10].

When particles come into touch with the surface, these forces tend to attract and bind them. Adsorption is not to be confused with adsorption. Adsorption is defined as the uniform distribution of the absorbent material on the absorbent material's surface; it occurs when both adsorption and desorption take place at the same time [11-12]. An isothermal line [13] is used to represent the quantity of condensation of a substance on the surface of the adsorbent as a function of pressure (if it is a gas) or concentration (if it is a liquid) at a constant temperature. Different surfaces of adsorbent materials can be compared with the amount of adsorbent adjusted for the amount of adsorbent. Adsorption processes are spontaneous processes involving spontaneous reactions that should result in a decrease in the system's free energy and a negative system G value. Whatever the drawbacks, values are, the unpredictability of the molecule decreases [14].

For a reaction to be spontaneous, it must be an exothermic process. The process of adsorption is carried out by sorption when the adsorbent is adsorbed at the mass of the adsorbent. There are chances for attraction between adsorbents and absorbers, and thermal energy is generated as a result of these forces of attraction. Adsorption is hence an exothermic process. The unequal valence forces of the particles on the surface, as a result of the breaking of a big crystal into smaller units, as well as the residual forces or spaces on the solid occupied by the molecular species, cause residual forces in the solid state, which leads to adsorption [15].

Adsorption in the liquid state: The water molecule on the surface attracts the bulk of the water molecules present in the liquid state. As a result, surface tension develops. Water molecules are subjected to zero total force in vast numbers, while the force of attraction at the surface is equal in all directions. The particles on the surface and the particles in the mass are clearly in different habitats. Many natural, physical, biological, and chemical systems have adsorption. Adsorption is also employed in industrial applications such as heterogeneous catalysts, activated charcoal, and the collection and use of waste heat to supply cold water for air conditioning and other process demands [16]. Adsorption can be classified into two forms based on the nature of the forces that exist between the adsorbent and the sorption molecules: Physical adsorption (physisorption): the force attraction between the molecules and the surface is Vander Wahl forces, so the adsorption is called physical adsorption, also known as Vander Wahl adsorption, because the force between the adsorbent and the desorbent is very weak, and this type of adsorption is easily reversed by heating or reducing pressure[17]. Chemical adsorption is a type of adsorption in which the force attraction between adsorbents and the adsorption is largely chemical bonding. Langmuir adsorption is

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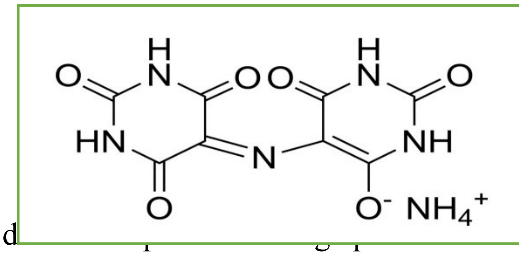
another name for it. Chemical adsorption is difficult to reverse because the force of attraction is so high. tincture of murexide: ($NH_4\ C_8\ H_4\ N_5\ O_6$ or $C_8\ H_5\ N_5\ O_6\ NH_3$) It's called ammonium purpurate or MX, and it's also known as an ammonium salt of purpuric acid. It's made by boiling uramil (5-aminobarbituric acid) with mercuric oxide or heating alloxantin in ammonia to 100°C [18].



Hartley found it d e samples to obtain consistent absorption spectra data, so he created a modern process for producing the moroxide, [19]. The alloxanthin is dissolved in a huge excess of boiling absolute alcohol, and dry ammonia gas is passed over the solution for three hours, followed by filtration and washing with absolute water to produce a solution of precipitated moroxide [20].

Murexide is a reddish-purple powder moderately soluble in water in the solid state; In the case of solution, the color spectrum is yellow in strong acid, reddish-purple in weak acidic solutions, and blue-violet in alkaline solutions [21]. Antimony trioxide is a white crystalline powder with the chemical formula Sb_2O_3. Antimony trioxide is an inorganic flame retardant that is white or colorless on the inside. The cubic structure is colorless, while the rhombic structure is white. Antimony trioxide is formed by heating antimony trisulfide in an atmosphere of oxygen. Cubic antimony trioxide is stable below 570°C, while rhombic antimony trioxide is stable after 570°C (roasting) [22].

$Sb_2S_3 + 9/2O_2 \rightarrow Sb_2O_3 + 3SO_2$

It's also made from antimony that's been burned, according to the equation.

$Sb + 3O_2 \rightarrow 2Sb_2O_{34}$

Jura - Isotherm Harken Harken and Jura were the two scientists who applied this isotherm, and it was named after them in 1943. As illustrated in equation (1-2), it describes multi-layer adsorption on heterogeneous surfaces $1/(q_e)^2 = B/A - 1/A \log c_e$ ……..(2-1)

C_e: indicates the solute concentration at equilibrium in mg/L, qe: the amount of adsorbent in mg/g, and A and B are the Harken-Jura constants. Model of inter-minute propagation: Model Intra-particle Diffusion[22].

In a vacuum, open region, or permeable membrane, diffusion is the process of molecules, atoms, or grains dispersing. The non-uniform thermal motion of matter particles collides and diverges to occupy all available space, causing diffusion. The kinetics results are validated using the particle diffusion equation when the erroneous first and second order models, as well as the Elovitch model, cannot effectively capture the adsorption mechanism. This model was created by

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researchers (McKayandPoots), Weber, and Morri (who came up with the following linear equation (3-4):

qt = Kdiff.t1/2 ....(2 -1)

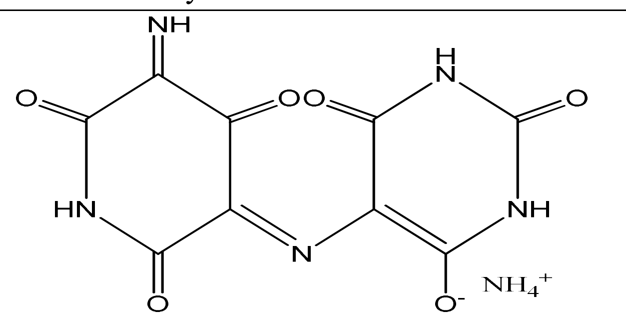
whereas : qt = the amount of adsorption is measured in milligrams per gram (mg/g). Kdiff. = The constant of the diffusion equation between minutes, measured in (mg/g.min-1/2).

a practical aspect:

Instrumental, pH meter, pH-meter, HANA, Portugal GCA Precision Shaking Inducator in a water bath with a temperature-controlled agitator. Chicago, Illinois, United States of America, Scientific Chicago, Illinois, United States of America, Scientific Chicago, Illinois Centrifuge. Centrifuge/Megafuga1.0/HerousSepatec. UV\Visible. Spectrophotometer from England, LibraBiochromS60.

Chemical materials:

Table: (2-1) Murexide's chemical and physical properties

MUREXIDE		
Specification sheet		Structure of dye
Empirical formula	$C_8H_5N_5O_6 \cdot NH_3$	
Molar mass	284.19 g·mol−1	
Melting point	>300 °C(lit.)	
source	BDH	
solubility	Water	ammonium (E)-5-((5-imino-2,4,6-trioxopiperidin-3-ylidene)amino)-2,6-dioxo-1,2,3,6-tetrahydropyrimidin-4-olate

Preparation of standard solutions: Stoke's solution was prepared at a concentration of (50 mg/L) by dissolving a particular amount in distilled water, then filling the capacity to 1000 ml (2-25ml). As a reference adaptor, distilled water was used to measure absorption. UV/visible spectroscopy was used to extract the wavelength that results in the highest absorption (max) using quartz cells with a cell thickness of 1 cm, max values for the dye under study. Murexide is a type of murexide that is (Literature
525, Observed515)

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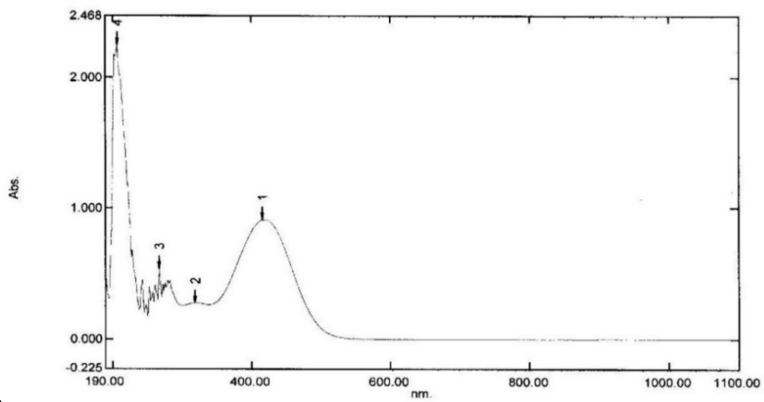

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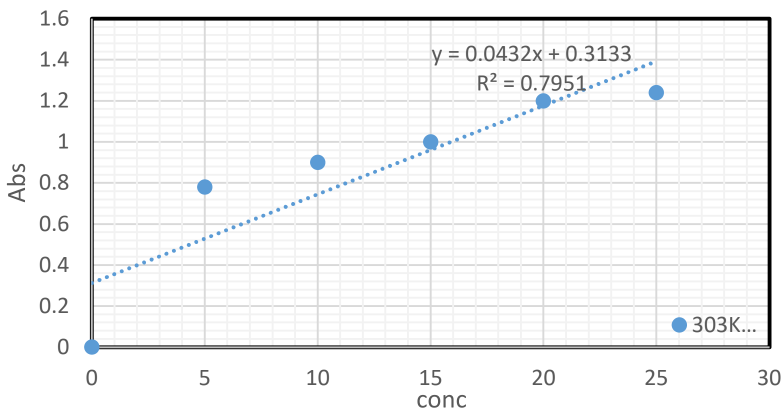
Figure (1-2): Murexide absorption spectrum



Figure(2-2): At 303 K and pH = 7, the titration curve for murexide is shown.

All conditions of temperature and acidity were fixed with one factor change, which was time, as (20ml) of the dye solution was taken at a certain concentration and placed in a volumetric vial with a capacity of (50 ml) and 0.1g was added to it for the purpose of determining the equilibrium between the adsorbent surface and the adsorbent material. By taking samples in different time periods and measuring the absorbance for them after performing the filtration and separation process by a centrifuge and then filtering again and following the change of absorbance with time at the maximum length, from the adsorbent surfaces used in this study, at room temperature, with a neutral acid function, and then placed in the shaker device, and by taking samples in different time periods and measuring the absorbance for them after performing the filtration and separation process by a centrifuge and then filtering.

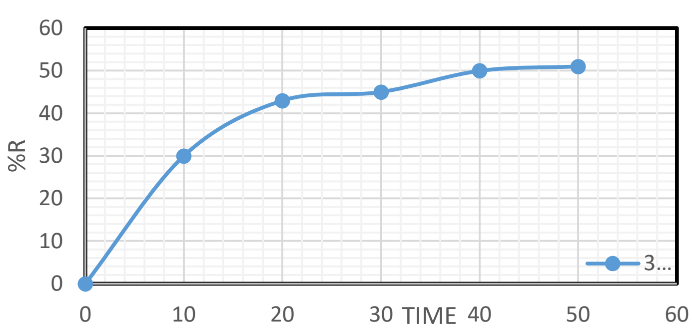


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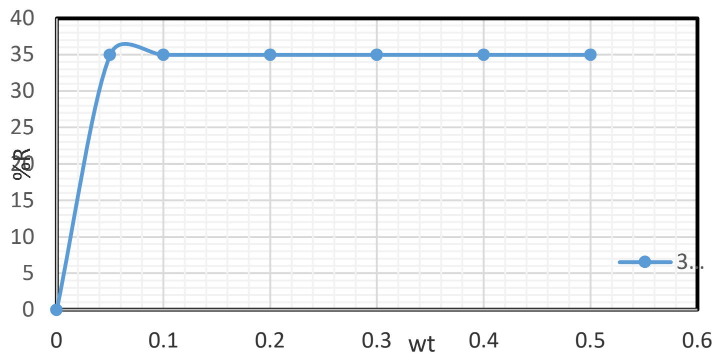
Figure (2-3): The percentage of dye removed is affected by the length of time spent in contact with antimony oxide.

At a temperature of K303 and an initial concentration of murexide (15mg/L), the effect of surface weight on the quantity of adsorption was tested using 5 different weights (0.5, 0.4, 0.3, 0.2, and 0.1 g) and the time required for the equilibration process to occur, as shown in Figure 3. -2) The ideal weight for murexide adsorption is 0.5g.



(2-34) Calculate the impact of surface weight on the hydroxide removal %.

Initial Dye Concentration Effect:

Table (3-1) shows the amounts of adsorption on the surface of antimony oxide at various concentrations mg/L530- and an acidic function pH = 7, as shown in Figure (3-3), which shows the relationship between the amounts of adsorption at equilibrium and the equilibrium concentration and that the general form of adsorption isotherms indicates that it is of type S -shape according to Gils Classification. Within the surface's thermal range of 0.5 g, the amount of murexide adsorption by (1-3 table) 30 minutes. And an acidity function (pH = 7) and an equilibrium time (313-303K).

q_e	C_e	q_e	C_e	
313K		303K		Co
0	0	0	0	0
33	3.9	54	3.2	5
48	8.4	87	7.1	10
84	12.2	75	12.5	15
60	18	30	19	20
90	22	51	23.3	25

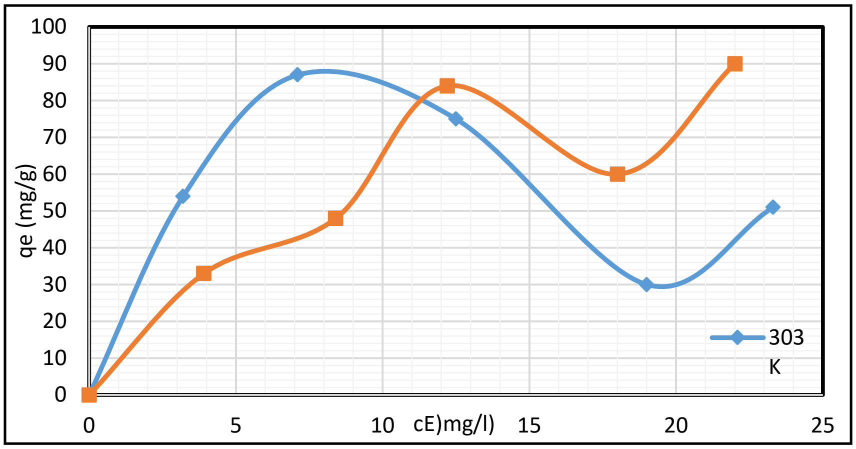


Figure (3-1): Murexide adsorption isotherm on Sb2O3 surface in the heat range (303K-313) and acidity function pH = 7

(2-3) Table, 0.5 g acidity function of Sb2O3 on the surface of the murexide, pH = 7, 313 -303K.

Dye	Linear equation of Kinetic model	Parameters	Temperature	
			303 K	31 3K
Murexide	Harkins-Jura $\frac{1}{q_e^2} = \frac{B}{A} - \frac{1}{A}\log C_e$	A B R^2	0.5 0.00 25 0.58 8	1.1 11 0.0 22 0.5 13

The adsorption correlation coefficients are as follows: Within a 30-minute thermal range, comparing the constants of the adsorption isotherm equation. When the balance is reached.

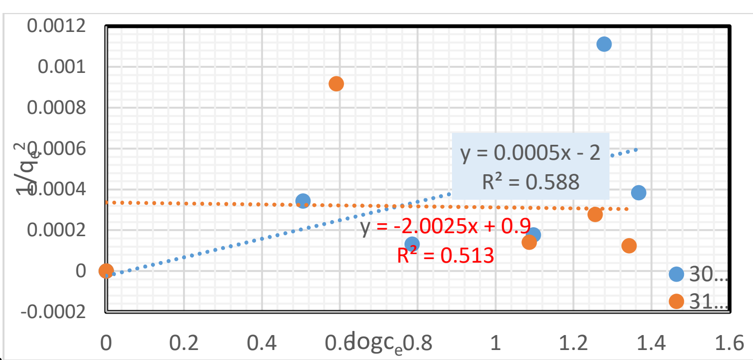


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Figure (3-2): Harken Jura rectilinear for murexide adsorption on 0. 5g of Sb2O3 after 30 minutes in a range of temperatures (303-313K).

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adsorption kinetics: The batch approach was used to analyze the kinetics of murexide adsorption on the surface of triple antimony oxide in the temperature range (313-303K). Figure 3-5 displays the equation and correlation coefficients for murexide dye adsorption under experimental conditions, indicating that the dye under study is not subject to the intermolecular diffusion equation.

Table (3-3): Intermolecular diffusion equation constants and meroxide adsorption correlation coefficient at wt 0.5g Sb2O3 and PH=7

Dye	Linear equation of Kinetic model	Parameters	Temperature	
			303K	313K
Murexide	Intra – partical -diff $q_t= k_{diff}\, t^{1/2}$	k(mg /g min$^-$	1.229	0.6914
		R^2	0.547	0.498

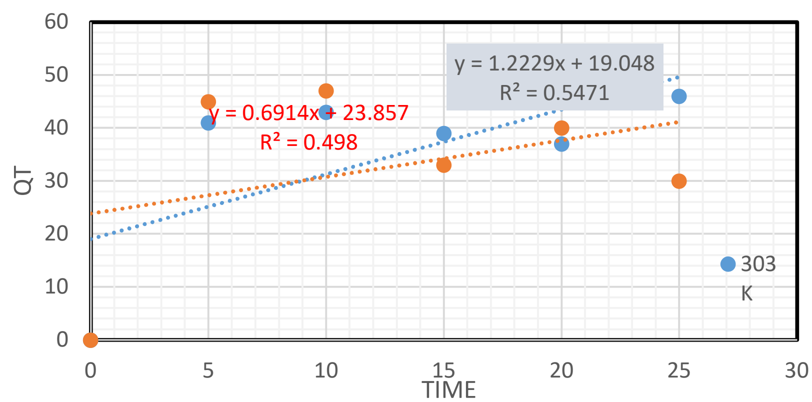

Figure (3-5): The intermolecular diffusion equation for murexide adsorption has a linear connection under certain conditions.

Conclusion:

The use of antimony trioxide in the adsorption of meroxide dye damaging the aquatic environment was established in this study, and the adsorption kinetics were studied using the Harken Jura isotherm. A UV-visible gadget was used to monitor the procedure.

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