Kinetic Adsorption Studies of Oreng Acid 2 onto Banana Skin

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Abstract: In this work removal of Acid orange 2 from aqueous solution onto banana skin Substrates was studied. The effect of operational parameters including pH, temperature, agitation speed, contact time, adsorbent dose and initial dye concentration were evaluated in a batch mode reactor. The optimum results were obtained at pH 2 and banana skin dose of 0.1g. According to the analysis of different kinetic models for adsorption of Acid orange 2 onto banana skin obeys pseudo- second order kinetic. Gibbs free enthalpy, and entropy as thermodynamic parameters were calculated and it was found that the process is exothermic.

Keywords: banana skin, Acid orange 2, Adsorption, Langmuir Isotherms, Thermodynamic Study

1. Introduction

From the very beginning of the time the colored materials have been used by the humans. These materials have been attaining from mineral, plants, and animal materials and by passing the time and being industrial, the colored materials are classified into two natural and artificial categories. The colors in the industry are classified according to their applications and in industry this kind of classification is preferred more than the chemical form. Even, in Color Index (CI), the commercial colors are classified according to their usage. Color Index Number is a five-digit number that is allocated to a color while its chemical form is made by its producer. **[1]**. the orange acid 2 is a mixture of D Azo with the molecular formula of $\mathbf{C_{16}H_2NaO_4S}$ (sodium salt). This odorless orange powder possesses a molecular body of **350.32 g/m** and unmixed percentage of **99**. This matter can absorb the light and in length of wave **484nm** indicates the highest absorption, that it is used for determining the amount of the orange acid (**II). [2]**.

Sublime absorption, the process of sublime absorption is also used for the elimination of color vastly and its application is extensive in refining the weakest water.

The phenomenon of sublime absorption, the absorption of absorptive molecules is (a part of gas or liquid) on the absorbent surface. The interval solids are with a very high surfaces and tiny volumes that cause to increase in absorption. The phenomenon of sublime absorption was observed by Shell in 1773 for the gases imposed in Carbon. These observations were accomplished by Lovitz in 1785 through revocable elimination in color and scent of the components in the water by the charcoal. [3].

The phenomenon of sublime absorption is used in refining processes and separation such as gas separation from the absorption process, recycling the solvent from external air in evaporation process, dehydrating the gases, furbishing toxic gases in ventilation systems for controlling air pollution, rubbing off the scent and flavor in water.

The cons and pros of sublime absorption in comparison with the other absorptive methods

The sublime absorption is one of the methods in elimination that is used vastly. The advantages of this method of elimination in comparison with the other kinds of elimination are as follow: its expense is lower than the distillation operation that is slightly and also the cost of extraction is lower than that. For example, the normal elimination of isoparaffin in distillation method is too difficult while in sublime absorption it is so suitable.

Banana

Banana is also called talh and banan. In ancient books it is mentioned Talr and Talh.Banana is a grassy plant that its leaves are so big and wide and sometimes it reaches more than two meters. Its flowers are complex and spiky. At first its

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fruit is green and then it becomes yellow after the ripe. Banana has been discovered from four thousand years ago in India.

Banana and anti-cancer property

The bananas in which are black-colored in the refrigerator after one day, have a property of discovering cancer cells and the more they are black-colored, the more they have this kind of property.

According to the Japanese scientist's investigations, among those fruits that have a property of anti-cancer such as grape, apple, water melon, pineapple, pear, and persimmon, banana has the most property to increase the amount of white blood cells and making strong the immune system of the body and defeating the cancer cells because the amount of T-N-F matters in the banana is more than the other fruits.

Studies and accomplished investigations in this area:

Mel and his colleagues in 2006, the elimination of OG & MV colors through the sublime absorption on the megass ashes. These researchers studied the synthetic models, like the first grade, second grade and intra absorption and concluded that in each of the two colors case the second one is true. Also, the obtained data in OG color absorption process had more accordance with the Frondlichisotrom model and in MV color case the most accordance was agreeable with Redlich-Peterson isotrom model. [4].

Wang and his co-workers, studied on the cooling and they concluded that regarding the essence of involved forces in the absorption process, the absorbent materials used in this process can be divided into two physical and chemical categories. Addition to this, they presented some methods for equipment in absorptive matters in sublime model [5].

Ozjan and his co-workers in 2005 studied the absorption of color AR57 from water solutions on adjusted Sepiolites. The synthetic studies showed that the process of absorption followed from the second grade model; also experimental data have more accordance with Frondlichisotrom model. The positive amount of DG states that the process of absorption is not by itself [6].

Aton and his co-workers in 2003, studied the sublime absorption of acid Carminic on the glass powder and concluded that Frondlich and Longmir model are in accordance with the experimental data and thermodynamic parameters according to Anthrophy and enthalpy amounts, are spontaneously and warming and the speed of absorption increases with the increase in temperature and the concentration of color [7].

Materials and Methods

The method of preparing the absorbent

At first the skin of the banana that is dried before in a well-washed mortar and it is distilled in the water properly and then we shape it like the powder and to remove the probable impurity we wash it with water.

The method of preparing solutions

Supplying the solutions in orange acid2

An amount of 0/01 gram of orange acid powder2 weight by a digital scale and then spill 100 cc into the balloon and it should be bulked with distilled water. The concentrate of the solutions is 100 ppm. By using the relation of $C_1V_1 = C_2V_2$, we can prepare some kind of needed concentrations and it can be used.

Preparing qualitative solutions for determining its λmax

To determine the amount of elimination of orange acid 2 it is needed that in different levels and certain times, the concentration of this matter should be determined. Since the orange acid 2 is a colorful material, we can use the property of light absorption to determine its concentration. To do this we use from the solvent 100ppm of orange acid 2 (major solvent) by Pipit Jose, we take 5 Ml liters and reach it to 25 Ml with distilled water and prepare 20ppm of the solvent. The needed amount of this solvent is entered into the celli in 1 centimeter and by spectrophotometer in the area of (200-800) nano. Through the landau graph the maximum of this composition is reached. According to spectrum, the amount is $\lambda_{max= 484.}$

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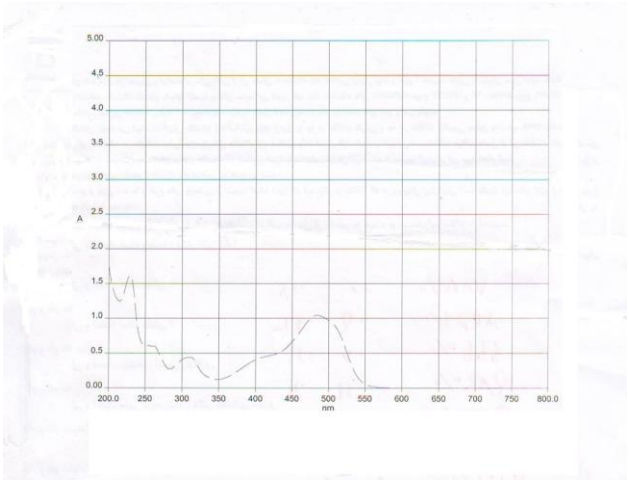

Figure 1: the amount of absorbent orange acid 2

Preparing different solutions from the orange acid 2 for drawing Calibration graph

To determine the relationship of orange acid 2 absorption to the concentration, it is used of the Calibration graph method. In this method by using of the major **solutions** of orange acid 2 into 100ppm of concentration, the relation of $C_1V_1 = C_2V_2$ in 9 container of 50 Ml we prepare solvents of different concentrations of orange acid 2 (2,4,6,8,10,13,15,18,20) ppm and after reaching it to pH=2 by using the spectrophotometer (UV-VIS) the amount of absorption of this **solutions** are scaled in 484nm wave meter.

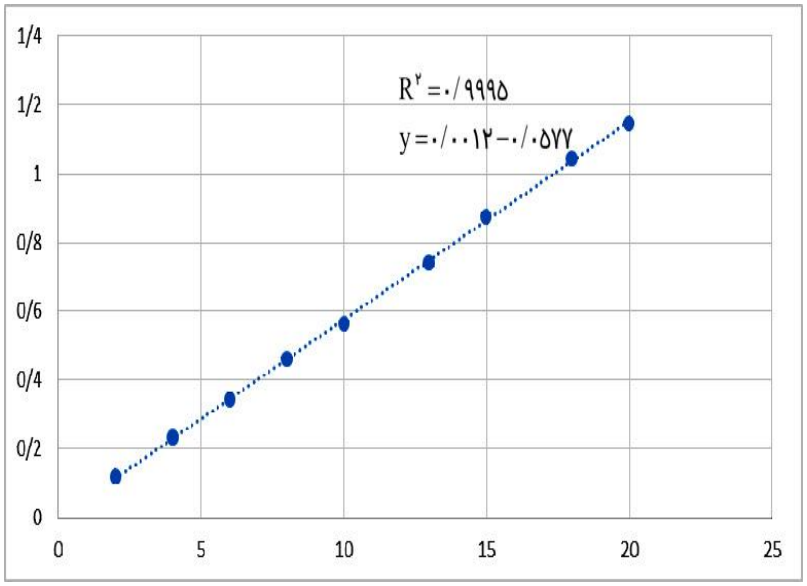

Figure 2: the graph of orange acid 2 **solutions** calibrations in 484nm

considering the calibration graph, the concentration of 20ppm of orange acid 2 was determined to accomplish the other levels of the experimentation. Because among the prepared samples, 20 ppm is an average concentration with the absorption of 1/1482 that is neither more that may exit from the spectrophotometer sensitivity nor less that the investigation of different parameters may cause errors on it.

Determining the proper amount of adsorbent

By using the major **solution** orange acid 2 it is made 10 solvents of 20ppm and then pill 50 Ml container and adding some drops of HCL of solvents in pH=2 is settled and later into each **solutions** we add (0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9 and 1) grams of banana's skin absorbent. By a magnetic mixer in 60 minutes with a cycle of 5 (250rpm) it is mixed. After smoothing the **solutions** the sampling process is done and the absorption of the samples was reported.

determining the best time of contact

By using the orange acid **solution** the following **solutions** prepared:

concentration of the **solution**: 10ppm, 20ppm, 30ppm, 40ppm, 50ppm

Then the prepared solvents were settled in pH=2 and for each of them added 0/1 gram of banana's skin absorbent and by a magnetic mixer it is mixed with 250 rpm in (10, 20, 30, 45, 75, 90, 120, 150 and 200) times and after smoothing the **solutions** by spectrophotometer they were reported.

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Method of analyzing the results

In all of the experiments for scaling the percentage of elimination the following equation is used.

$$R(\%) = \frac{C_0 - Ct}{C_0} \times 100 \text{ (Equation 2-1)}$$

Also for comparing the amounts of q_t and q_e the following equations were used:

$$q_e = \frac{(C_0 - Ce)V}{W} \text{ (Equation 2-2)}$$

$$q_t = \frac{(C_0 - Ct)V}{W} \text{ (Equation 2-3)}$$

Results and discussion

The investigation of the effect of different operational parameters in random elimination of orange acid 2 by using banana skin

Determining the proper amount of absorbent

To determine the optimum amount of absorbent, different amounts of needed absorbent is mixed with 25 Ml of orange acid 2 **solution** in concentration of 20mgL^1 and by adding some drops of HCL the **solutions** are settled in PH=2 and then by using the magnetic mixer in speed of 250 rpm in 60 minutes and absorption of the samples in 484 wave nanometer is read.

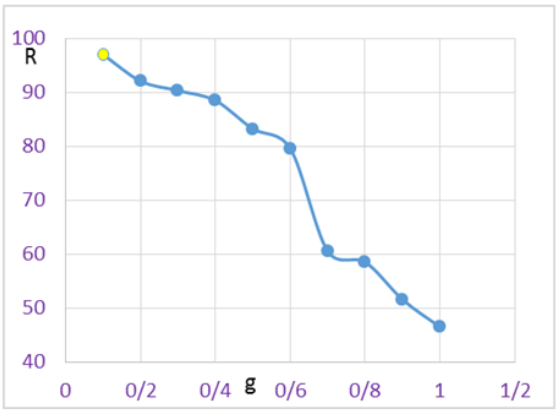

Figure3: the percentage of orange acid 2 elimination in terms of the absorbent grams

The results showed that the most random of elimination is while that the amount of banana's absorbent is 0/1 gram. Therefore, this amount is determined as the most suitable amount in elimination of orange acid2.

Determining the best time of contact

To determine the best time of contact of the absorbent with absorbing different samples of the **solutions** with 25 Ml liter mass of orange acid 2 in different concentrations (10,20,25,30,40,50 mg L^1) is prepared and added an amount of 0/1 gram of banana's skin. The needed **solutions** for different required periods with a cycle of (250 rpm) were mixed. After finishing every certain time, the **solution** is smoothed and then after the sampling, the absorption of the last **solution** was scaled by the spectrophotometer. The following graphs show the effect of time on the rate of orange acid 2 absorption by the banana's skin absorbent in different concentrations.

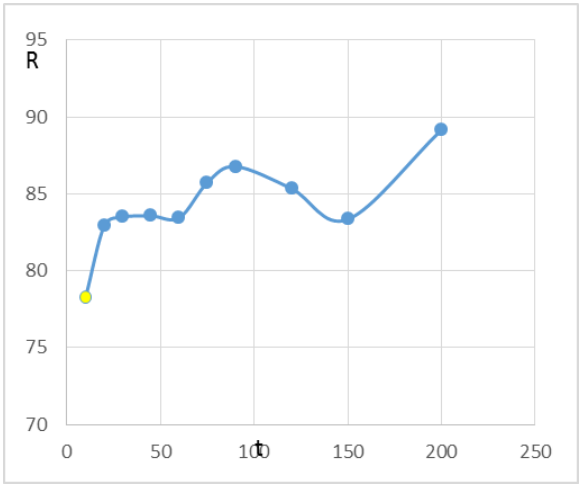

Figure4: the effect of contact time on the rate of orange acid 2 elimination by the banana's skin in constant concentration 10 mgL^1

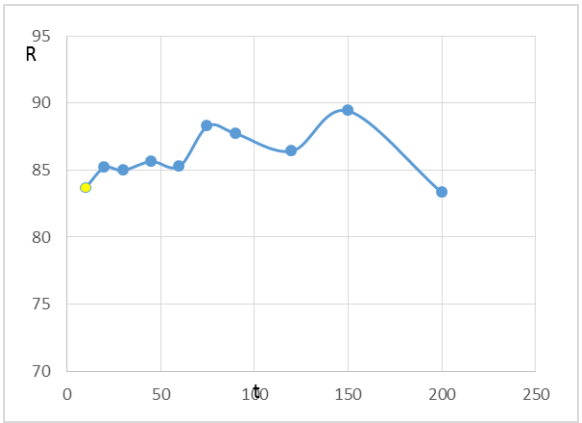

Figure5: the effect of time on the rate of orange acid 2 elimination by the banana's skin in constant concentration 20mgL^1

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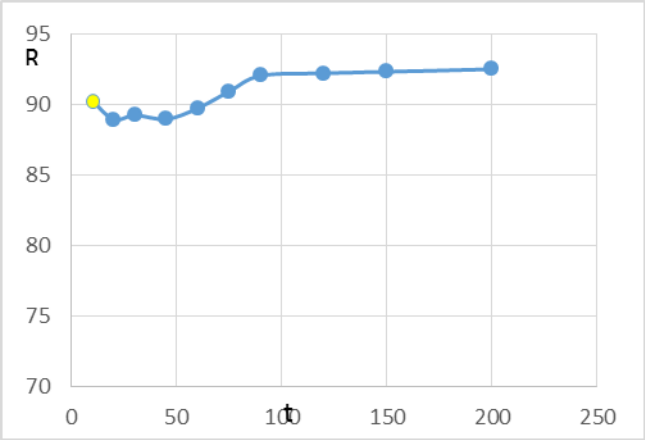

Figure6: the effect of time on the rate of orange acid 2 elimination by the banana's skin in constant concentration 40mgL^{1}

These results showed that the optimum time of contact for absorption process is 60 minutes.
So, for the rest experiments this kind of contact time of mixing up to 60 minutes the random of elimination becomes high and after that ere is not any significant change because the amount of absorption increases with increase in time and reaches to a consent rate in a certain time and it is not eliminated any orange acid 2 and in this moment the amount of absorbed orange acids are in a thermodynamic balance with unabsorbed amounts. In the times from 1 to 60 minutes there are blank spaces for absorption accessible and by passing the time the occupying the blank spaces becomes more difficult because there is a kind of repulsive force between orange acid 2 molecules and molecules that are in the process of solution. Therefore by studying the table's data and graphs it is determined that in 40 mgL^{1} concentration and in 60 minutes the random of elimination has its own highest amount and because of this kind of concentration is used for studying the effect of temperature.

Conclusion

In this study the elimination of colored material orange acid 2 is done by sublime absorption through the banana's skin absorbent. The obtained conditions are as follows: 0/1 gram of banana's skin absorbent, the time of contact in 60 minutes, the magnetic mixer 250 rpm and pH=2.
According to the obtained results in demanded conditions, different synthetic models are used and the second grade synthetic model was the most suitable respond for absorbing the orange acid 2 on banana's skin that its fixed speed is -0/1 g/mg min.

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