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DESIGN A SYSTEM TO ADSORB THE SOLUBLE METALLIC IONS USING BIOMASS MATERIALS TO MAINTAIN THE SAFETY AND STABILITY OF THE SATURATED LIQUIDS

Abbas A. Karwi[1]

[1] **PhD, Professor, Al-Furat Al- Awsat Technical University, Technical Institute of Babylon, E-mail: abbas30032002@yahoo.com**

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ABSTRACT

Researcher design an ionic system to adsorb ions from industrial water of companies and factories, system consisted of three integrated phases designed to test the efficiency of an unspecified number of residues of food as adsorb materials. We adsorb copper and cobalt ions, these ions are available at high rates in Al Musayab thermal station, high concentration of these ions pose a threat to the health of the population. In general, the presence of these ions in the proportions set by the World Health Organization, namely, (1mg/L) are very useful for the completion of the metabolic processes of the living cell, but a greater focus for this will lead to tremendous health risks. Testing processes proved that there is an exact match between empirical testes and typical results of (**Freundlich** and **Langmuir**) models, through the mathematical analysis of the trial data under different thermal conditions, all testes proved that (husks of sunflower) is the best hypertext filtered materials for its high adsorption efficiency which equal to (71%) with enthalpy equal to (33KJ/mol), followed in the second place (peel peanuts), these peels proved have an excellent efficiency which equal to (72%) with enthalpy equal to (-14.8KJ/mol). In general, food remnants which have been selected for testing on an ion adsorption system designed by researcher have high capacity to adsorb various ionic roots of industrial water of Al-Musayab thermal station.

KEY WORDS: Processes, Remnants, Ions, Efficiency, Enthalpy.

تصميم منظومه لامتزاز الايونات الفلزيه الذائبه باستخدام مواد صديقة للبيئة للحفاظ على سلامة واستقرارية السوائل المشبعه

أ. د. عباس على محمود الكروى

معهد تقنى بابل، جامعة الفرات الاوسط التقنيه

الخلاصه

قام الباحث بتصميم منظومه الامتزاز الايونى لمياه الشركات والمصانع, المنظومه تتكون من ثلاث مراحل متكامله مصممه لاختبار كفاءة عدد غير محدد من مخلفات المواد الغذائيه كمواد ممتزه, تم امتزاز ايونى النحاس والكوبالت والمتوفره بنسب عاليه فى مياه محطة المسيب الحراريه وهذايشكل خطرا على حياة الكائنات الحيه بشكل عام. وجود تلك الايونات بالنسب التى حددتها منظمة الصحة العالميه وهى (1ملغم/لتر) مفيدة جدا لاتمام العمليات الايضيه للخلية الحيه ولكن زيادة التركيز عن ذلك يؤدى الى مخاطر صحيه هائله. اثبتت نتائج الاختبار التطابق التام بين الفحوصات العمليه ونتائج نموذجى (لانكمير وفراندلج) النظريه وذلك من خلال التحليل الرياضى لمعطيات التجربه وتحت الظروف الحراريه المختلفه. نتائج التطابق مع الموديلات الرياضيه (LANGMUIR & FREUNDLICH) اثبتت ان الماده الممدصه (قشور زهرة الشمس) هى افضل ماده مفلتره لكفائتها العاليه فى الامتزاز (71%) ومحتواها الحرارى الكامن (-33) كيلوجول/مول. يليها فى المرتبه الثانيه قشور فستق العبيد الذى اثبت انها ذات كفاءة ممتازه (63%) ومحتوى حرارى كامن يساوى (-14.8) كيلوجول/مول. وعليه فبشكل عام تعتبر مخلفات المواد الغذائيه التى تم اختيارها للاختبار فى منظومة الامتزاز والتى صممت من قبل الباحث ذات قدره عاليه على امتزاز مختلف الجذور الايونيه للمعادن الفلزيه الذائبه فى مياه محطة المسيب الحراريه.

1. INTRODUCTION

Surface area of the active carbon in nature characterized by non polar, but through the extraction and production processes are interacting with oxygen, which leads to the production of many effective and specific sites and can give polar vulnerable feature (Ruthven, 1984) on the product of carbon substance, as a result of natural activation, the carbon can be used widely in the treatment of ores using aqueous solutions to extract gold and silver and other metals (Sugumaran etl, 2012). So the most important industrial processes for the production of active carbon with high capacity and large sizes (Tsai etl, 2001) is the use of potassium hydroxide (Zou and Han, 2001). Accordingly, the adsorption process is a process that is used to isolate the heavy metals from aqueous solutions (Ganzerli, 1997: Anjalikoli, 1997). So there are many studies about the types of materials which absorb ions of different metals from aqueous their solutions (Kartel, et al., 1999: Koffman, 1999). Biomass of organic matter has proved that it has good ability to isolate and reduce the concentration of heavy metals from the aquatic environment, also there are many studies which have shown the ability of bacterial cell walls, fungi and algae on linking the heavy ions and attach it to their content of organic (Kartel, 1999: Prodhan, 1995), the use of dead biomass to remove heavy metals from aqueous solution has been studied extensively in recent years. Also it proves that the plant cell walls (Nuhoglu, 2002) which differ in their composition and characteristics according to the type of great importance plant cell to remove these ions from their solutions because of the a substance of the polymeric substance, which may lead to the effective surface activity (Ferguson, 1996). The most important of these is the rice bran fiber as one of the wastes (Adachi, 2001), this rice bran is a by product of milling process, this material is very cheap, costing about ($ 1 for each $ 50) of the cost of the activated carbon material. There are two theories are essential to describe the relationship between the concentrations of metals before and after treatment processes, these theories are Langmuir and Freundlisch. Other researchers like, (Hameed and Rahman, 2008) studied the effect of the active carbon manufactured from coconut charcoal to remove phenol from water of industrial plants, they found very good response, also found very congruence and compatibility between theoretical calculations using theories of Langmuir and Freundlisch and the results obtained (Karwi, 2012).

2. MATERIALS AND METHODS

A bioreactor was designed for the purpose of conducting the process of interaction between the green leaf alga which is available in abundance in rivers and salt lakes and ciprofloxacin material. Interacting processes took place with the hot steam supplied by attached tank, also supplied by a tank with the hole diameter not exceed than (5mm) filled with water and equipped with the severe a heating system steam supplied to tank from the top down, the tank is supplied with keys, keys are clsosed, so water in tank stay period of time not less than (10 minutes), then filtering the water and pumped after measuring the flow rate to table food wastes filters, table is equipped with a whole system of keys to control the flow rate to each filter. Through this table we can test the effectiveness of the hundreds of food wastes to demonstrate their ability to adsorption of free radicals and so we can utilize waste intended as one of the environmental waste for use in industrial purposes. We are tested (6 types) of food wastes like; powder of anguish palms, tea waste, coal powder, palm leaves, husks of peanuts, sunflower husks, peel of egg powder. System and adsorption materials can be seen in Fig.1, while the industrial water of Al- Musayyib electrical thermal station is shown in Fig. 2. The schematic representation of the designed system is shown in Fig. 3. All samples were analyzed by using a spectrometer of the atomic absorption type (AA-6300). The principle of testing is depending on the extent radiation based on Beer-Lamberts law, so the wave length absorption for each ion is recorded and compare with the standard tables, heavy ions have lower photometric of the wavelength, so we can determine the concentration for each ion by this method.

Fig. 1. System designed by researcher with three main stages.

Fig. 2. Industrial waste water of Al-Musayyib electrical thermal station.

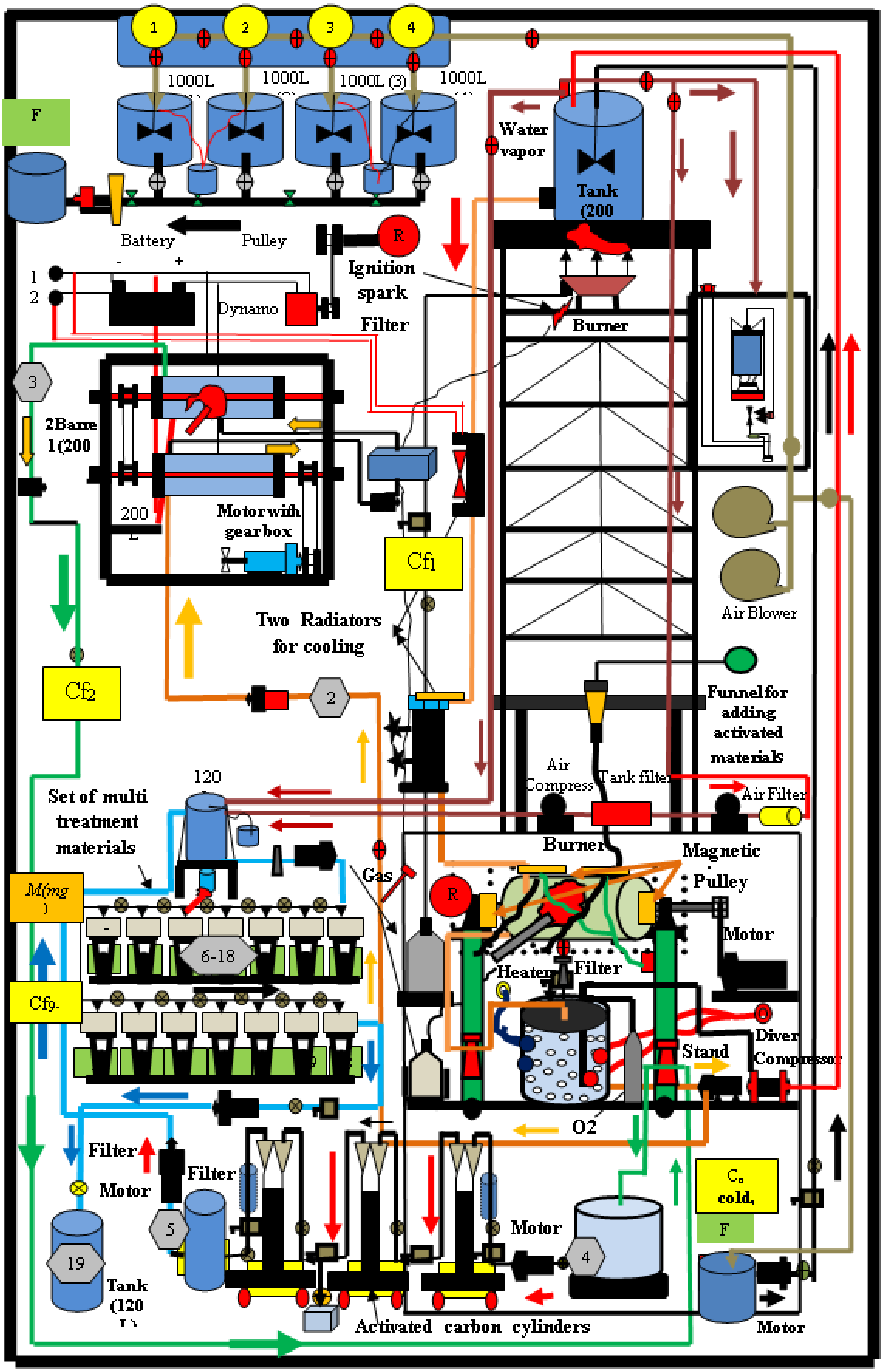

Fig. 3. Schematic representation of the system designed to adsorb the soluble metallic ions.

3. RESULTS AND DISCUSSION

3.1. Results of matching between practical results and theoretical models results

All stages of the designed system produced clean water without free radicals with efficiency more than (72%) as shown in Fig.4, high efficiency percent is due to optimal use of the designed equipment systems. Filters powders which are used as a biomass treated materials exposure to high temperatures inside the furnace more than (150 Co) to get carbonization and activation processes, carbon dioxide used in the oven at high temperatures to eliminate the substances that inhibit pores interfaces between molecules during the carbonization process, so that the pores at activation process depends on the time required to stay, whenever stay long time inside the oven, the great size of pores formed. Nitrogen supplied inside oven to isolate and remove carbon dioxide for the purpose of reducing harmful emissions ratio, also used to reduce the ratio of carbon combustion inside the furnace.

The preference criteria for the selection best biomass filtration materials depend on the number of model variables of (Freundlich and Langmuir). The practical tests proved that the husks of sunflower is one of the most efficient adsorbent materials with an efficiency of up to (71%) as shown in Fig. 4. Enthalpy value for anguish palm powder and peanuts peel is shown in Fig. 5. Inverse of maximum capacity for these two biomass materials is shown in Fig. 6.

The maximum absorbent capacity for anguish palm powder and peanuts as the best materials is shown in Fig. 7, while Langmuir constant and shape of isotherm is shown in Fig. 8. Equilibrium adsorption capacity for these materials can be seen in Fig. 9. Inverse of Equilibrium Capacity is shown in Fig. 10. Efficiency of all adsorbent materials is shown in Fig. 11. Thermal confident, Gips free energy for all used biomass materials are shown in Figs. 12, 13. The comparison between all theoretical variables for all biomass materials is shown in Fig. 14. Mathematical model results of different biomass materials are shown in Table 1 and Table 2, while thermodynamic results are shown in Table 3.

3.2. Results of bacterial and viruses tests

Samples have been taken with volume equals to (0.5 liter for each sample) to be tested at biological lab of our office. The treatment water is free from viruses and bacteria because of high steam temperatures through various treatment stages. A number of laboratory devices, including microscopes and high speed centrifuges more than 3000 rpm have been used.

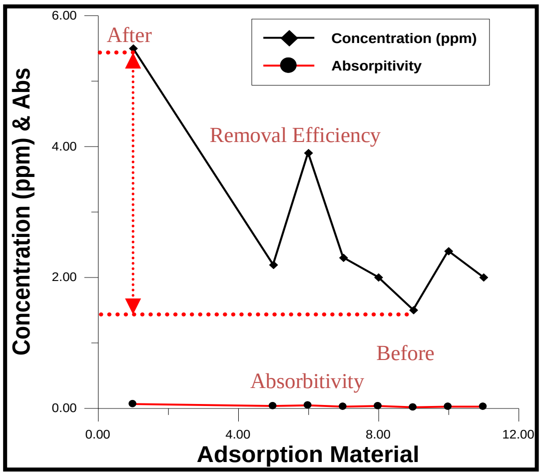

Fig. 4. Practical concentration of copper ions before and after treatment.

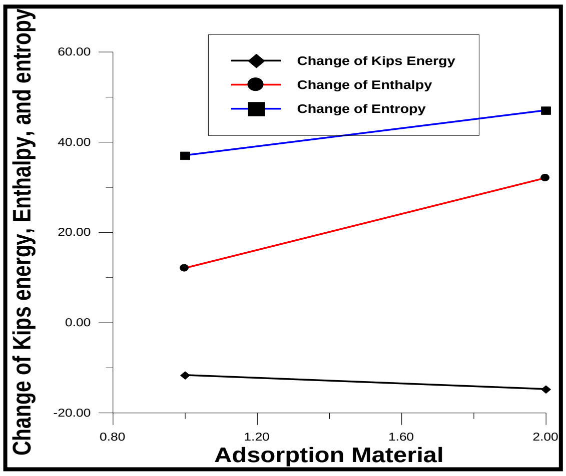

Fig. 5. Enthalpy due to use; 1- anguish palm powder, 2- peanuts peel.

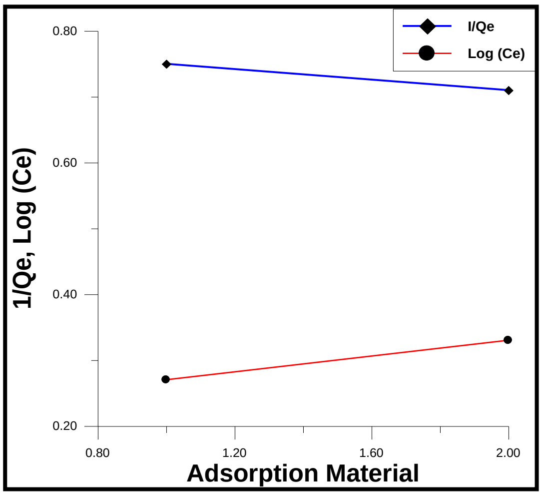

Fig. 6. Inverse of Maximum Capacity; 1- anguish palm powder, 2- peanuts peel.

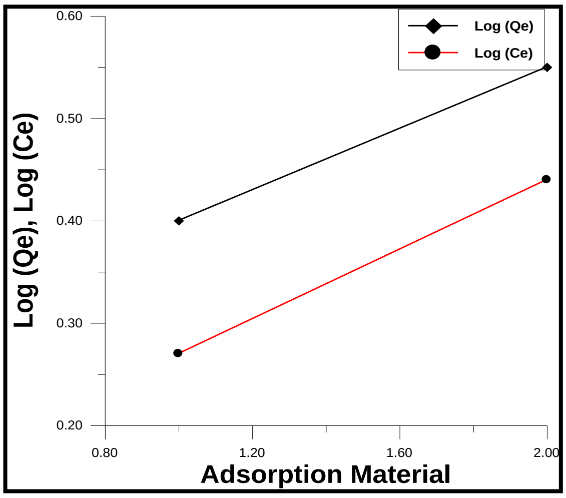

Fig. 7. Maximum Absorbent capacity; 1- anguish palm powder, 2- peanuts peel.

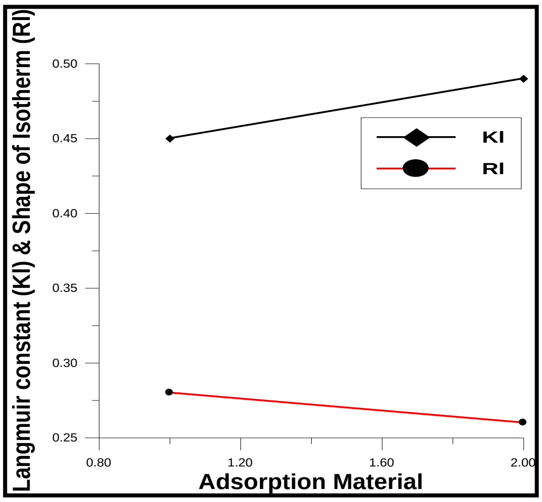

Fig. 8. Langmuir constant and shape of isotherm; 1- anguish palm, 2- peanuts peel.

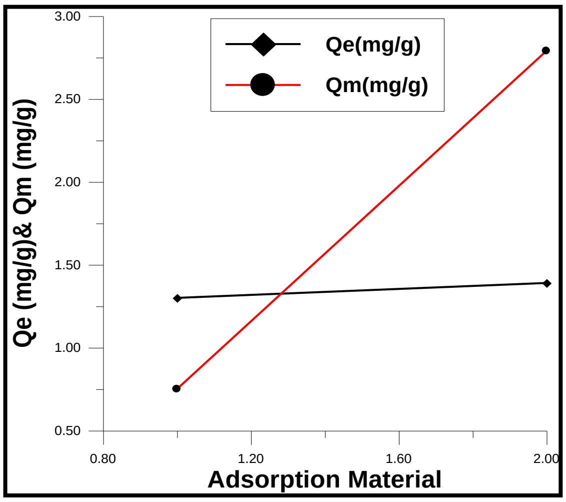

Fig. 9. Equilibrium adsorption capacity; 1- anguish palm powder, 2- peanuts peel.

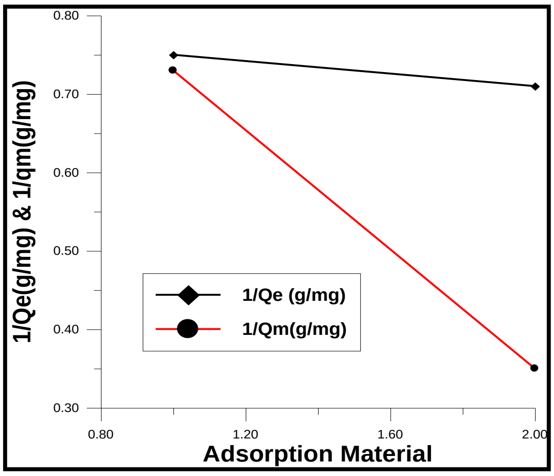

Fig. 10. Inverse of Equilibrium Capacity; 1- anguish palm powder, 2- peanuts peel.

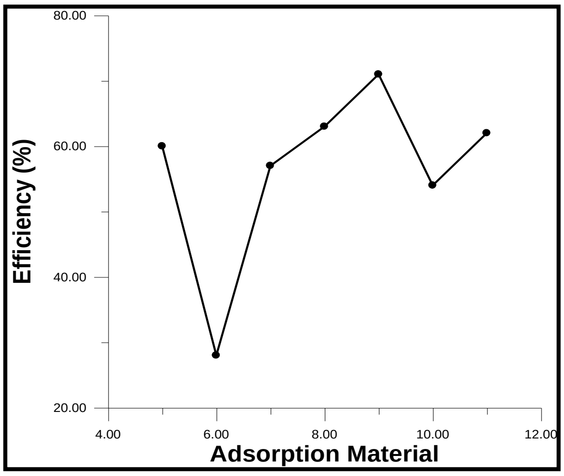

Fig. 11. Efficiency of adsorbent materials.

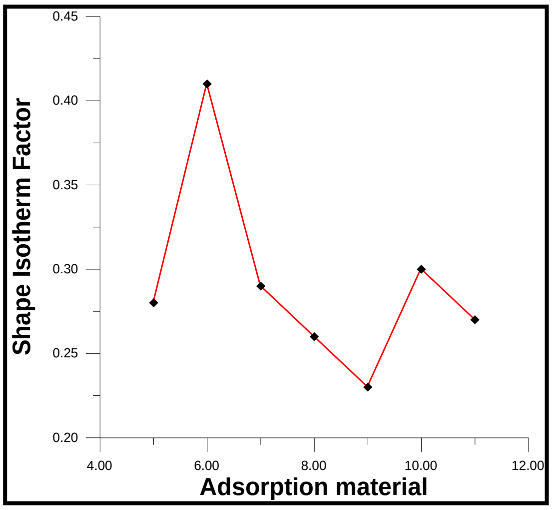

Fig. 12. Thermal confident of adsorbent materials.

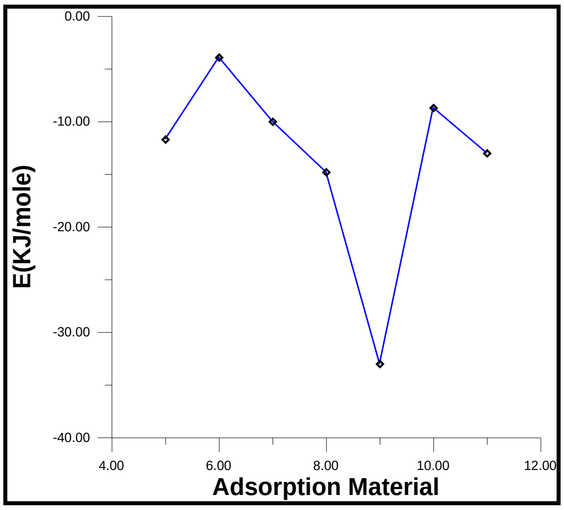

Fig. 13. Gips free energy of adsorbent materials.

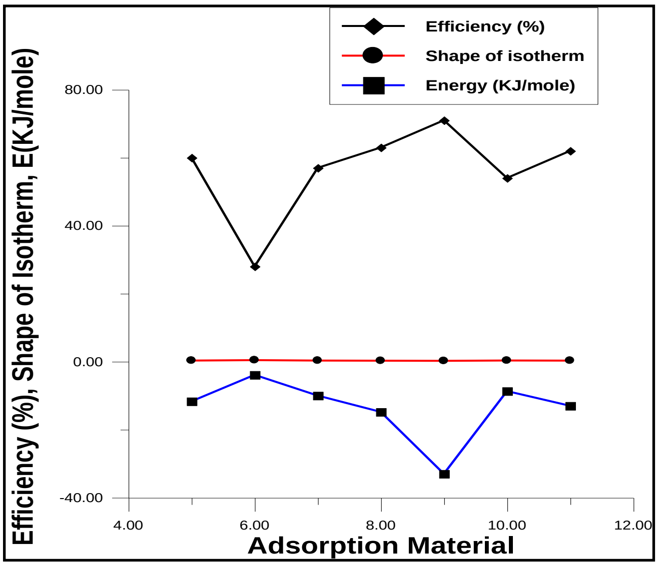

Fig. 14. Comparison between different variables of adsorbent materials.

Table 1. Mathematical model results of different biomass materials.

Adsorption Materials	Variable	Value	Symbol
Anguish palm powder	Removal Efficiency	60%	RE
	Equilibrium Adsorption Capacity	1.3(mg/g)	Qe
	Equilibrium Constant	1.5	Kf
	Inverse of Equilibrium Capacity	0.75(g/mg)	1/Qe
	Logarithm of (Qe)	0.4	Log (Qe)
	Equilibrium Concentration	2.1933(mg/l)	Ce
	Logarithm of equilibrium Concentration	0.27	Log Ce
	Initial Concentration	5.4988(mg/l)	Ci
	Inverse of Slope	0.625	n
Peanuts peel	Removal Efficiency	63%	RE
	Equilibrium Adsorption Capacity	1.39	Qe (mg/gm)
	Equilibrium Constant	1.7	Kf
	Inverse of Equilibrium Capacity	0.71	1/Qe
	Logarithm of (Qe)	0.55	Log (Qe)
	Equilibrium Concentration	2.0077	Ce (mg/l)
	Logarithm of equilibrium Concentration	0.33	Log Ce
	Initial Concentration	5.4988	Ci (mg/l)
	Inverse of Slope	0.32	n
Remnants tea powder	Removal Efficiency	%28	RE
	Equilibrium Adsorption Capacity	0.63	Qe(g/mg)
	Equilibrium Constant	0.40	Kf
	Inverse of Equilibrium Capacity	0.15	1/Qe
	Logarithm of (Qe)	0.9	Log (Qe)
	Equilibrium Concentration	3.9116	Ce(mg/l)
	Logarithm of equilibrium Concentration	0.45	Log Ce
	Initial Concentration	5.4988	Ci(mg/l)
	Inverse of Slope	0.31	n
Coal powder of palm fronds	Removal Efficiency	%57	RE
	Equilibrium Adsorption Capacity	1.2	Qe
	Equilibrium Constant	1.36	Kf
	Inverse of Equilibrium Capacity	0.78	1/Qe
	Logarithm of (Qe)	0.3	Log (Qe)
	Equilibrium Concentration	2.3	Ce
	Logarithm of equilibrium Concentration	0.23	Log Ce
	Initial Concentration	5.4988	Ci
	Inverse of Slope	0.8	n

Adsorption Materials	**Variable**	**Value**	**Symbol**
Sunflower peel	Removal Efficiency	%71	RE
	Equilibrium Adsorption Capacity	1.5	Qe
	Equilibrium Constant	2.5	Kf
	Inverse of Equilibrium Capacity	0.063	1/Qe
	Logarithm of (Qe)	0.94	Log (Qe)
	Equilibrium Concentration	1.5405	Ce
	Logarithm of equilibrium Concentration	0.45	Log Ce
	Initial Concentration	5.4988	Ci
	Inverse of Slope	0.09	n
Age peel powder	Removal Efficiency	%54	RE
	Equilibrium Adsorption Capacity	1.2	Qe
	Equilibrium Constant	1.2	Kf
	Inverse of Equilibrium Capacity	0.08	1/Qe
	Logarithm of (Qe)	0.19	Log (Qe)
	Equilibrium Concentration	2.4	Ce
	Logarithm of equilibrium Concentration	0.18	Log Ce
	Initial Concentration	5.4988	Ci
	Inverse of Slope	0.048	n
All adsorption	Removal Efficiency	%62	RE
	Equilibrium Adsorption Capacity	1.37	Qe
	Equilibrium Constant	1.67	Kf
	Inverse of Equilibrium Capacity	0.072	1/Qe
	Logarithm of (Qe)	0.51	Log (Qe)
	Equilibrium Concentration	2	Ce
	Logarithm of equilibrium Concentration	0.31	Log Ce
	Initial Concentration	5.4988	Ci
	Inverse of Slope	0.31	n

Table 2. Mathematical model results of different biomass materials.

Biomass materials	Variable	Value	Symbol
Anguish palm powder	Langmuir Constant	0.45	Kl
	Shape of Isotherm 0<R<1	0.28	Rl
	Maximum Absorbent capacity (mg/g)	2.6	Qm
	Inverse of Maximum Capacity	0.73	1/Qm
	Logarithm of Maximum Capacity	0.97	Log Qm
Peanuts peel	Langmuir Constant	0.49	Kl
	Shape of Isotherm 0<R<1	0.26	Rl
	Maximum Absorbent capacity (mg/g)	2.79	Qm
	Inverse of Maximum Capacity	0.35	1/Qm
	Logarithm of Maximum Capacity	1.02	Log Qm
Remnants tea powder	Langmuir Constant	0.25	Kl
	Shape of Isotherm 0<R<1	0.41	Rl
	Maximum Absorbent capacity (mg/g)	1.26	Qm
	Inverse of Maximum Capacity	0.78	1/Qm
	Logarithm of Maximum Capacity	0.23	Log Qm
Coal powder of palm fronds	Langmuir Constant	0.42	Kl
	Shape of Isotherm 0<R<1	0.29	Rl
	Maximum Absorbent capacity (mg/g)	2.5	Qm
	Inverse of Maximum Capacity	0.039	1/Qm
	Logarithm of Maximum Capacity	0.9	Log Qm

Biomass materials	Variable	Value	Symbol
Sunflower peel	Langmuir Constant	0.6	Kl
	Shape of Isotherm 0<R<1	0.2	Rl
	Maximum Absorbent capacity (mg/g)	3.1	Qm
	Inverse of Maximum Capacity	0.03	1/Qm
	Logarithm of Maximum Capacity	1.15	Log Qm
Age peel powder	Langmuir Constant	0.4	Kl
	Shape of Isotherm 0<R<1	0.3	Rl
	Maximum Absorbent capacity (mg/g)	2.4	Qm
	Inverse of Maximum Capacity	0.04	1/Qm
	Logarithm of Maximum Capacity	0.87	Log Qm
All adsorption	Langmuir Constant	0.48	Kl
	Shape of Isotherm 0<R<1	0.27	Rl
	Maximum Absorbent capacity (mg/g)	2.7	Qm
	Inverse of Maximum Capacity	0.03	1/Qm
	Logarithm of Maximum Capacity	1	Log Qm

Table 3. Thermodynamic results for biomass materials.

Biomass materials	Variable	Value	Symbol
Anguish palm powder	Gips Free energy(KJ/mole)/ The best is the more negative	-11.7	ΔG
	Enthalpy(KJ/mole)/ Endothermic processes	12	ΔH
	Entropy(KJ/mole)/ Reaction by itself	37	ΔS
Peanuts peel	Gips Free energy(KJ/mole)/ The best is the more negative	-14.8	ΔG
	Enthalpy(KJ/mole)/ Endothermic processes	32.1	ΔH
	Entropy(KJ/mole)/ Reaction by itself	47	ΔS
Remnants tea powder	Gips Free energy(KJ/mole)/ The best is the more negative	-3.9	ΔG
	Enthalpy(KJ/mole)/ Endothermic processes	8.5	ΔH
	Entropy(KJ/mole)/ Reaction by itself	12.4	ΔS
Coal powder of palm fronds	Gips Free energy(KJ/mole)/ The best is the more negative	-10	ΔG
	Enthalpy(KJ/mole)/ Endothermic processes	22	ΔH
	Entropy(KJ/mole)/ Reaction by itself	32	ΔS
Sunflower peel	Gips Free energy(KJ/mole)/ The best is the more negative	-33	ΔG
	Enthalpy(KJ/mole)/ Endothermic processes	74	ΔH
	Entropy(KJ/mole)/ Reaction by itself	108	ΔS

Biomass materials	Variable	Value	Symbol
Age peel powder	Gips Free energy(KJ/mole)/ The best is the more negative	-8.7	ΔG
	Enthalpy(KJ/mole)/ Endothermic processes	19	ΔH
	Entropy(KJ/mole)/ Reaction by itself	27	ΔS
All adsorption	Gips Free energy(KJ/mole)/ The best is the more negative	-13	ΔG
	Enthalpy(KJ/mole)/ Endothermic processes	30	ΔH
	Entropy(KJ/mole)/ Reaction by itself	44	ΔS

4. CONCLUSIONS

1. Testes show an exact match between empirical and mathematical modeling results at different temperatures.
2. Mathematical results of (Langmuir & Freundlich) models show that sunflower husks is the best filtered biomass materials, because its high efficiency which equals to (71%).
3. Peanuts peel show an excellent efficiency which equals to (63%).
4. All biomass materials have thermal coefficient located between ($0<R<1$), this value represents the perfect choice for all materials.
5. This system has high ability for testing different types of biomass materials.

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