The Feasibility of Rice Husk to Remove Minerals From Water by Adsorption and Avail From Wastes

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ABSTRACT: - This investigation is concerned to study the susceptibility of Iraqi Rice Husk (IRH) on the removal of five minerals pollutants which were (B, Ba, Be, Bi, and Se) ions from simulated synthetic aqueous solution (SSAS) using different design parameters by adsorption process. Results show that the removal efficiency of minerals (B, Ba, Be, Bi, and Se) from (SSAS) was decreased with increasing of initial concentration, flow rate and pH for some minerals which were (B, and Bi) while it was increased with increasing absorbance material bed height, feeding temperature and pH for rest minerals (Ba, Be and Se). Statistical model is achieved to obtain an expression relates overall operating parameters with the removal efficiency for each mineral ions used in this treatise in a general equation. The samples of (IRH) remaining after using it in adsorption of these seven metals above from (SSAS) were predestined to investigate the utilization of it in different methods. One of these methods was preparing of promoted type Y-zeolite catalyst and compared these type prepared with normally type Y-zeolite catalyst prepared from (IRH) alone in the process of n-heptane isomerization under different temperatures. Another method was study the using of these (IRH) as a rodenticide directly without any pretreatment. The results show that the promoted type Y-zeolite catalyst by (B, Ba, Be, Bi, and Se) ions give higher conversion and better selectivity of n-heptane isomerization than normally type Y-zeolite catalyst and the (IRH) adsorb (B, Ba, Be, Bi, and Se) from (SSAS) showed a good behaviour as rodenticide. By this way we can possess different benefits which are: remove the five mineral ions contaminated the water, get rid of agricultural waste (IRH), in the same time, produce light and more benefit hydrocarbons from n-heptane isomerization using a type Y-zeolite catalyst synthesis from remaining (IRH) and prepare an active rodenticide. So, it can discard more toxic waste in a coast and eco-friendly method.

Key- Words: rice husk, type-Y zeolite catalyst, minerals, adsorption, wastes and residues

1 Introduction

The greater environmental awareness in both the public and regulatory sphere in recent year has necessitated greater treatment of industrial effluent [1]. The interest has been increased in recent years over the discharge of pollutants from industrial wastewater to reach the standard values of these pollutants before their discharge to the aquatic system (like river) or to the sewer network. In the field of environmental pollution, there are few subjects that, during the latest years, have developed as rapidly as the study of toxic metals [2]. According to the World Health Organization (WHO), the metals of most immediate concern are Al, Cr, Mn, Fe, Co, Ni, Cu, Zn, Cd, Hg and Pb [3]. It is apparent that the presence of a toxic metal may not represent a hazard if a threshold exists below which there are no observable effects. It should be noted that certain heavy metals, including Al, Cu, Cd, Fe, Pb, Mn and Ni are essential or beneficial or harmful in trace quantities [4]. The toxicity of a given heavy metal depends on the total amount ingested, pH of treated water as well as a number of factors [5]. Heavy metal ions can came from many sources like industrial and municipal wastewater in the absence of the affective treatment, urban runoff, rain water and agricultural fertilizer may be the most important sources of heavy metals in aquatic environment. A large number of different industries produce effluents contaminated with heavy metal ions. Industries such as minerals and metallurgical processing, leather, textile, chemical manufacture, metal finishing and many other industries produce heavy metals in aqueous solution as waste [1]. In this paper the adsorption of mineral which are (B, Ba, Be, Bi, and Se) using Iraqi rice husk was examined and endeavour of utilizing from the waste residue in a convenient, economical way and ecofriendly.

2 Experimental Work

2.1 Materials

2.1.1 Iraqi rice husk (adsorbent media)

Iraqi rice husk was collected from Al-Shanafia fields for rice in the Southern of Iraq. The rice husk was washed three times with doubled distilled water. Excess distilled water was used to remove the soluble materials present in the rice husk bringing from the field, boiled to remove colour and other fine impurities may be found in the rice husk, and then dried at 105°C for 24 hours and the adsorbent thus processed was used in its original piece size. The surface area of Iraqi Rice Husk was measured by BET (Brunauer – Emmett – Teller nitrogen adsorption technique). Characteristics of (IRH) were presented in Table 1. When the (IRH) was heated at 105°C in an oven, most of the water had been removed while the second major mass loss of about 45-65% was attributed to the breakdown of cellulose constituent char, which is a carbonaceous residue.

Table1: Characterization properties of Iraqi rice husk

Chemical Composition	
Compound	Composition wt %
SiO_2	90.7
Al_2O_3	0.13
Fe_2O_3	0.06
TiO_2	0.015
CaO	0.61
MgO	0.25
Na_2O	0.09
K_2O	2.64
P_2O_5	0.73
LOI	4.71
S.A (m^2/g)	57.5

2.1.2 Stock solutions

In order to avoid interference with other elements in wastewater, the experiments in this study were carried out using (SSAS) of different minerals. 1000 mg/l stock solution of each mineral ions was prepared by dissolving known weight of (B+3, Ba+2, Be+2, Bi+3, and Se+4) mineral salt in one liter of double distilled water as shown in Table 2. All (SSAS) using in the experiments were prepared by diluting the stock solution with double distilled water to the desired concentrations for the experimental work of this investigation. The mineral ion concentrations were measured using spectrophotometer thermo – genesys 10 UV, USA.

Table 2: Heavy metals and it's salts uses

Heavy Metal	Salt of Heavy Metal Uses
B	$B(NO_3)_3$
Ba	$Ba(NO_3)_2$
Be	$BeSO_4.4H_2O$
Bi	$Bi(NO_3)_3.5\ H_2O$
Se	$SeCl_4$

2.2 Sorption unit

Fixed bed column of continuous mode experiments were conducted in order to test the mineral (B, Ba, Be, Bi, and Se) ions removal by treated SSAS of above mineral ions individually at desired concentration with the various bed heights of the adsorbent media (IRH) using different flow rates of (SSAS) of mineral ions at various pH. The pH value was adjusted using 0.1 N NaOH and 0.1 N HCl solutions. A schematic representation of the sorption unit is shown in Figure1 where the flow direction is downward by gravity. The sorption unit consists of two glass container of (SSAS) of mineral ions one for inlet and the other for outlet each of (1 liter) capacity. Glass column has 2.54 cm ID and 125 cm height. The sorption column packed with adsorbent media to a height of (10, 20, 30, 40, 50, 60, 70, 80, 90 and 100 cm) supported from the top and the bottom by glass hollow cylinder layer, each cylinder have (0.5 cm ID, 0.1 cm thickness and 1 cm long). Before starting the runs, the packed bed sorption column was rinsed by double distilled water down flow through the column. The IRH is packed in the column to the desired depth, and fed to it as slurry by mixing the media (IRH) with distilled water in order to avoid the formation of air bubbles inside the media.

After the packed bed sorption column was accommodation and putting the required amount of adsorbent media, the adsorption process started by allowing the mineral SSAS of required concentration and pH down flow through the sorption column from inlet container by gravity at a precise flow rate in experiment which is adjusted by the valve as shown in Figure 1. To determination the best operational conditions, the experiments were carried out at a temperature between (20–55°C), various pH values which are (1–8) and initial feed concentrations of SSAS of different mineral (B, Ba, Be, Bi, and Se) ions which are between (1–100) mg/l individually and at different flow rates which are between (5–100) ml/min for each mineral initial feed concentration. Outlet samples after treatment in each experiment were collected every 5 minutes from the bottom of packed column and the unadsorbed concentration of mineral (B, Ba, Be, Bi, and Se) ions in SSAS was analyzed by spectrophotometer.

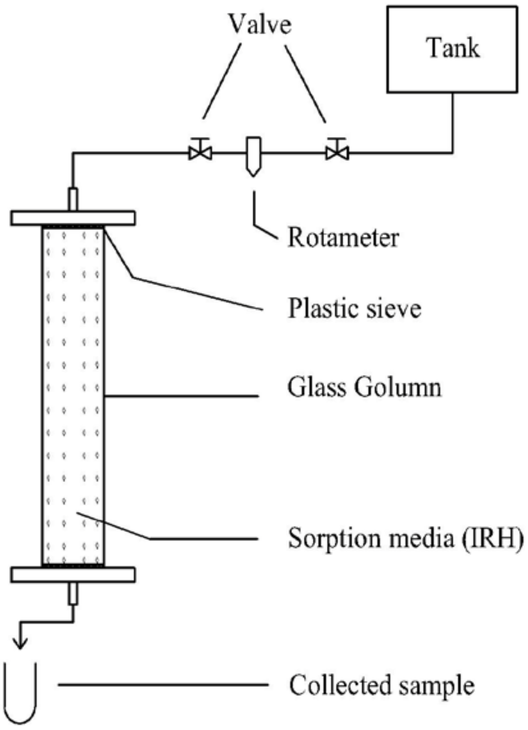

Fig. 1: The experimental setup for adsorption runs

2.3 Reusability of Iraqi rice husk

In order to check the reusability of sorbent media, treated Iraqi rice husk with different minerals were firstly dried at 105°C after that tested again in sorption unit at the conditions of experiment gives the best percent removal of mineral ions individually from aqueous solution aforementioned. The capacity of the sorbent was found to be decreased until be constant at destined percent removal after different times repeated use. The destined percent removal and number of repeated uses were dependent on mineral; thus multiple use of sorbent was seen to be feasible.

Table 3: Experimental results of final percent removal of minerals after reusability of Iraqi rice husk

Mineral	Final percent removal reached after reuses	Times of repeated uses
B	5.85	10
Ba	7.35	8
Be	9	12
Bi	12.5	7
Se	6.25	13

3 Result and Discussion

The ability of IRH to remove mineral (B, Ba, Be, Bi, and Se) ions from SSAS in fixed bed column of continuous mode at various parameters which are pH’s of SSAS of mineral (B, Ba, Be, Bi, and Se) ions, (pH), height bed of adsorbent media (IRH) (h), flow rates of SSAS (F), SSAS temperature (Tfeed) and time of treatment (t) was investigated. The experiments were achieved by varying all above parameters for different initial concentrations (Co) of SSAS of mineral (B, Ba, Be, Bi, and Se) ions individually. Thus, the results obtained are explained below.

3.1 Effect of Initial Concentration

The results showed that using adsorbent material, the percent removal of mineral (B, Ba, Be, Bi, and Se) ions individually was decreased when the initial concentration (Co) of SSAS of mineral ions was increased at constant other variables as shown in Figure 2. This can be explained by the fact that the initial concentration of mineral (B, Ba, Be, Bi, and Se) ions had a restricted effect on mineral ions removal capacity; simultaneously the adsorbent media (IRH) had a limited number of active sites, which would have become saturated at a certain concentration. This was lead to the increase in the number of mineral ion molecules competing for the available functions groups on the surface of adsorbent material (IRH). Since the solution of lower concentration has a small amount of mineral ions than the solution of higher concentration of it, so the percent removal was decreased with increasing initial concentration of mineral (B, Ba, Be, Bi, and Se) ions. For adsorbent media, higher percent removal were (98.72, 95.09, 96.84, 97.75, and 96.76,) % for mineral (B, Ba, Be, Bi, and Se) respectively, at initial mineral ion concentration of 1 mg/l, so adsorbent material was found to be efficient to mineral ions removal from SSAS and wastewater.

3.2 Effect of pH

The results showed that using adsorbent material (IRH), the percent removal of mineral (B, and Bi) ions was decreased when the pH of SSAS of above mineral ions was increased at constant other variables, while the percent removal of mineral (Ba, Be, and Se) ions was increased when the pH of SSAS mineral ions was increased at constant other variables as shown in Figure 3. It is well recognized that the pH of the SSAS is an important parameter in affecting adsorption of mineral ions [6]. High adsorption of mineral (B, and Bi) ion individually at low pH can be explained in both terms; the species of mineral and the adsorbent surface. For this case, at low pH, i.e. acidic conditions, the surface of the adsorbent (IRH) becomes highly protonated and favours adsorb of above group of mineral in the anionic form. With increasing the pH of aqueous solution, the degree of protonation of the surface reduces gradually and hence adsorption is decreased [7].

Furthermore, as pH increases there is competition between hydroxide ion and metal ions, the former being the dominant species at higher pH values. The net positive surface potential of sorbent media decreases, resulting in a reduction the electrostatic attraction between the (sorbent) metal ion species and the (sorbate) adsorbent material surface (IRH), with a consequent reduced sorption capacity which ultimately leads to decrease in percentage adsorption of metals ion [8]. In the other hand, the adsorption of mineral (Ba, Be, and Se) ions individually can be explained by ion-exchange mechanism of sorption in which the important role is played by functional groups that have cation exchange properties.

For this case at lower pH values, metals removal was inhibited, possibly as a result of the competition between hydrogen and metal ions on the sorption sites, with an apparent preponderance of hydrogen ions, which restricts the approach of metal cations as in consequence of the repulsive force. As the pH increased, the ligand functional groups in adsorbent media (IRH) would be exposed, increasing the negative charge density on the adsorbent material surface, increasing the attraction of metallic ions with positive charge and allowing the sorption onto adsorbent material surface.

3.3 Effect of Adsorbent Media Bed Height

The results elucidated that when the adsorbent media bed height was increased, the percent removal of all mineral ions individually was increased too at constant other variables as shown in Figure 4. The increased of bed height (h) meaning increased in the amount of adsorbent media, thus increasing the surface area of adsorbent material, hence increased the number of active sites in the adsorbent material surface i.e. increased the availability of binding sites for adsorption and consequently increase the mineral (B, Ba, Be, Bi, and Se) ions removal capacity on IRH. This lead to increase the ability of adsorbent media to adsorb greater amount of mineral ions from SSAS at different initial concentrations and ultimately the percent removal of all mineral (B, Ba, Be, Bi, and Se) ions individually increased.

3.4 Effect of Flow Rate

The results illustrated that when the flow rate of SSAS of mineral (B, Ba, Be, Bi, and Se) ions was increased, the percent removal of mineral ions was decreased individually at constant other variables as shown in Figure 5. This may be due to the fact that when the flow of SSAS of mineral ions increasing, the velocity of solution in the column packed with the adsorbent media (IRH) was increasing too, so the solution spend shorter time than that spend in the column while at low flow rate, the SSAS of mineral (B, Ba, Be, Bi, and Se) ions resides in the column for a longer time, and therefore undergoes more treatment with the adsorbent media, thus the adsorbent media uptake low amount of mineral ions from SSAS of mineral ions for high flow rate, therefore the percent removal of mineral (B, Ba, Be, Bi, and Se) ions was decreased when the flow rate was increased.

3.5 Effect of Feed Temperature

The results demonstrated that when the temperature of feed which was SSAS of mineral ions was increased, the percent removal of mineral (B, Ba, Be, Bi, and Se) ions individually was increased too at constant other variables as shown in Figure 6. The effect of temperature is fairly common and increasing the mobility of the metal cation. Furthermore, increasing temperatures may produce a swelling effect within the internal structure of the adsorbent media enabling mineral ions to penetrate further. It was indicated that mineral ions adsorption capacity increased with increasing feed temperature

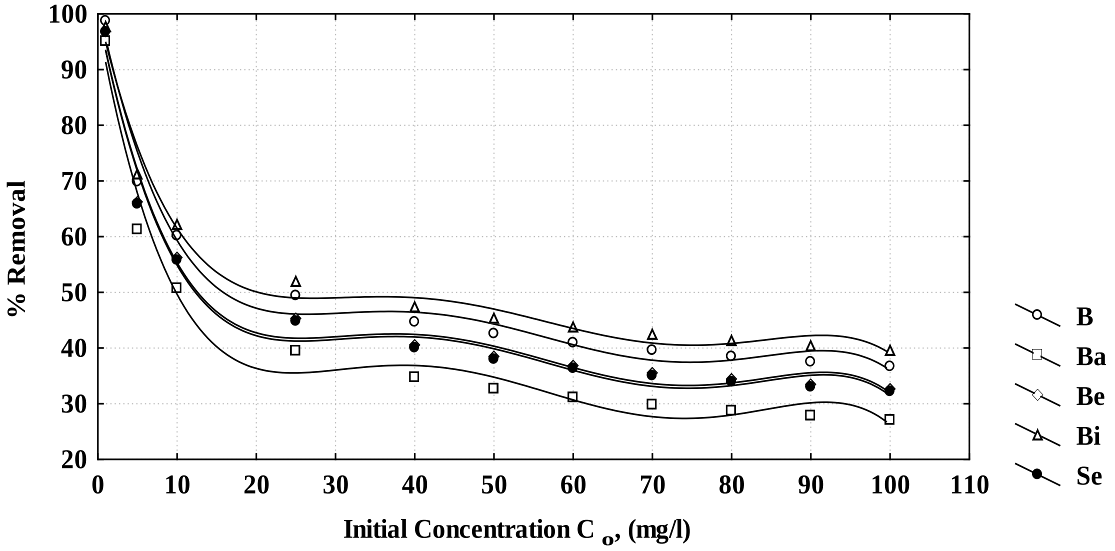

Fig. 2: Effect of initial concentration (C□) on the percent removal of different mineral ions @ Tf=55°C, hb = 1 m, t=60 min. and F=5 ml/min.

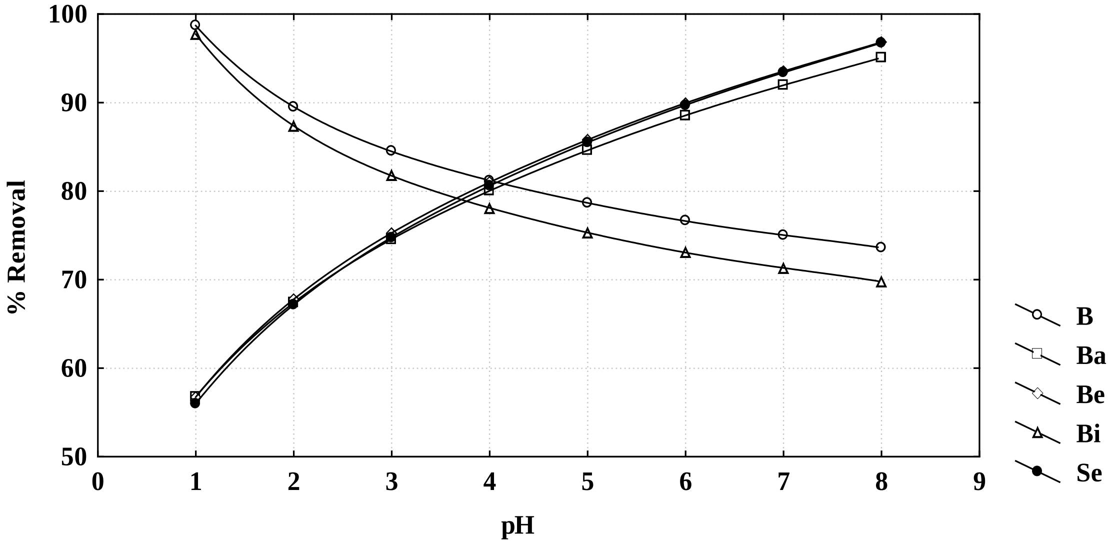

Fig. 3: Effect of pH on the percent removal of different mineral ions @ C□= 1 mg/l, Tf =55°C,hb = 1 m, t=60 min. and F=5 ml/min.

from 20 to 55°C. This effect may be due to the fact that at higher temperature an increase in active sites occurs due to bond rupture.

3.6 Effect of Treatment Time

The results demonstrated that when the treatment time of SSAS of mineral (B, Ba, Be, Bi, and Se) ions increased the percent removal of mineral ions increased individually at constant other variables as shown in Figure 7. This may be due to the fact that when the time of treatment of SSAS of mineral ions increasing and the velocity of solution in the column packed with the adsorbent material was remaining constant, the solution spend longer time than that spend it when the time of treatment decreased, so the adsorbent material uptake more amount of mineral ions from SSAS, therefore the percent removal of mineral ions from SSAS of mineral (B, Ba, Be, Bi, and Se) ions was increased.

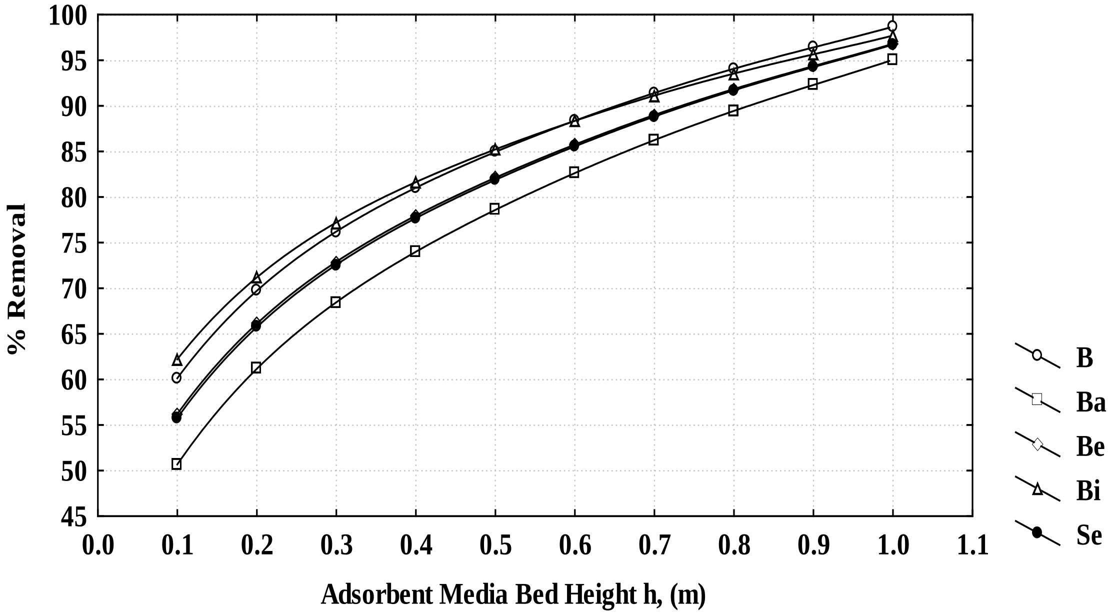

Fig. 4: Effect of adsorbent media bed height (h_b) on the percent removal of different mineral ions @ C□= 1 mg/l, T_f =55°C, t=60 min. and F=5 ml/min.

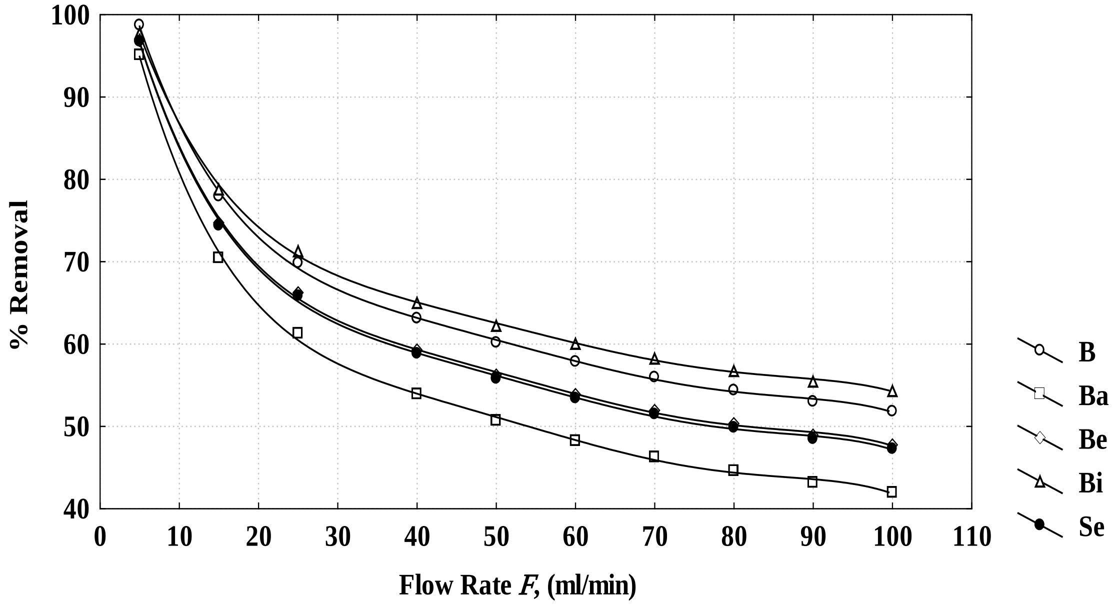

Fig. 5: Effect of aqueous solution flow rate (F) on the percent removal of different mineral ions @ C□= 1 mg/l, T_f =55°C, h_b = 1 m and t=60 min.

4 Statistical Model

A statistical model was carried out on the experimental results obtained from this study. Regression analysis and π theorem was adopted to maintain a relation between the percent removal of different mineral (B, Ba, Be, Bi, and Se) ions and the feed temperature, flow rate, pressure, pH of feed solution, initial concentration of mineral ion, adsorbent media bed height, treatment time and column diameter. These relations are shown in Table 4, which has a correlation coefficient (R2) as explained.

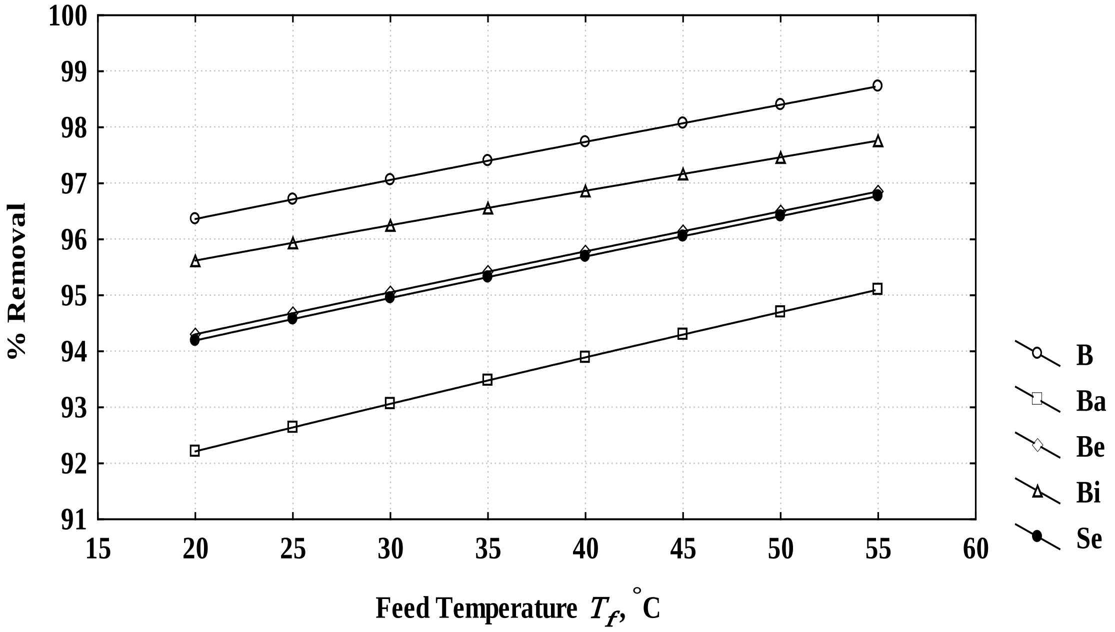

Fig. 6: Effect of feed temperature (Tf) on the percent removal of different mineral ions @ C□= 1 mg/l, hb = 1 m, t=60 min. and F=5 ml/min.

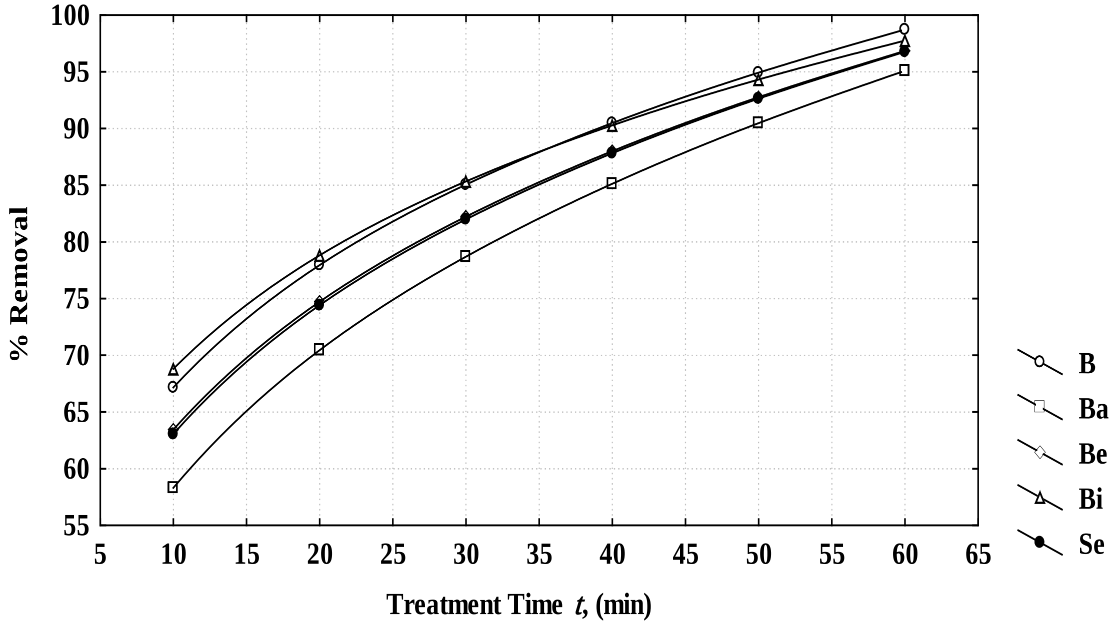

Fig. 7: Effect of treatment time (t) on the percent removal of different mineral ions @ C□= 1 mg/l, Tf =55°C, hb = 1 m, and F=5 ml/min.

5 Utilization of Iraqi Rice Husk After Uses

Huge amount of IRH was lingered after using it in removal of mineral (B, Ba, Be, Bi, and Se) ions from SSAS as explained above. Utilization from IRH uses can be achieved in different ways:

5.1 Employment of used Iraqi rice husk as a raw material to prepare promoted zeolite type Y catalyst

Table 4: Statistical equations of mineral ions removal using Iraqi rice husk

Toxic metal	Equation	R^2
B	$\%R = 2.4958 \times 10^{-5} \left(\frac{T_f \,.P\,.h_b\,.C_{P_{sol}}\,.t}{F\,.d\,.C_\circ\,.g}\right)^{0.215} (\frac{1}{pH})^{0.141}$	0.962
Ba	$\%R = 8.2567 \times 10^{-7} \left(\frac{T_f \,.P\,.h_b\,.C_{P_{sol}}\,.t}{F\,.d\,.C_\circ\,.g}\right)^{0.273} (pH)^{0.248}$	0.945
Be	$\%R = 5.1020 \times 10^{-6} \left(\frac{T_f \,.P\,.h_b\,.C_{P_{sol}}\,.t}{F\,.d\,.C_\circ\,.g}\right)^{0.236} (pH)^{0.257}$	0.897
Bi	$\%R = 6.2978 \times 10^{-5} \left(\frac{T_f \,.P\,.h_b\,.C_{P_{sol}}\,.t}{F\,.d\,.C_\circ\,.g}\right)^{0.196} (\frac{1}{pH})^{0.162}$	0.895
Se	$\%R = 4.3432 \times 10^{-6} \left(\frac{T_f \,.P\,.h_b\,.C_{P_{sol}}\,.t}{F\,.d\,.C_\circ\,.g}\right)^{0.239} (pH)^{0.263}$	0.922

where:

%R	Percent Removal of Mineral Ion from SSAS
Tf	Feed Temperature,(K)
P	Pressure,(Pa)
h_b	Adsorbent Material Bed Height,(m)
C_{Psol}	Heat Capacity of SSAS,(J/g.K)
F	SSAS Flow Rate,(m^3/s)
d	Internal Diameter of Sorption Column,(m)
C□	Initial Concentration of Mineral Ion,(g/m^3)
t	Treatment Time,(s)
g	Acceleration of Gravity,(m/s^2)

IRH waste which were adsorbed mineral (B, Ba, Be, Bi, and Se) ions from SSAS at different operating conditions were segregated and classified according to its contain of above mineral ions individually and utilization from these remaining samples as a raw material in synthesis of promoted catalyst used in n-heptane isomerization which is zeolite type Y. The samples give different ratios of mineral ions to IRH. The ratios were between (0.05 to 5.5 wt %) for mineral (B, Ba, Be, Bi, and Se) ions individually. IRH lingered with different ratios were firstly treated with 10% phosphoric acid (H3PO4) for 24 hours for preliminary removing all impurities. Then they were well washed with double distilled water, filtered, dried in air, and calcined at 750°C for 6 hours. 12 g of calcined Iraqi rice husk were then subjected for dissolution in sodium hydroxide NaOH (4 M) followed by refluxing at 90°C for 12 hours. After that concentrated hydrochloric acid (HCl (37%)) was added to the aforementioned base dissolved Iraqi rice husk for complete precipitation. Iraqi rice husks were filtered, washed with excess distilled water to be freeing from chloride ions and finally dried in an oven at 120°C for 6 hours. Zeolite type Y was synthesized using prepared Iraqi rice husk above as a silica source in the following method. 500 ml Teflon beaker containing a magnetic stirrer was washed with deionized water. Sodium hydroxide of 1.6616g was added slowly to deionized water and stir until clear and homogenous solution appeared for about 5 minutes. The aqueous solution of sodium hydroxide was ready for the preparation of seed gel. The gel was prepared according to the following molar chemical composition: 10.67 Na2O: Al2O3: 10 SiO2: 180 H2O. Two millilitres aqueous solution of sodium hydroxide was added to 0.7515g sodium aluminate oxide until a homogenous mixture was formed; 1.5361g of prepared IRH above was added separately to 5.5 ml sodium hydroxide aqueous until homogenously mixed. Both of the preparations were heated under vigorous stirring to obtain a homogenous mixture.

The sample was aged for 24 hours at room temperature in the Teflon bottle. The aluminate and silicate solutions were mixed together in the polypropylene beaker, subsequently stirred for 2 hours with the purpose of making it completely homogenized. This combined solution was used as the feed stock gel [9, 10]. The flow chart of the process is shown in Figure 8.

The synthesized zeolite type Y which was in sodium (Na+) powder form, mixed with 15 % montmorillonite clay as a binder then mixed with water to form a paste. A spherical shape (0.5 cm) was formed, dried overnight at 110°C. In order to make a promoted catalyst ready for test in any process, hydrogen zeolite (H-zeolite) form must be prepared. The M-HY-zeolite (where M is one of mineral (Co, Hg, Li, Sb, Sn, V, and W) ions used) was prepared by exchanging Na+ ions in the sodium form zeolite type Y with ammonium chloride solution NH4Cl. In order to obtain ideal degree of ion exchange the technique of multi-steps (three times repeating) was used. Thus, the first step, 2N of ammonium chloride solution (26.75 g of NH4Cl in 250 ml of distilled water) contacted with 90 g of prepared M-NaY-zeolite with stirring for 2 hours. In the second step, the procedure in the first step was repeated under the same conditions but on about 60 g of zeolite, which was taken from the total zeolite amount produced in the first step.

Finally, in the third step, the procedure under the same conditions was repeated again but on about 30 g of zeolite, which was taken from the total zeolite amount produced in the second step. The exchanged ammonia zeolite were filtered off, washed with deionized water to be free of chloride ions dried overnight at 120oC and then calcined initially at 150°C for two hours. The temperature was increased 75°C per hour until it reached 550°C and it was held constant for 5 hours at this temperature. During calcination, ammonia and water were liberated and promoted zeolites which are (B+3HY-zeolite, Ba+2HY-zeolite, Be+2HY-zeolite, Bi+3HY-zeolite and Se+4HY-zeolite) were formed [11].

5.1.1 Catalytic Activity of Synthesized Catalysts

The catalytic activity of synthesized promoted zeolite type Y catalysts was studied by applying n-heptane isomerization reaction. The n-heptane isomerization reaction was carried out in a laboratory isomerization unit shown in Figure 9 and Figure 10. This is achieved in a packed bed catalytic reactor of laboratory isomerization unit. The n-heptane supplied from Sigma Aldrich Co. and used as a raw material for isomerization process. The isomerization of n-heptane experiments were carried out in a laboratory isomerization unit at a temperature range of 300 to 400°C and atmospheric pressure for different quantities of prepared zeolite type Y catalysts. The n-heptane is evaporated at its normal boiling point and pre-heating the vapour before passing into the reactor which contains a known quantity of prepared zeolite type Y catalyst sample between two layers of glass wool and glass balls. The product vapour will be cooled in the condenser and condensed in the ice bath.

After that samples of product collected to be tested by gas chromatography device (GC) (Dani, Model GC 1000 DPC). The isomerization results of n-heptane over six prepared zeolite type Y catalysts are given in Table 6. Results listed in Table 5 were calculated based on concentration of n-heptane in the output of the reactor measured by gas chromatography GC investigation with corresponding input of 99% n-heptane purity by equation (1):

Conversion (wt%) = ((Initial weight of n-heptane)-(final weight of n-heptane)) / (Initial weight of n-heptane)...(1)

5.2 Employment of used Iraqi rice husk as a rodenticide

IRH waste which were adsorbed mineral (B, Ba, Be, Bi, and Se) ions from SSAS at different operating conditions were segregated and classified according to it’s contain of above mineral ions individually and avail from these remaining samples as a rodenticide without any treatment. The samples give different ratios of mineral ions to IRH. The ratios were between (0.05 to 5.5 wt %) for mineral (B, Ba, Be, Bi, and Se) ions individually. Before the treated IRH wastes with the above mineral take to the rats, the rats were left for one week and nurtured with normal feed to make sure that rats were not suffer from anything leading to death. After that the rats nurtured with treated IRH wastes with mineral (B, Ba, Be, Bi, and Se) ions individually, the results were fate the rats in a different periods as shown in Table 6. The inorganic pesticide, is one of the most important type of pesticide used in rodent control, and perhaps the most important components used in this field are cobalt, mercury, lithium, phosphorus, fluorine and aluminum inorganic compounds. There are several ways to use these pesticides, which can be used by spraying the vegetative plants, in rodents places passing where the pesticide inter to the mouth of the rodent when

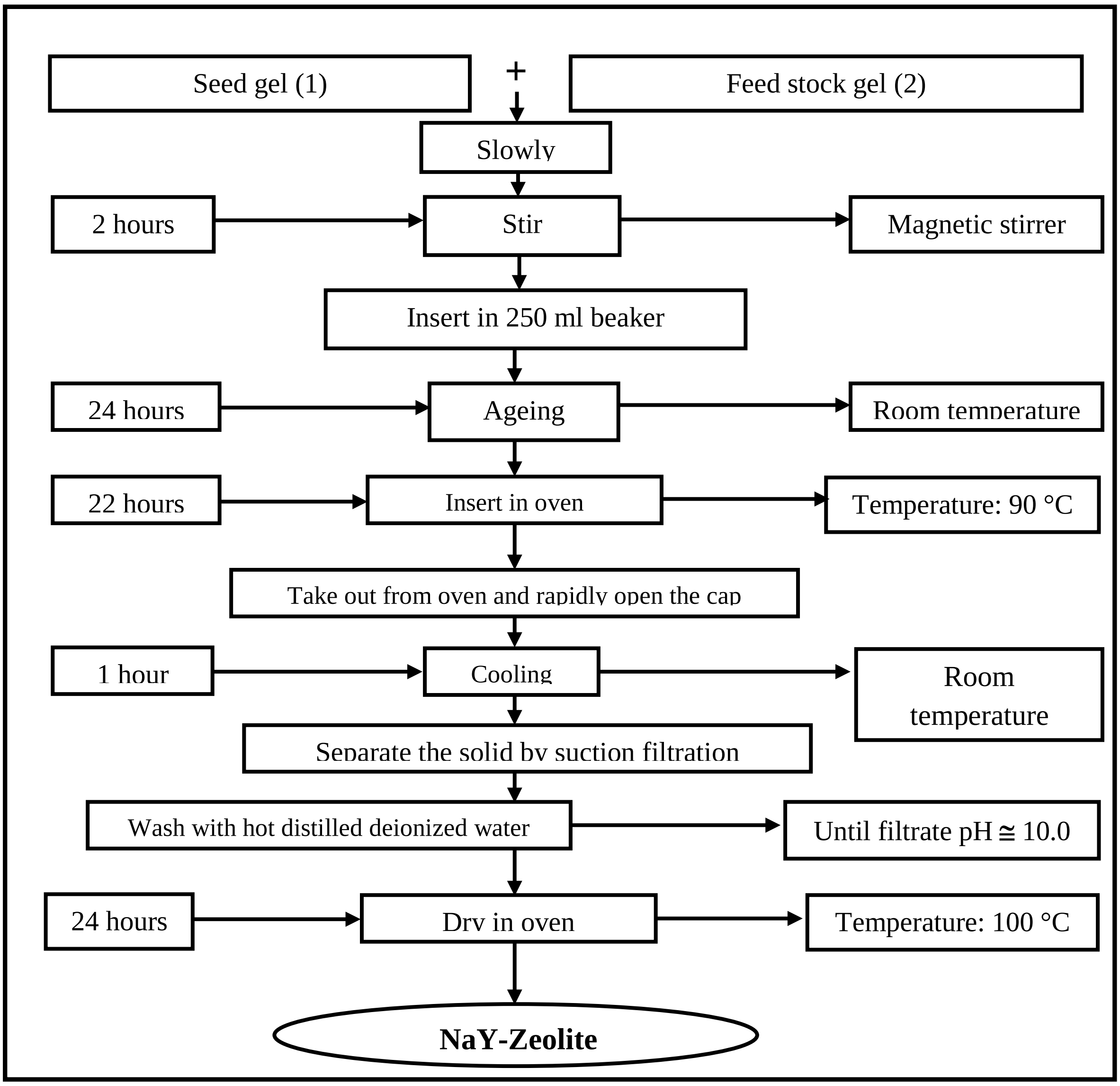

Figure 7: Flow Chart of the Synthesis of Type Y-Zeolite Catalyst Using Iraqi Rice Husk [9]

its clean parts of their bodies, or through mixing with attractive materials to rodent like rice husk or bread or vegetables pieces. Characterized compounds of this rodenticide being used successfully to combat rodent and where they are used as toxin infectious for their secured effectiveness, and severity of toxic, in addition to non-degradable and remain for a long time without changing their composition. There is more than one way to interpret the mechanical toxic effect of these elements compounds on rodents, which are:

1 – The compounds of these elements operate to prevent the phosphorylation process of Adenosine diphosphate (ADP) material in the process of oxidative phosphorylation and thus preventing the formation of Adenosine triphosphate ATP material necessary in the storage of energy required for the rodent.

2 – Theses compounds linked with many important enzymes required from the rodent body and discourage work, and these enzymes are dehydrogease, cytochrome oxidese, phosphatase where these inhibition process lead to an imbalance in the processes of chemical or biological eventually lead to the death of the rodent.

3 – The high concentrations of elements compounds lead to a deposition holistic and very fast for a protein in a living cell because it attack the sulphur bonds, which plays an important role in keeping the distinctive shape of the protein, it observed that the effect of these elements compounds are concentrated in the epithelium in the central gut of rodents.

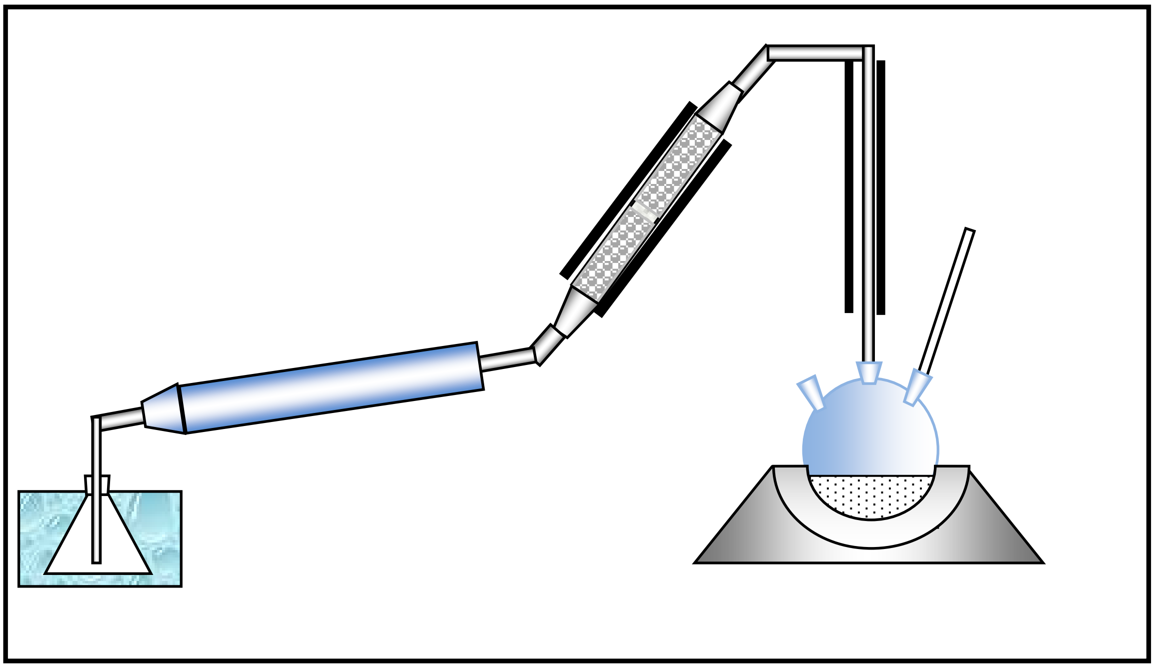

Fig. 8: Isomerization unit [12]

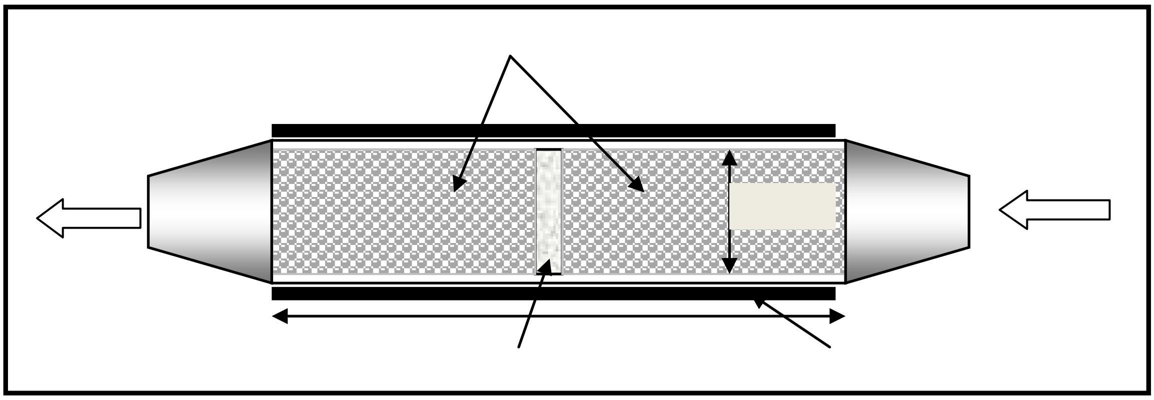

Fig. 9: Isomerization unit reactor [12]

4 – The low concentrations of these elements compounds leading to excessive drowsiness and lack of movement and the collapse of immune system and the failure of the ability to reproduce (infertility) of the rodent

6.3 Employment of used Iraqi rice husk in electric generation as a low value material

In many agricultural countries producer of rice, such as Thailand, Malaysia, Sri Lanka and others [13, 14], the of residual rice husk are used in the generation of electrical energy, so it is possible to use IRH to remove minerals from wastewater before using it in the production of electrical power and thus we have achieved two benefits from the use of IRH and contributed to reducing the use of fossil fuels and thus preserve the environment in a more convenient and economical way by getting rid of two pollutants by one material.

6 Conclusion

The following conclusions can be drawn:

IRH showed a good ability to remove mineral from SSAS using fixed bed adsorption unit. So, it could be recommended for removal of mineral ions from treatment plant wastewater in Iraq instead of other material like activated carbon because it is valid, cheaper, economical, easy and simplicity for using, and has a high ability to adsorb mineral ions, can be used several times by costly regeneration method and can be used finally in another benefit uses. Maximum removal of mineral ions were (98.72,

Table 5: n-heptane isomerization using prepared zeolite catalysts @ 350°C

Catalyst of mineral ions to Iraqi rice husk Ratio (0.5%)	Substances (wt%)								
	Propane	Butane	Isobutane	2,4-Dimethyl Pentane	2,3-Dimethyl Pentane	2-Methyl hexane	3-Methyl hexane	n-Heptane (isomerizes)	n-Heptane (unreacted)
HY-zeolite	3.11	1.65	2.03	–	–	–	0.66	7.45	92.55
B^{+3}HY-zeolite	0.05	0.18	3.57	17.35	15.37	3.85	5.75	46.12	53.88
Ba^{+2}HY-zeolite	0.02	0.16	2.73	15.66	14.26	4.11	6.32	43.26	56.74
Be^{+2}HY-zeolite	–	–	3.15	17.46	15.44	3.60	9.83	49.48	50.52
Bi^{+3}HY-zeolite	0.03	0.03	4.08	16.52	18.61	–	–	39.27	60.73
Se^{+4}HY-zeolite	0.01	0.12	2.97	16.57	14.09	–	–	33.76	66.24

Table 6: Hours lead to kill rat when it nurtured with treated Iraqi rice husk

Mineral ion adsorbed on Iraqi rice husk	Mineral ions (B^{+3}, Ba^{+2}, Be^{+2}, Bi^{+3}, and Se^{+4}) to Iraqi rice husk ratio (wt%)								
	0.05	0.5	1	2	3	4	4.5	5	5.5
Boron, (B^{+3})	96	73	62	53	48	36	24	12	10
Barium, (Ba^{+2})	132	96	48	40	30	18	15	9	7
Beryllium, (Be^{+})	–	126	96	48	36	24	12	10	8
Bismuth, (Bi^{+3})	–	240	180	96	73	24	12	8	5
Selenium, (Se^{+3})	120	96	80	48	26	18	9	7	3

95.09, 96.84, 97.75, and 96.76,) % for mineral (B, Ba, Be, Bi, and Se) ions respectively, at initial mineral ion concentration of 1 mg/l. The percentage removal of mineral ions was increased with decreeing flow rate of SSAS and initial concentration of mineral ions while the percentage removal was increasing with increasing of treatment time and the height of adsorbent material (IRH). For pH the percentage removal was decreased with increasing pH for (B and Bi) and Increased with increasing pH for other mineral ions.

It can be prepared a promoted catalyst (which is zeolite type Y) for isomerization process from the residual samples of IRH that adsorb the mineral ions (B, Ba, Be, Bi, and Se) from SSAS to produce a fuel of higher octane number and remove the hazards waste causes carcinogenic in economic and eco-friendly method.

It can be prepared a rodenticide for rodent control from the residual samples of IRH that adsorb the mineral ions (B, Ba, Be, Bi, and Se) from SSAS.

It can use the IRH for generated electric power after using it to remove the mineral ions from wastewater, thus we getting rid of two pollutants by one material in an economical and eco-friendly method.

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