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Study about efficiency of nitrate removal from water by activated carbon prepared by pistachio, walnut and almond shells

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Abstract

Materials that are used for preparing activated carbon are very important on adsorption ability of the activated carbon. Chip agricultural waste, same as nut shells successfully can be used for preparing activated carbon .the abject of this research is comparing characteristics of activated carbon that are prepared by pistachio, walnut and almond shells in removing nitrate from aqueous solutions. Various samples of activated carbons was prepared by pistachio, walnut and almond shells .chemical activation was done by zinc chloride with weighting rate equale150%.the effect of PH ,Nitrate concentration, reaction time on efficiency of nitrate removal ,also was investigated. The results show the efficiency of nitrate removal for three nut shell consist of pistachio, walnut and almond shells were respectively,45.74%,41.7% and43.49%.most nitrate removal was happened on PH equal 8 for pistachio and PH equal 2 for walnut and almond shells. As the conclusion, activated carbon prepared by chip agricultural waste such as pistachio, walnut and almond shells have can be used for increasing the water quality. Carbon active that prepared by pistachio shell have better result on nitrate removal comparing to walnut and almond shells.

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Introduction

Nitrate is one of the most important pollutants in water supply systems. Nitrate also is one of the essential elements in increasing in algal population. In infants, nitrate can cause methaemoglobinemia, commonly known as "blue baby syndrome" (Shrimali and Singh ,2001). Recent studies have found that nitrate can cause diabetes. (Bhatnagar and Sillanpää ,2011). High concentration of nitrate in drinking water can cause cyanosis and cancer of the alimentary canal, creating a potential public health risk. (Lohumi et a.,2004). The(WHO,2004b) has established a drinking5water guideline value (short5term exposure) for nitrate and nitrite of 50 mg/L and 3mg/L, respectively, to protect against aemoglobinaemia in infants.

The following treatment processes have been studied or applied to remove nitrate from drinking water: biological de-nitrification, ion exchange, reverse osmosis, electro dialysis, chemical de-nitrification, chemical reduction and adsorption.(Nassar .,2012). Various agricultural solid waste have been used for preparing activated carbon some of this waste are consist of peach stones, (Attia *et al*.,2008) apricot stones,(Gergova and Eser .,1996) bagasse, (Valix *et al*.,2004) pecan shell, (Guoans and, Rockstraw ,2007) almond shells, (Toles *et al* .,2000) Rice husk,(Chuah *et al* .,2005) waste tea, (Yagmur *et al*.,2008) corncobs, (Hendawy *et al*.,2001) cotton-seed, (Pütün *et al*.,2006) Olive stones,(El-Sheikh *et al*.,2004) sawdust, (Rafatullah.,2009) coconut shells,(Azevedo *et al*.,2007) nutshells, (Arjmand.,2006) bamboo scaffolding, (Cheung *et al*.,2006) grape seeds (Al Bahri*et al* .,2012) hard shell of pistachio(Eksiri,2004).

Pistachio, walnut and almond are the most important agricultural production in Iran And so there are high productions of this e product shells as agricultural solid waste. As the Chip agricultural wastes successfully can be used for preparing activated carbon .the abject of this research is study of characteristics of activated carbon that are prepared by pistachio, walnut and almond shells in removing nitrate from aqueous solutions.

Material and methods

In this research Sirgan pistachio sell, walnut and almond shells were used as raw materials. The method of activation was similar to previous study that was done in preparing activated carbon using from pistachio sell.(Eksiri.2004).

At first grinding of pistachio sell was done. It sieved in a sieve mesh equal 70. The sieve pistachio sell was washed with deionized water and dried in an oven in 150c .the 60gr of powder of shell, were mixed by stirring with90 gr zinc chloride solution(5 molar) in 200ml glass container. mixing was done in 12hr.the mixture put in an oven with 20c for 24hr.after drying chemical-loaded samples were then carbonized at varying temperatures ranging from 450°C to 750°C.a flow of nitrogen gas in flow of 100ml/sec was passed from the mixture .cooling was done with nitrogen gas and the samples existed from the oven. The carbonized Products were washed with deionized water, to remove until removing the zinc chloride and to adjust the pH in the range6-7.The final product was dried in an oven at 110°C and stored in a desiccator for further use. This process was done also for walnut and almond shells. For examination of nitrate adsorption, various concentrations of nitrate between (50-200mg/l) were prepared using potassium nitrate. an unit of *spectrophotometer* (Hach-DR-2800)was used for measuring of ion nitrate as standard method. The effect of pH on nitrate adsorption was investigated in pH(2-5).HCl and Na OH were used for adjusting the pH. The adsorption temperature was 20c.The acrobats were increased to nitrate solutions (50mg/l and100mg/l) after optimization of pH. The samples and adsorbent were shaked for 2 hr.

For investigating about kinetic process of nitrate adsorption, one gram of adsorbent was increased to nitrate solution (50mg/l and 100mg/l) .pH was optimized .nitrate concentration was examined in various times. First and second order models were used for study of kinetic adsorption in adsorption

test, one gram of pistachio carbon active was increased to nitrate solution in various concentration(50mg/l and 100mg/l). PH was optimized. And the container was shaked for 24 hr. The primary and finally concentration of nitrate were examined. The amount of adsorption in equilibrium q_e (mg/gr) was calculated in equation 1.The data were analyzed by Langmuir and Freundlich equations.

$$q_e = \frac{(C_0 - C_e)V}{W} \quad (1)$$

C_0 And C_e is the nitrate concentration in the first and after equilibrium (mg/l) V, is volume of solution W is the mass of dry adsorbent (gr).

Nitrate removal from water by activated carbon prepared by pistachio, walnut and almond shells was examined. 1 gr of each adsorbent (pistachio, walnut and almond shells) were increased to nitrate solutions. After adjusting the pH, the samples were shaked 2hr and at last nitrate were measured).

Results and discussion

As the figure 1 show, pistachio shell activated carbon have higher adsorption compare to walnut and almond shells. All shells have notice ability in adsorption.

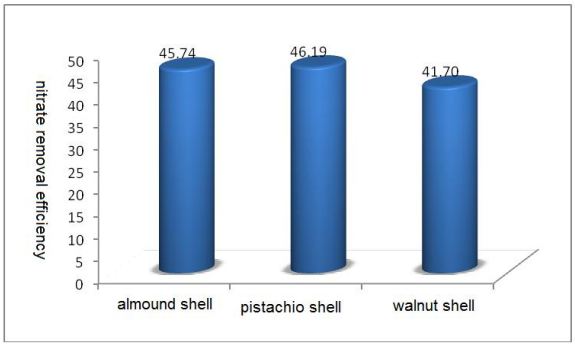

Fig. 1. Nitrate removal efficiency for activated carbon from pistachio, walnut and almond shells.

The effect of pH on nitrate removal is shown in fig 2. The maximum removal efficiency for pistachio is happened in pH equal 8.

The f Effect of contact time on nitrate removal efficiency is shown in fig3.this fig shows that the maximum adsorption is done in the first 15 minutes. After 15 minutes, concentration of nitrate is remain constant.

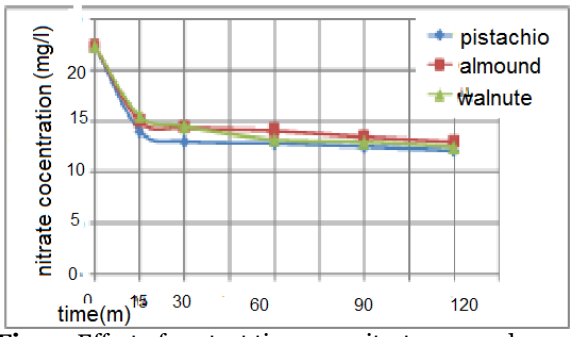

Fig. 3. Effect of contact times on nitrate removal.

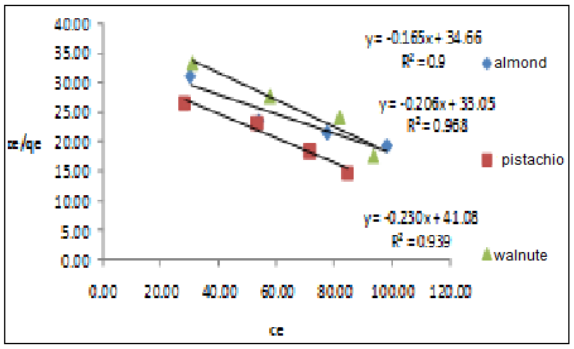

Fig. 4. Langmuir model for adsorption of sell.

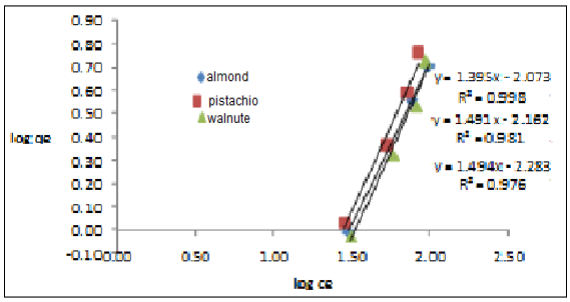

Fig. 5. To Freundlich model for adsorption of shells.

The reason of decrease the rate of nitrate removal after 15 minutes is that at first there are many holes in the activated carbon. But after 15 minute this holes will be fill with nitrate iones.so by increasing time of contacts, active place in surface of carbon active will decrease. Isotherm studies were carried out and the data were analyzed by Langmuir, Freundlich equations the results are shown in the fig4 and 5.by comparing the coefficient of determination (R^2), can conclude that all of samples are more near to Freundlich equations.

Conclusion

It can concluded that by activated carbon prepared by pistachio, walnut and almond shells are adequate material for decreasing the nitrate in water. Using from this shells decrease agricultural solid waste and these kind of carbon actives are economic. The contact time is short(contact time is 15 minutes) and so volume of reactor will be small. Some time by decreasing of 45% of nitrate, its concentration will reach to standard limits. The optimum PH is 8 and it is more practical that this kind of shells don't need to increase acid or base.

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