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Elaboration of peach pit and olive pit activated carbon for cyanide adsorption

Elaboração de carvão ativado de caroço de pêssego e caroço de azeitona para adsorção de cianeto

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ABSTRACT
In the present research, activated charcoals were made from peach pits and olive pits. The peach pit was activated with 30% phosphoric acid followed by a heat treatment of 550°C under a controlled atmosphere and the olive pits with hydrogen peroxide$_{H2O2}$ and 30% potassium hydroxide. Subsequently, adsorption isotherms were carried out with the aim of adsorbing cyanide, metals and organic compounds from mining effluents. It was concluded that cyanide adsorbs on the surface of the activated charcoal of peach and olive peach and olive pits, mainly due to the functional groups that coexist on the surface of the latter.

Keywords: Activated charcoal, Peach pits, Olive pits.

1 INTRODUCTION

Activated carbons are manufactured by pyrolysis of carbonaceous materials of plant origin, such as wood, charcoal, peat, stones and fruit shells, or synthetic polymers or phenolic compounds, after which the activation of these. This route is known as heat treatment or physical treatment as it involves two stages of treatment. An alternative route is chemical activation and consists of a single stage of heat treatment comprising decomposition and activation measures. For many decades, zinc chloride has been the chemical of choice as an activatant, but it was replaced by phosphoric acid in the past decade (1, 2). Phosphoric acid activation offers many advantages as it only requires a single pyrolysis step at a much lower temperature (400-600°C) and most impregnation can be recovered by several extraction steps.

Any carbonaceous material with high carbon content and low ash content, natural or synthetic, can be used as a precursor for the preparation of activated carbon.

Several factors are considered when choosing a suitable raw material. Industrially, a low-cost material with high density and sufficient volatiles available in large quantities, is usually more accepted in the market. Classic examples as raw material for charcoal production such as wood shell, coconut shell charcoal are still in use (3). However, this material is not widely found in most countries that turn their eyes to other locally more abundant and very inexpensive sources.

From these sources, agricultural waste and derived products are fascinating and meet most of the required properties, as they are endowed with high carbon content and low inorganic content, and they are also renewable materials that are generated in large quantities every year.

To this end, a more detailed review on the suitability of agricultural waste for the production of activated carbon has been published by Heschel and Klose (4), consequently a large amount of raw material of botanical origin has been widely studied, such as wood bagasse (5), fruit stones, coffee beans (6), cotton stem (7), olive stones (8) and many others.

In relation to impregnation with phosphoric acid, lignocellulosic material, among others, indicates that the optimal temperature range is 400-500°C and turned out to be the optimal range for the development of high quality and better adsorption capacity of activated carbons (9).

Cyanides, considered among the most toxic compounds for humans and nature, are discharged by several industries, particularly chemical synthesis plants (nylon, fibers, resins, and herbicides), metallurgical processes (gold and silver extraction), and plant and surface finishing (10) Algerian standards limit their rejection to 0.1 mg/L in wastewater (Official Gazette of the Republic of Algeria, 1993). Several processes can be used for the removal of cyanide compounds in solutions and suspensions (11-18). The alkaline coloring process is very effective, and was at one point the most widely used.

In the present research, the activated carbons developed were prepared from peach pits, both natural and activated with 30% phosphoric acid, followed by a heat treatment of 550°C under a controlled atmosphere and the olive pit with hydrogen peroxide and potassium hydroxide. Adsorption capacity testing of the solution was carried out by determining adsorption isotherms with the aim of evaluating the possibility of adsorbing cyanide, metals and organic compounds from mining effluents.

2 EXPERIMENTAL DEVELOPMENT

2.1 PEACH PIT AND OLIVE PIT MILLING

First, samples of olive and peach pits were taken, with a total weight of 10g each and was ground for 2 hours at a speed of 20 rpm, to observe what was the best grinding time, with 0.5 hours of rest for each hour of work. This experimentation was carried out with the intention of finding the best grinding time.

The steel components and balls were loaded into a stainless steel vial, the grinding was done in a Restch mill to produce powder from the different samples to be treated, the total weight of the sample was 10g.

In the mechanical grinding process, it was necessary to consider 0.5 hours of rest for each hour of work, which was due to the heating of the mill motor. Once a large amount of powder was obtained from the product of the mechanical grinding, it was stored in glass vials with lids to avoid any contamination.

Figure 1 Restch Mill.

Mill.

Vial.

Parameters.

2.2 HEAT AND CHEMICAL TREATMENT OF PEACH PIT AND OLIVE PIT ACTIVATED CARBON

2.2.1 Preparation of activated carbons by physical activation

After grinding in the RESTCH it is placed in crucibles in a muffle furnace at 800°C for 1 hour. The samples were then cooled to room temperature

2.2.2 Preparation of activated carbons by chemical activation

For chemical activation, the peach and olive pit that comes from physical activation is impregnated with a solution of phosphoric acid, hydrogen peroxide and potassium hydroxide for a period of time of 24 hours at room temperature.

Finally, the samples were carbonized at 550°C for 1 hour, when cooled they were washed with Tridistilled water to neutral pH, then the sample was dried in an oven at 110°C, and packaged for later use.

2.3 ADSORPTION OF CYANIDE ON ACTIVATED CARBON FROM PEACH PIT AND OLIVE PIT

- Activated carbons from physical and chemical activation are weighed
- Deionized water was prepared, adjusting the pH to 12.
- After adjusting the deionized water to a pH of 12, mixtures with CN were prepared. In a 250 ml beaker with 100ppm CN.

Figure 2: Adsorption of cyanide with carbon.

Stirring 1g of charcoal in 250ml of CN

Milling

Charcoal.

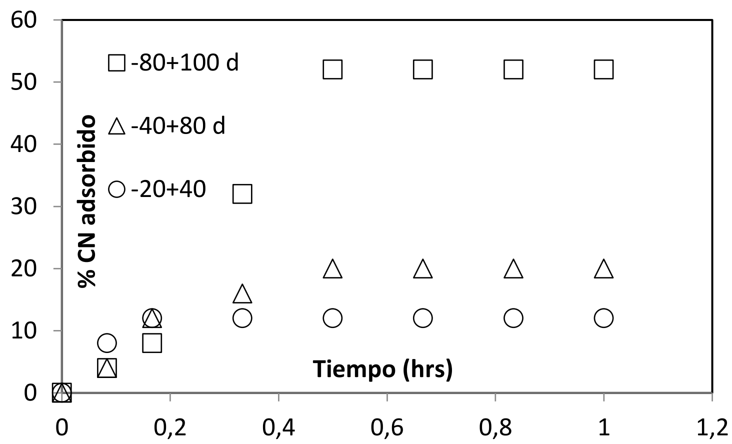
Cyanide adsorption experiments with activated carbon from olive pit and peach pit were carried out in a 600 mL beaker containing 250 mL of reactive grade cyanide and deionized water, adjusting the pH to 12 with a NaOH solution as shown in Figure 2. The system was kept in constant agitation throughout the experiment. The progress of the process is continuously monitored by changing the cyanide concentration. The agitation was regulated by a magnetic stirrer placed inside the beaker and actuated by means of a magnetic stirring grid; The cyanide extracted from the process was determined with silver nitrate titration according to the APHA-AWWA 4500-CN D method.

3 DISCUSSION OF RESULTS

3.1 PEACH ACTIVATED CHARCOAL RESULTS

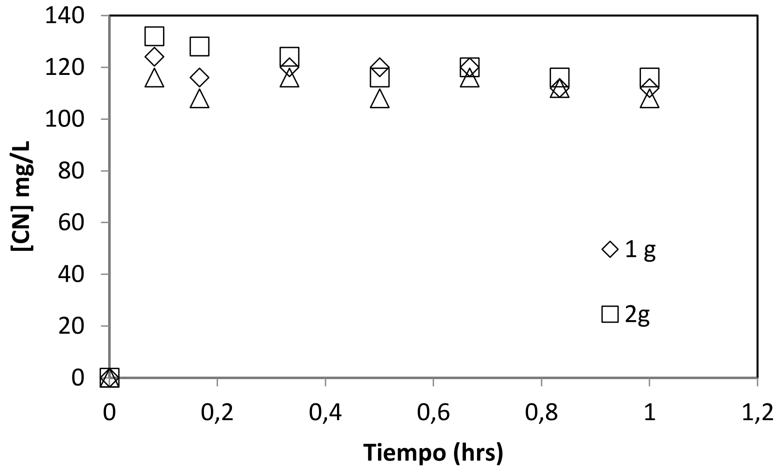
The results obtained in the study of the effect of particle size are shown in Figure 3. It is observed that the smaller the particle size, the higher the concentration of cyanide; This is because smaller particle size there is more surface area available for cyanide adsorption to take place: adsorption was 53% for a particle size of -80+100 at a time of 1 hour.

Figure 3.- Effect of particle size on adsorption of 200 ppm cyanide.



In the following diagram, an evaluation of the amount of peach pit charcoal added to the experiment was made and it was also taken into consideration that the particle size that best adsorbed was used in the process; selecting the size -80+100, and we got Figure 4 where it is shown that the greater the number of grams added to the solution, the greater the adsorption of cyanide

Figure 4.- Evaluation of the number of grams added at particle size of -80+100.



In relation to the activation of the peach stone charcoal with phosphoric acid, it was put in contact with the cyanide solution and an adsorption of 90% was achieved on the surface of the peach stone as shown in Figure 5, it is mainly predicted that this good adsorption is due to the phases it presents according to the characterization (Table 1). And also, since these phases have positive charges and the cyanide ion is negatively charged, therefore they make a good attraction.

Figure 5.- Comparison of modified peach pit and unmodified peach stone

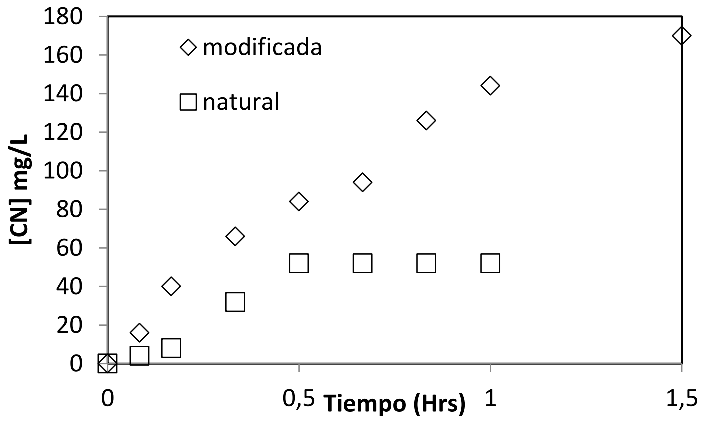


Table 1.- Phases present in peach pit charcoal

Phase Name	Elements present in the phase
Tridmite	Silicon Oxide
Armstrongite	Calcio, Silicon
Sugilite	Sodium
Pio Width	Sodium

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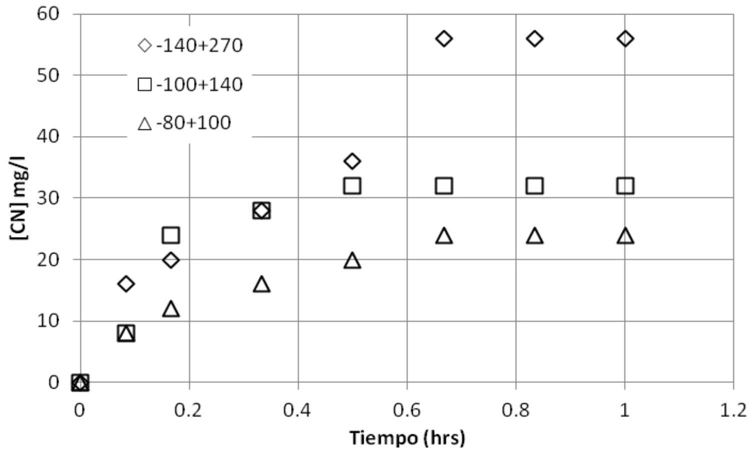
3.2 RESULTS OF OLIVE PIT ACTIVATED CHARCOAL

The results obtained in the study of the effect of particle size are shown in Figure 6. It is observed that the smaller the particle size, the higher the concentration of cyanide; This is because with a smaller particle size there is a greater surface area available for cyanide adsorption to take place: adsorption was 58% for a particle size of -140+270 at a time of 1 hour.

Figure 6.- Effect of particle size on the adsorption of 200 ppm cyanide



In relation to the activated olive stone charcoal with hydrogen peroxide and potassium hydroxide, this was put in contact with the cyanide solution and 85% was adsorbed on the surface of the olive stone as shown in Figure 7, the maximum adsorption that was achieved is mainly due to the phases it presents according to the characterization (Table 2). And also, since these phases have positive charges and the cyanide ion is negatively charged, therefore they make a good attraction.

Figure 7.- Adsorption of cyanide in original and modified olive stone charcoal in a solution of 200 ppm cyanide

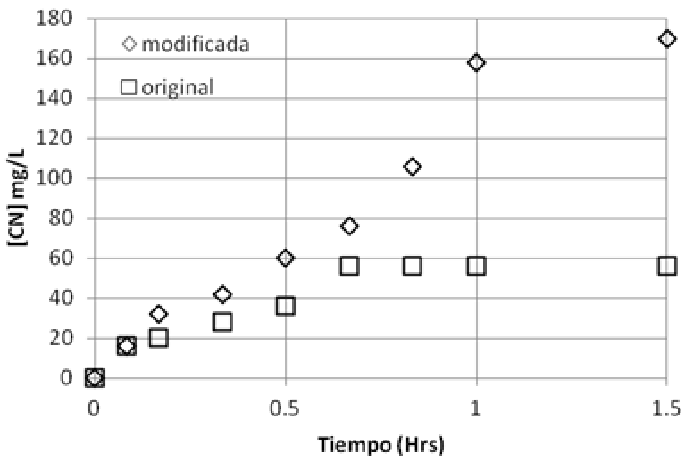


Table 2.- Phases present in olive stone charcoal

Phase Name	Elements present in the phase
Levyne	Na, K, Ca
Barrerite	K, Na, Ca
Stock	Na, Al, Yes
Stellerite	Ca, Al, Yes

3.3 RESULTS OF CHARACTERIZATION OF ACTIVATED CARBONS BY MEANS OF X-RAY FLUORESCENCE

Table 3. Olive pit charcoal

Component	Percentage
Al	.204
Si	.156
Ca	6.394
S	.340
Fe	.203
P	.232

Table 4. Peach pit charcoal

Component	Percentage
P	.546
S	.546
Si	.117
K	9.014
Ca	2.524
Fe	.496
Cu	.059

A characterization of the carbons manufactured in the research was carried out and the highest percentage of adsorption was the peach pit due to the cyanide-related components, this due to the chemical interaction by ion exchange with copper and iron, this has also been reported by several researchers with different bones.

4 CONCLUSIONS

4.1 PEACH PIT ACTIVATED CHARCOAL

It can be concluded that cyanide adsorbs on the surface of peach pit activated charcoal as it is an effective material for its removal.

Thanks to this previous work, it gives us the guideline to study the use of peach pits for adsorption of metals that are present in effluents and, on the other hand, the use of peach peach kernels in the adsorption of cyanide as well as for the destruction of compounds harmful to the environment and health.

4.2 OLIVE PIT ACTIVATED CHARCOAL

It can be concluded that cyanide adsorbs on the surface of olive pit activated charcoal mainly due to the functional groups that coexist on the surface of the olive pit.

This research and the modifications that were achieved on the surface surface of the bone, we can adsorb as many metals or other organic ions in effluents.

4.3 X-RAY FLUORESCENCE CHARACTERIZATION

The carbons manufactured in the research had the highest adsorption of peach peach due to the cyanide-related components, due to the chemical interaction by ion exchange with copper and iron, which the olive pit does not have.

REFERENCES

J. Laine, S. Yunes, Carbon 30(1992) 601.

B.S. Girgis, A.N.A. El –Hendawy, micropor.mater. 52 (2002) 105.

R.C. Bansal, J.B.Donnet, F. Stoeckli, Active carbon, Marcel Dekker , Inc., New York and Basal, 1998.

W. Heschel, E. Klose, Fuel 74 (1995) 1786.

B.S. Girgis, L. B. Khalil, T.A.M. TawfiK, J. Chem. Technol. Biotechnol. 61 (1994)

H.F. Stoeckli, carbon 28 (1990)

B.S Girgis, M.F. Ishak, Mater. Lett. 39 (1999) 107.

L.B. Khalil, B. S. Girgis, T.A.M . Tawfik, Adsorp.Sci. Technol. 18 (2000) 373.

H. Teng, T.-S. Yeh, L.-Y. Hsu, Carbon 36 (1998) 1387.

Botz, M., Mudder, T., Akcil, A., 2005. Cyanide treatment: physical, chemical and biological processes. In: Adams, M. (Ed.), Advances in Gold Ore Processing. Elsevier Ltd., Amsterdam, pp. 672–702 (Chapter 28).

Faria, P.C.C., Orfao, J.J.M., Pereira, M.F.R., 2005. Mineralisation of coloured aqueous solutions by ozonation in the presence of activated carbon. Water Research 39 (8), 1461–1470.

Georgi, A., Kopinke, F Mackenzie, K., Battke, J., Kopinke, F.D., 2005. Catalytic effects of activated carbon on hydrolysis reactions of chlorinated organic compounds. Part 1. g-Hexachlorocyclohexane. Catalysis Today 102–103, 148–153.

Mudder, T.I., Botz, M.M., 2004. Cyanide and society: a critical review. The European Journal of Mineral Processing and Environmental Protection 4 (1),
62–74.

Mudder, T.I., Botz, M.M., Smith, A., 2001. Chemistry and Treatment of Cyanidation Wastes, second ed. Mining Journal Books Ltd., London.

Ubago-Perez, R., Carrasco-Marin, F., Fairen-Jimenez, D., Moreno-Castilla, C., 2006. Granular and monolithic activated carbons from KOH-activation of olive stones. Microporous and Mesoporous Materials 92 (1–3), 64–70.

Kula, I., Ugurlu, M., Karaoglu, H., Celik, A., 2008. Adsorption of Cd(II) ions from aqueous solutions using activated carbon prepared from olive stone by ZnCl2 activation. Bioresource Technology 99 (3), 492–501.

Lucking, F., Koser, H., Jank, M., Ritter, A., 1998. Iron powder, graphite and activated carbon as catalysts for the oxidation of 4-chlorophenol with hydrogen peroxide in aqueous solution. Water Research 32 (9), 2607–2614.

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Mackenzie, K., Battke, J., Kopinke, F.D., 2005. Catalytic effects of activated carbon on hydrolysis reactions of chlorinated organic compounds. Part 1. g-Hexachlorocyclohexane. Catalysis Today 102–103, 148–153.