"Active Carbon Obtained from Cob by Chemical Method"

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Abstract – *The Zahuapan river is the main flow source in Tlaxcala´s State. Until a few decades ago it was possible the organism's development as, amphibians, fish, among others. Industrial growing, agricultural activities and demographic growth have contributed to the contamination of this affluent, to such a degree that present the rivers functions as a drainage channel, transporting pollutants generated by industry, municipalities (gray water) and agriculture, constituting a risk to human health, considering that it crosses the entire state. Pollution in the Zahuapan River is latent, and the content of pollutants is innumerable. According to a study carried out by National Polytechnic Institute in 2019, the river contributes eight tons of pollutants per day. Given the lack of water and the increase in gray water, it is necessary to take measures to recover the quality of the river water, for this porpoise, we focused our study, it is on the absorption from activated cob carb to use in the purification of gray water. In this study, it obtained an active carbon using cob (agro-industrial waste residue). The carbon is obtained by pyrolysis, pulverizing the carbon and activating it by means of a thermal treatment, from which the activated filter is obtained, designed to receive discharge of gray water, allowing the removal of colorants and thus contribute to the decrease in the concentration of pollutants in the tributary.*

The product obtained is an excellent adsorbent of colors demonstrated in the adsorption tests of methylene blue, being noticeable only by simple observation. By making the column with activated carbon obtained from corn cob, it allowed us to purify gray water from a household discharge, in Apizaco, Tlaxcala, so that through this activated carbon it could reduce the pollutants discharged to the Zahuapan river and improve the quality of life of the inhabitants.

Key Words: active carbon, Maize cob heart, gray water.

1.INTRODUCTION

Increasing economic, social, technological development, and in particular, industrialization, have led to major environmental degradation, including water pollution. Although it is a renewable resource, the high percentage of contamination prevents it from being suitable for human consumption and some other activities such as agriculture, due to the fact that its use can have a harmful effect on public health and for the organisms that live in it.

Tlaxcala is one of the smallest states in Mexico, it is there where the Zahuapan river is located, this river is one of the four most polluted in Mexico [1]. From the 26 parameters evaluated by the NOM- 001-SEMARNAT-1996, most of them are above the permitted levels, this is because, in different parts of the river, pollutants that come from industrial processes and human settlements are being dropped.

Referring to Tlaxcala, the textile industry has an important contribution to the process of water resources pollution, because it develops large volumes of wastewater contaminated with dyes, which, due to their high molecular weight, their complex structures, and especially their high solubility in water, show great persistence in the environment, generating serious problems due to the implications it has for both public health and ecosystems. On the other hand, the discharge of these substances into aquatic systems impedes the normal development of plants because they inhibit photosynthesis.

Effluents containing azo dyes, even in small concentrations, cause a strong opacity in the water and thus prevent light from passing through this contamination, inducing eutrophication of the medium. This has a great impact, as the animal and plant species present in these bodies of water die in most cases [1].

Several alternatives for wastewater treatment have been studied; within which stand out; biological processes, advanced oxidation and physicochemical processes; such as: membrane filtration systems, silica sands and activated carbon [3]. The latter has a porous structure that contains small amounts of different heteroatoms such as oxygen and hydrogen, which interact with carbon atoms, generating functional groups that subserve the absorption mechanism.

The mechanism for decontamination of wastewater by activated carbon is physical, which allows the pollutant to be desorbed once it has been saturated, due to the reversible nature of this type of absorption.

To obtain activated carbon, "Olote" (Maize cob heart) was used, which has a high xylene content (28-35% dry base), and in lower concentration, lignin, cellulose and hemicellulose. This is an agricultural waste or by-product that is generated in large quantities in the process of cob grain, this is the result of the corn cultivation that is produced in the state and it is estimated that for each ton of corn it generates 17kg of by-product. Obtaining activated carbon through the use of maize cob heart cam mainly benefit agricultural producers in the state of Tlaxcala, allowing to convert a waste material into a product for the adsorption of dyes and pollutants in wastewater discharges.

The objective of this project is to establish a protocol for the production of activated carbon by chemical method for maize cob heart and to evaluate the ability to remove dyes in wastewater.

2. METHODOLOGY

The maize cob heart was obtained from the residues of the corn crop in the municipality of Apizaco, Tlaxcala. The plant material was washed with distilled water and dried in drying oven for 24 hours to 100°C, once processed there were stored in hermetic container and was subjected to the pyrolysis process, by gradually increasing the temperature from 10°C/min to 850°C [9], the material was pulverized and sieved until a particle size of 3-5 mm was obtained.

To improve absorption capacity, the carbon obtained was activated by a chemical treatment of phosphoric acid [7]. The impregnation was carried out at 85°C for 2 h with 40% phosphoric acid solution, after treatment, the samples were heated to 600°C, with a temperature increase of 8°C/min. Subsequently, the samples were washed with distilled water and constant stirring, the water was changed every 24 h until the pH of the sample was 7. Finally, the material obtained was dried at 105 +- 5°C during 24 h, with the purpose to eliminate humidity in the samples, as you can see in Figure 1.

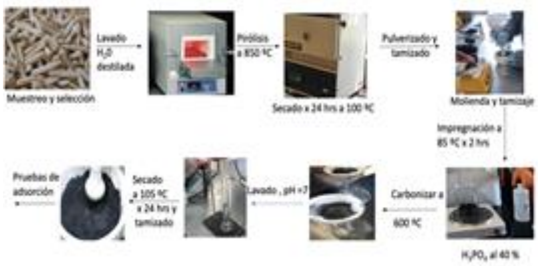

Fig 1.- Methodology for obtaining activated carbon from maize cob heart.

The methylene blue absorption analysis was performed to determine the absorption capacity of activated carbon. A 1% w/v methylene blue stock solution was prepared in a volumetric flask. From this solution 1 cc was taken and gauge to 1000cc, this second solution is called a control solution.

One gram of dry base activated carbon was weighed, mixed 100 ml of the control solution in a 250 ml Erlenmeyer flask. Subsequently, the mixture was allowed to stand for 5 minutes and was filtered using stainless steel mesh no 40. Total removal of color was observed in the recovered liquid.

In the present study, gray water clarification tests obtained from the municipality of Apizaco were also carried out. The tests were carried out in an activated carbon column consisting of 50% granules and 50% powder, see Figure 2.

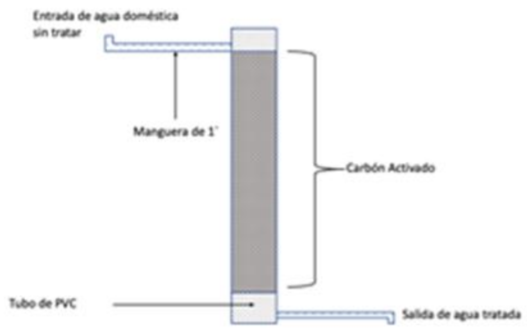

Fig 2. PVC column design with activated carbon

3. Results and Discussion

The activation of the carbon obtained from the pyrolysis of maize heart cobs, was activated by a chemical method using phosphoric acid, see Figure 3.

Fig. 3.- Chemical activation of carbon by phosphoric acid

However, the pH of the sample must be neutralized by washing with distilled water, which generates an acid effluent that must be treated or before being discarded.

During the process of pyrolysis, it was observed that the humidity of samples is an important factor to control. The samples must be dried before being introduced to pyrolysis, in order to avoid a thermal shock, and the temperature of pyrolysis needs to be controlled to avoid the production of ashes in excess, see Figure 4.

Fig. 4.- Activated carbon from maize heart cob

3.1 Methylene blue adsorption

For the test methylene blue adsorption, different removal times were tested, obtaining the total elimination of the dye at 25 minutes and the decrease in color in the samples was observed from 13 minutes comparing them with the control sample.

In the case of grey water, treatment was realized in the pvc column with activated carbon, observed the elimination of color when the grey water through to the column, see Figure 8.

Fig. 8.- Methylene Blue test

4. CONCLUSION

The treatment with phosphoric acid of the carbon obtained from maize heart cob allowed the acquisition of activated carbon with good capacity for adsorption of organic dyes in water. This capacity was verified in the methylene blue absorption test, where the total elimination of the coloration in the treated samples was visually identified.

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