Transcription

1 PRESENTATION

Hello, welcome to the ACS fall 2020 virtual meeting and expo, today I will present you our research: “New nanotechnologies for water treatment: characterization of magnetic nanoscavengers”

2 SEWAGE TREATMENT

Water treatments for ionic metal removal can be classified in two branches: *i*) Conventional proceedings such as: Chemical precipitation, Adsorption, Ion exchange, Electrochemical deposition; and *ii*) Alternative techniques like: Membrane filtration, Photocatalysis and Electrodialysis.

3 SEWAGE TREATMENT DISADVANTAGES

But both have disadvantages that make their use inefficient and impractical. For example: Conventional proceedings demands large amounts of chemical reagents and they produce large quantities of sludge and dirt, on the other hand Alternative techniques results in High operating costs, High energy consumption and High handling costs for sludge disposal. These are some of the reasons why scientists are looking for new techniques and materials for additional and complementary water treatments, such as nanomaterials

4 MAGNETIC NANOPARTICLES (MNP)

One of the nanomaterials with attractive properties for use in water treatment are magnetic iron oxide nanoparticles, because they have the following advantages: High surface area, Adsorption capacity, easy removal using an External magnetic field, Low toxicity and they exhibit superparamagnetic properties.

5 OBJECTIVES

Therefore, the objective of this project is to synthesize and functionalize hybrid and multifunctional magnetic nanoparticles to obtain efficient and versatile systems for the detection and removal of metal ions present in treated wastewater (Ca^{2+}, Mg^{2+}).

6 Experimental strategy

In this project, we followed the next Experimental strategy:

First, we synthesize magnetic nanoparticles and modified chitosan with a carbamoyl benzoic acid.

Afterward, we modified the magnetic nanoparticles with chitosan, nanodiamond, and chitosan modified with a carbamoyl benzoic acid.

Hereupon, we characterized the obtained nanoscavengers using infrared spectroscopy, thermogravimetric analysis, zeta potential, and dynamic light scattering.

And finally, we apply the nano scavengers in recovered water to measure the changes in the conductivity, alkalinity, and hardness

7 NPM

Superparamagnetic magnetite nanoparticles were prepared by the chemical coprecipitation method under alkaline conditions, maintaining a molar ratio of Fe2 +: Fe3 + = 1: 2 in an argon gas environment to avoid critical oxidation.

The experimental procedure was carried out using the synthesis route previously reported by Liu and collaborators for the synthesis of NPM by coprecipitation, with small variations. At the end of the reaction, the nanoparticles are recovered and washed with deionized water multiple times and separated using magnetic decantation. finally, they are dried with using a desiccator and stored until use

8 Modification of CH

For the modification of chitosan, we followed the methodology reported by Martinez. Briefly, we mixed chitosan with benzophenone in ethanol, after 2 h of reaction we added naphthyl ethyl amine drop by drop, the reaction was carried for 5 h, at the end of this time, chitosan modified with a carbamoyl benzoic acid was obtained.

9 FT-IR: CH

We first characterized the nanoscavengers for infrared spectroscopy.

In the infrared spectra for Magnetic chitosan nanoscavenger, we found the characteristic signal of the stretching vibration of the iron-oxygen bond coming from the magnetite, Also, we find the signals of the oxygen-hydrogen and Nitrogen-hydrogen bonds and the signal of the Carbon-oxygen bond from chitosan. The structure for this material has been proposed as follows by hussain-al-ali et al.

10 FT-IR: NPM.CH-ANCB

now for the Magnetic chitosan-carboamyl benzoic acid nanoscavenger, we can observe the following signals: Carbon bound to oxygen through a double bonding, the secondary amide signal, and the carbonyl signal from benzoic acid. Finally, the characteristic signal of the iron-oxygen stretch from the magnetite is observed. Based on the hussein-al-ali proposal, we think that the union between magnetite and modified chitosan can be as seen in the following image

11 FT-IR: NPM-ND

For the spectra of the magnetic nanodiamond nanoscavenger, we find the signals due to the presence of hydroxyl groups and the carbonyl flexion band coming from the diamond. In the end, we find the characteristic peak of magnetite, the stretch signal of iron-oxygen bonds.

We think that the union between the nanoparticles of magnetite and diamond can be occurring between the hydrogen groups on the surface of the magnetite and the carbonyl groups remaining on the surface of the diamond, in a net-like structure as we can see in the following image.

The infrared spectra gave us an idea good the correct modification of the magnetite but thermogravimetric analysis were carried to assure the correct modification of the materials.

12 TGA

In the thermograms, we can see that magnetite (the black line) only degrades 1.59 percent, which makes it a very thermally stable material.

then, in figure a, we observe that chitosan (pink line) degrades to a remnant of 18.93 percent, and magnetic chitosan (olive green line) degrades 30 percent.

In figure b, it is found that the modified chitosan (yellow line) now degrades to a level of 4.08 percent and the magnetic carbamoyl chitosan (dark cyan line) degrades 11.78 percent.

In figure c, we can see that the nanodiamond (green line) is degraded to a remainder of 78.58 percent and the magnetic nanodiamond (blue line) degrades 11.56 percent.

the three thermograms show us the correct modification of the magnetite.

13 DLS-Z POTENTIAL

Besides, the nanoscavengers were characterized by dynamic light scattering and zeta potential to determine the size of the particles in solution and their surface charge. The studies were carried out in deionized water, varying the pH from 2 to 12 using solutions of sodium hydroxide and hydrochloric acid. 0.001 molar, to know the dependence of size and charge with the pH.

Both magnetic nanodiamond and magnetic chitosan-modified nanoscavengers were found to exhibit their largest sizes at more acidic pHs, decreasing in size as pH increases. the potential of these nanoscavengers also has similar behavior, where at pH 2 we find positively charged molecules, reducing their charge to negative values as we increase the pH. therefore we can say that both nanoscavengers have an almost proportional behavior between their DLS values and zeta potential.

on the contrary, the magnetic chitosan nanoscavenger exhibits smaller sizes and positive charges at more acidic pH values, increasing its size as the pH value increases, which decreases its positive charge, having an inversely proportional behavior between the value of its size and the value of its electric charge

14- STEM NPM-ND

Additionally, and as a plus, since they are recently obtained results, we present the images of Scanning transmission electron microscopy for the magnetic nanodiamond nanoscavenger.

Where we can observe its spherical shape and the tendency of the material to self-agglomerate. Presenting sizes close to 20 nanometers, this indicates that the material still retains good magnetic properties.

15 imagenes y video NPM

the application of the nanoescavengers was carried out in reuse water.

In Mexico, in the state of Baja California, the government is launching a project to promote the reuse of reuse water in the irrigation of green areas, in industry and construction, in order to obtain greater conservation of drinking water for domestic use.

this water is transferred in purple pipes, hence it is called purple water

This water barely meets the minimum regulation for use posed by the government, but recently high levels of unwanted ions have been found.

16 CONDUCTIVIDAD

As mentioned, the nanoscavengers were tested in purple water.

These tests were performed by direct exposure of the water with the nanoscavengers for 10 minutes at 350 revolutions per minute, where at the end the nanoscavengers were separated from the water by magnetic decantation, and the recovered water was analyzed using different techniques and methodologies.

all the experiments were carried with a dosage of 30 milligram per liter of water and tested a ph 7, 8 and 9, because purple water is obtained at pHs close to these values when the samples are collected

The conductivity of the purple water was measured, before and after the treatment with each nanoscavenger at each pH

In the graph, we can see that in some cases the conductivity value increases with respect to purple water, and only in some cases, this value decreases.

looking at the table we see that these values are within the values of wastewater but close to the maximum values for drinking water, which suggests that this water can be used for the purposes proposed by the government

18 DLS – ζ

We also measured DLS and Zeta potential values before and after treatment with the nanoscavengers.

It was found that for almost all cases and at different pHs the size of the particles suspended in the water was decreased, and water treated with the magnetic chitosan nanoscavengers the smallest sizes were found.

In the case of zeta potentials, it was found that the water treated with the nanoscavengers at pH 7 and 8 significantly increased the value of their charges (from negative to less negative, close to zero or positive)

19 ALKALINITY REMOVAL

Alkalinity removal tests measured as a percentage of milligrams of calcium carbonate were performed.

It was found that more calcium carbonate was removed at pHs of 7 and 8 using the magnetic chitosan nanoscavengers, while at pH 9 the lowest carbonate removals were obtained.

20. HARDNESS REMOVAL

The purple water was also tested for the removal of hardness measured in the percentage of milligrams of calcium.

In the graph, we can see that at all pH levels a removal of more than 20 percent of calcium was achieved using the magnetic chitosan and magnetic modified-chitosan nanoscavengers.

21. TABLA

finally, we present a table with the different nanoscavengers and the values obtained after the treatment applied to the purple water.

we conclude that so far, the most functional nanoscavenger is the magnetic chitosan.

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23. Contact

If you want to know more about this research or for more questions you can reach me via email, text message, linked in, or with the other authors via email

Thank you so much for your attention