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Elimination of the Organic Pollutants by Biochar from Pomegranate Powder Activated by Phosphoric Acid in an Aqueous Solution: Influence of the Stirring Speed

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ABSTRACT

The protection and preservation of the environment are the pillars of sustainable development, which currently constitutes a major challenge for the future of man and the planet. Currently, humanity is faced with an alarming increase in the pollution of the natural environment by various organic or inorganic materials: endocrine disruptors, pesticides, dyes... The purpose of this study is to explore the possibility of recovering a natural waste, (pomegranate powder) to eliminate Bisphenol A (BPA) and Methylene Blue (MB), in an aqueous solution, and improve the retention capacity by calcination and activation by phosphoric acid (H3PO4). The material produced was analyzed by different techniques: ash rate, humidity rate, iodine index, methylene blue index, the pH of the zero charges, infrared spectroscopy (IR), scanning electron microscopy (SEM) and fluorescence spectroscopy (FRX). The material was evaluated in the treatment of BPA and MB, and the parameter of stirring speed was studied. The results obtained showed that the elimination efficiency was about 98% for BPA and MB. So, we can replace expensive adsorbent materials with materials prepared from natural biomass for the treatment of wastewater and the elimination of Bisphenol A and Methylene blue.

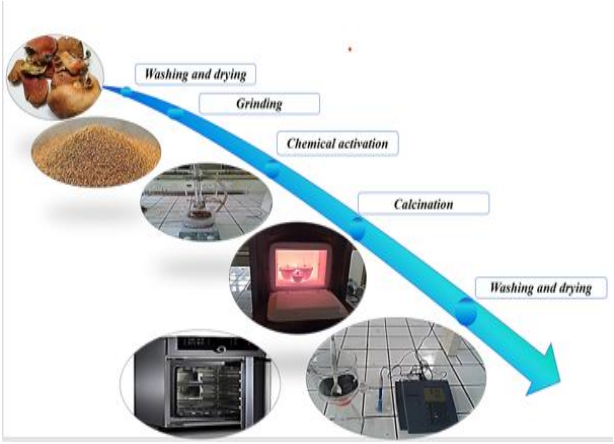

Figure1: Preparation of Activated Carbon

Keywords: biochar, pomegranate powder, BPA, MB, stirring speed.

1 Introduction

Water pollution from industrial wastewater is a serious problem in the world. This pollution can cause adverse effects on the environment. To reduce the harmful effects of these pollutants, several methods for wastewater treatment, especially physicochemical are implemented, in particular, the technique of adsorption [1]. Bisphenol A (BPA) and methylene bleu (MB) are an industrial component commonly used. Due to its mass productions and widespread applications, the presence of BPA and BM are ubiquitous in the environment. [2]. BPA is applied mainly in the agri-food industry: epoxy resin, polycarbonate, unsaturated polyester, water bottles, many reusable foods contact containers and many other packaging, coatings of cans, tin cans and metal lids etc.BM is applied mainly in the garment and textile industries for the dyeing of various fabrics. It is also used to dye paper and leather. The National Health and Nutrition

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Examination Survey (NHANES) estimated that between 2005 and 2010, the daily dietary intakes of BPA ranged from 0.03 to 0.07 µg/kg bw/day for adults [3]. For MB At high doses of 2 to 4 mg per kg it causes peeling of the skin, and at 7 mg per kg it causes nausea, vomiting, fever, abdominal and chest pain

2 Experimental

Dried pomegranate powder has been steeped in a solution of phosphoric acid. The resulting material was placed in a crucible and carbonized in a muffle furnace. After carbonization, the sample was washed with distilled water several times until a pH≥6 of the filtrate was obtained, in order to eliminate the ashes. The activated carbon obtained was dried in an oven at 100°C. The material produced was analyzed by different techniques: ash rate, humidity rate, iodine index, methylene blue index, the pH of the zero charges, infrared spectroscopy (IR), scanning electron microscopy (SEM) and fluorescence spectroscopy (FRX). The material was evaluated in the treatment of Bisphenol A and methylene blue, and the parameter of stirring speed was studied.

3 Results and Discussion

Physico-chemical analyzes of the material have shown that the elaborated activated carbon is an excellent adsorbent because it represents low ash and moisture content, and has a developed microporous structure. The SEM gave excellent images which confirm the porosity of the activated carbon.From the figures (2, 3) we notice that the efficiency of the elimination of bisphenol A and methylene blue increases with the increase in the stirring speed from 200 to 500 rpm. A maximum adsorption was observed at a speed of 500 rpm in both cases 98%, beyond this speed a decrease in the adsorption rate was noted. The high stirring speeds are able to force BPA and MB to penetrate the micropores and reach more available adsorption sites. However, a stirring speed greater than 500 rpm caused shear forces which led to the desorption of BPA and MB from the surface of the adsorbent and therefore a reduction in the adsorption rate.

4 Conclusions

This study allowed us to test an adsorbent material from pomegranate powder with a large adsorption capacity, less expensive and available. The characterization results showed that the elaborated activated carbon has a fairly high porosity. The adsorption process is a simple technique to implement which gives very effective results for the elimination of BPA and MB when using this activated carbon.

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