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ASSESSMENT OF LEACHING OF ELEMENTS FROM CHARS OBTAINED FROM PYROLYSIS OF POST-CONSUMER PLASTIC WASTE

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PURPOSE OF THE ABSTRACT

Plastics play a vital role in the human's daily lives because they are tactical in sectors like packaging, construction, motoring, electronics or agriculture. So far, the use of plastic in modern life has become more widespread and unavoidable, resulting in an annual increase in global plastic production from various industries and households. Every year, the world generates 381 million tonnes of plastic waste, which is expected to double by 2034 [1]. In addition, if plastics are exposed to sunlight and oxygen for several decades, this results in their degradation via fragmentation into microplastics and nanoplastics, which can easily interact with biota.

In consequence, the plastic waste management is one of the greatest challenges of the current century. Common treatment procedures for post-consumer mixed plastic waste (PC-MPW) include landfilling, mechanical recycling, and incineration processes. In addition to these processes, one of the most promising strategies for treating post-consumer mixed plastic waste is pyrolysis, a thermochemical process that transforms plastic waste at moderate-high temperatures (> 400 ºC) in a deoxygenated atmosphere into gases, organic vapors (liquid oil) and a solid product (char) [2].

Char derived from PC-MPW and other residual materials has been successfully used in applications as adsorbent [3]. This work is a part of a project whose objective is to develop carbon-based materials including activated carbons to be applied effectively for the removal of a wide range of pollutant species from wastewater. First, an investigation on the leaching produced by the material when it is in contact with an aqueous medium has been carried out. Investigation of leaching is important, which enables the evaluation of potential environment risks of produced carbon materials during its practical applications.

Chars were produced as by-product from the pyrolysis of different currently dirty non-recyclable mixed plastic waste (low quality plastic waste). The surface of carbon-based materials were modified to improve its adsorption capacity. For this, the activation was carried out through different ways. A physical activation of chars with CO2 in a fixed-bed reactors operating in batch mode (temperature, 760-840 ºC, heating rate, 10 ºC/min and residence time 60 min) was made. In addition, a chemical activation of chars with a chemical agent (KOH and NaOH) was also carried out.

For the leaching tests, a known amount of char was contacted with water, maintaining a char:water weight ratio of 0.1:10. The pH of the water was adjusted to the desired value (3, 7 and 11) and it was kept under stirring for 24 h. At the end of that time, the solution was filtered and analyzed by Inductively Coupled Plasma Mass Spectrometry (ICP-MS) to determine the content of elements in the water. A total of 60 elements were analyzed.

Figures 1 and 2 show as an example, the leached elements as a function of pH, for native char and KOH-activated char. It is observed that the solids produce leaching of various elements when they were placed in

an aqueous medium. In general, the effect of pH is not very significant with all the treatments carried out. A greater leaching of some elements in the activated materials has also been obtained, which may be due to the fact that, when carrying out the treatment, the loss of organic matter occurs, causing the concentration of inorganic compounds. These elements could come from compounds present in the pyrolyzed material, in this case plastic waste that incorporates different additives in its manufacturing process. These results are important for the use of these materials as adsorbents since only the adsorbents with a minimal leaching potential can be considered for practical use.

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FIGURES

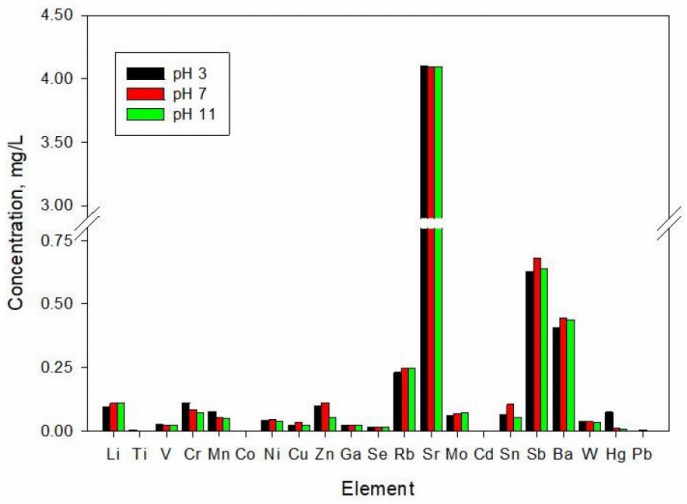

FIGURE 1

Elements leached by the native char as a function of the pH of the medium.

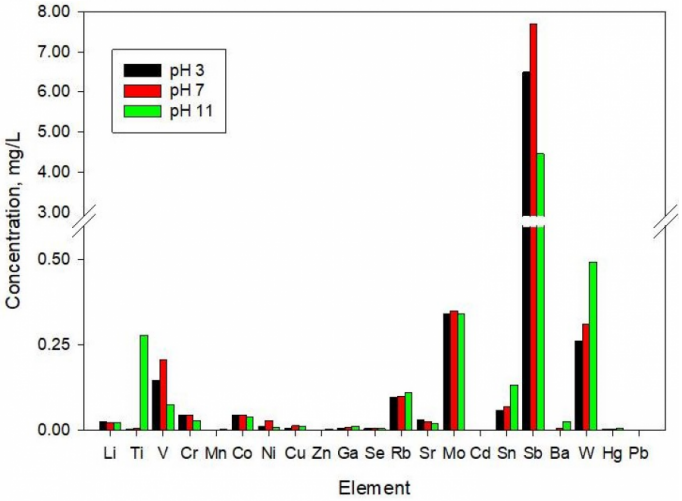

FIGURE 2

Elements leached by the KOH-activated char as a function of the pH of the medium

KEYWORDS

Adsorbent | Char | Plastic waste | Pyrolysis

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