Valorization of carbon materials from gasification processes in liquid fase adsorption of probe melecules

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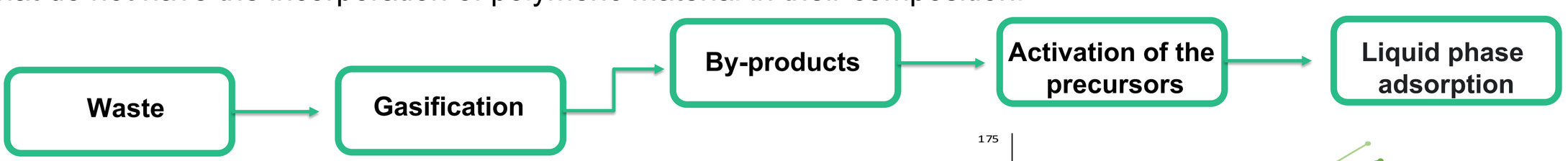
Abstract

It is intended to evaluate the possibility of valorization of the by-products, resulting from the gasification of polymeric and natural residues, through their application in liquid phase adsorption processes. The selected residues and the carbon by-products resulting from their thermochemical conversion, after their physical and chemical characterization, will be the target of chemical activation processes. The by-products and the resulting activated materials will be tested in aqueous liquid phase adsorption processes of probe molecules. Regarding the samples, after being chemically activated, the ones that show the best results are those that do not have the incorporation of polymeric material in their composition.



Introduction

There is a wide range of technologies that allow the recovery of waste in terms of energy and the production of materials [1]. Among these conversion processes, thermochemistry is promising, namely incineration, gasification, pyrolysis and carbonization [2] . Adsorption is one of the most important methods today, simple and depending on the pollutants a relatively simple method to apply for the removal of pollutants in the aqueous phase. There are the most varied types of pollutant adsorption studies using waste as precursors [3] [4] [5] [6] .

Materials and methods

Two different precursors were obtained through the gasification process. One of the precursors was obtained through gasification of biomass residues only and the second precursor with a combination of biomass residues with a small percentage of heterogeneous solid residues. After the precursors were obtained, chemical activations were carried out, including a basic chemical activation and an acid chemical activation. For a more illustrative understanding, designations were assigned to the samples. Samples A and B correspond to the chemically activated samples, basically just biomass and the combination of biomass and waste, respectively. Samples C and D correspond to chemically acid activated samples, biomass only and biomass with waste combination, respectively.

Results and discussion

Liquid phase adsorption studies were carried out for two different probe molecules, PNF and Phenol. The initial solution concentrations were varied and the graphs obtained can be seen in Fig. 1 and 2. By analyzing these graphs, it is possible to notice that the samples with the most promising results are the samples whose precursors are only biomass.

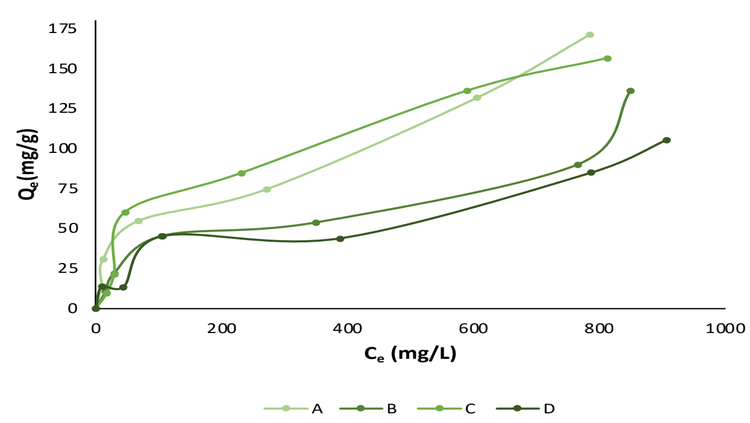


Figure 1: Liquid phase adsorption isotherms for the samples A, B, C and D for PNF molecule.

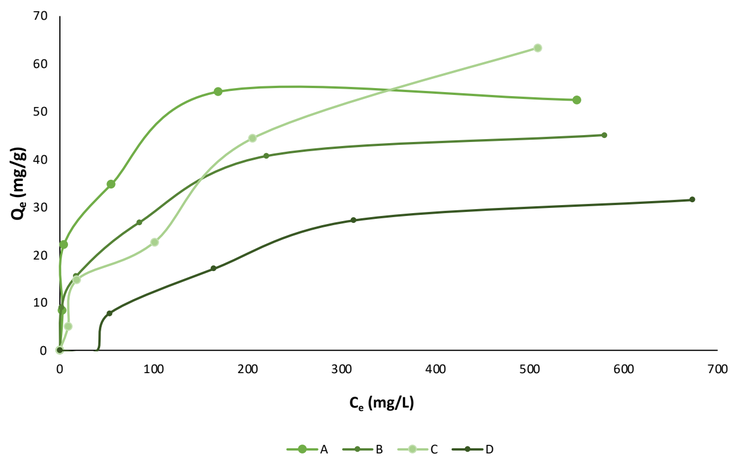


Figure 2: Liquid phase adsorption isotherms for the samples A, B, C and D for Phenol molecule.

Can we use this type of carbon materials as pollutant adsorbents?

It is possible to see that there is a very large potential in the use of these carbon materials as adsorbents. There are several advantages and disadvantages. Regarding the advantages, the economic point of view can be highlighted, as they are waste materials produced from waste, the point of view of the circular economy, valorization of by-products of a thermochemical process, and the environmental point of view, since that the purpose of these materials is adsorption of pollutants. With regard to the disadvantages, one of the main disadvantages is the availability of these materials, they are only available in certain industries where there is gasification, and the advance in academic studies with this type of materials is considered reduced. Further studies are needed, however materials with great potential are considered.

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