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ELECTRO-ACTIVATION OF GRANULAR CARBON FROM OLIVE MILL SOLID RESIDUE

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ABSTRACT

A technique for activation of granular activated carbon (GAC) is presented based on the electrochemical method. In this study, we investigate the effectiveness of the electroactivated GAC in removing phenol from water and determine the optimum conditions for activation. Electro-activation of the GAC appears to be an interesting technique; it requires a short electro-activation time T_a= 30 min and an optimum potential ranging from +200 mV/SCE to 400 mV/SCE. Phenol adsorption isotherms gave a limiting adsorption capacity Q_m dependent on the applied potential, which at potential E=+300 mV/SCE was improved by about 55%, giving Q_m = 75 $mg_{phenol}\,g^{-1}_{GAC}$.

Keywords: Electro-activation, activated carbon, phenol, modelisation.

INTRODUCTION

A previous study [1] presented a process for producing high quality activated carbon from Algerian mill waste. Solid olive mill residue was carbonised at 800°C and physically activated with CO_2, air or steam. An optimum activation temperature of about 850 °C was determined for all the activation agents used. Steam appeared to be the most efficient activator. An optimal activation time of about 2 h was then determined with steam as the optimum activation agent with specific surfaces in order of 1500 $m^2\,g^{-1}_{carbon}$.

Previous electrosorption studies have also been conducted to determine the sorption capacity of a variety of ions and of neutral organic compounds on metallic electrodes [2- 9]. In these works, researchers demonstrated that the electrosorptive technique may be introduced to increase the adsorption capacity of granular activated carbon (GAC) and alumina bed adsorbent [10-13].

The aim of this study is to propose an activation technique for carbon based on application of an electric field, which could significantly improve the performance of this adsorbent. This operation is different from the electrosorption technique, since in this case the GAC is separately electro-activated before the adsorption experiments. In this study we investigate the effectiveness of the electro-activated carbon for removing phenol from water and determine the optimum conditions in the batch mode.

MATERIALS AND METHODS

Granular activated carbon (GAC) with a particle size of 1.4-2.0 mm, produced in the laboratory [1], was soaked overnight in distilled water before the beginning of each experiment. The main characteristics of the GAC used as an adsorbent are presented in Table 1.

Electro-activation apparatus

The electro-activation experiments were conducted using an electrochemical cell designed in our laboratory (Figure 1). This apparatus was equipped with two stainless steel electrodes utilized as working and auxiliary electrodes. They were introduced into a PVC column (2 cm in diameter and 20 cm long) to produce an electrical field in the GAC bed. Previously, the column was filled with wet GAC, and deionized water was added until contact with the salt bridge was assured. An electrochemical potential was then maintained constant during a chosen activation time by means of a Tacussel PRT20-2X potentiostat. The electrochemical potential applied was measured by means of saturated calomel electrode (SCE), as reference and working electrodes. The phenol adsorption capacity of electro-activated GAC was then tested in batch mode. The effect of various parameters — potential, electro-activation time and pH - on the performance of the electro-activated adsorbent was determined.