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Metribuzin removal with electro-activated granular carbon

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a r t i c l e i n f o

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The main purpose of this work was to extend the application of a novel separation technique to the removal of pesticides from superficial waters. The technique is based on the process of adsorption on granular activated carbons (GAC) that are initially activated by an electrical potential. The activation technique, so-called electro-activation, was applied to a column of GAC, in which the adsorption of the pesticide metribuzin was investigated under process-affecting variables, namely, the electrochemical potential, the initial metribuzin to GAC concentration ratio and the ionic strength of the adsorbed solution, which was varied by adding solutions of NaCl, KCl and Na_2SO_4. The results obtained for a solution with an initial metribuzin to GAC concentration ratio of 30 mg/g, an electrical potential of −200 mV/SCE and an NaCl solution of 2 g dm^{-3} showed a maximum increase in the adsorption capacity of metribuzin of 38% compared to that obtained without the electro-activation of GAC.

1. Introduction

The last decade has seen increasing concern about the pollution of surface waters by pesticides, which has led to renewed interest from industrial operators in existing processes in order to be able to promote affordable pesticide use in the face of increasingly severe environmental standards [1–4]. Several techniques have been used in the treatment of pesticides. These processes are based on conventional techniques of oxidation [5], photoly- sis [6,7], chemical hydrolysis [8], adsorption [9,10] and microbial degradation [11]. The electro-sorption process, however, is a new separation technique that has been used successfully for removal of organic compounds using granular activated carbons (GAC) [12,13]. Lounici et al. [14,15] and Yahiaoui et al. [16] demonstrated that electro-sorption could be used to increase the adsorption capacity of a packing bed for a defluorination process, under selected electrical potential values, however, the adsorbent capacity was lower than that obtained in the absence of electrical potential activation [17].

Thus, the aim of the present study was to investigate the abil- ity to enhance the adsorption capacity of pesticides in water on GAC by applying external electrical field activation of GAC over a range of operating conditions, and to determine the operating conditions for maximum efficiency in the electro-activation process. The pesticide metribuzin was utilized as a reference species and the operating conditions assessed were electrical potential, electro-activation time, metribuzin to electro-activated GAC concentration ratio (C_{po}/C_A) and ionic strength. In our previous work [13], the removal of metribuzin from aqueous solutions in a batch and continuous mode using electro-sorption technique was studied. Obtained results demonstrated that the electro-sorption technique reduced considerably the drastic decrease encountered when passing from batch mode to continuous column mode.

2. Materials and methods

2.1. Materials

The granular activated carbon, NFEN12915 (OTV©, France), with a surface area of 1183 m^2/g, was prepared for each experiment by soaking it overnight in distilled water. The metribuzin solu- tion was prepared synthetically by mixing the required amount of metribuzin (Bayer©, Germany) in a solution of distilled water. The detailed physicochemical characteristics of both herbicide and GAC can be found in a previous work on application of the electro-sorption technique to remove Metribuzin pesticide [13].

2.2. Methods

2.2.1. Electro-activation operation

The electro-activation experiments were conducted using an electrochemical cell designed in our laboratory (Fig. 1). This

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