

Novel technique to regenerate activated alumina bed saturated by fluoride ions

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Abstract

A novel technique to regenerate adsorbent column is presented. The process used is based on the utilization of an electrochemical cell which regenerates several saturated adsorbent bed. This paper presents the regeneration of the activated alumina (AA) bed saturated by fluoride ions. The results obtained in this study demonstrated that desorption of fluoride from activated alumina is a rapid process. Most of the fluoride content desorbed within 6–15 min. The utilization of the electrochemical cell allows a complete desorption of the fluoride under optimum conditions. The reduction of about 90% of the sodium hydroxide amount was attained by the electrochemical process. A study of adsorption–regeneration cycles showed that the electrochemical technique was more efficient than current techniques. A 95% recovery of the adsorption capacity was realized with the electroregeneration system. In addition, the volume of water used to regenerate the saturated bed was lower than for current regeneration techniques. The washing did not exceed 6% of the treated water volume. The electrodesorption operation was successfully applied for fluoride desorption from saturated activated alumina column by natural water with strong mineralisation. © 2001 Elsevier Science B.V. All rights reserved.

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1. Introduction

Adsorbent bed regeneration is an important operation which strongly influences the economical performance of adsorption process. Any innovative technique that can reduce the cost of the regeneration operation will contribute to making column bed adsorption more efficient and more attractive.

Electrosorptive techniques have already been used to treat various contaminated waters [1,2] and/or to deionize water [3,4]. Most of the previous electrosorption studies have been conducted to determine the adsorption capacity of a variety of ions and of neutral organic compounds on metallic electrode [5–12]. In a previous work, the authors demonstrated that the electrosorptive technique may be introduced to increase the adsorption capacity of the adsorbent [1]. Under some chosen electrical potential however, the adsorbent capacity was lower than that obtained without

electrical potential. This result may be used to improve the performance of adsorbent bed regeneration.

The aim of this study is to propose a novel electrodesorption cell and test the ability of this system to ameliorate significantly the performance of the desorption operation. This paper investigates the regeneration of the activated alumina bed saturated by fluoride ions. Several regeneration methods of activated alumina column saturated by fluoride ions have been reported in the literature [13–19]. These techniques denoted that, as a cleaning product caustic soda was more efficient than other products such as alumina sulfate, sulfuric acid and aluminate [13–19]. Since chemical desorption with sodium hydroxide does not provide complete restoration of the original fluoride adsorption capacity of activated alumina, electrodesorption techniques can be used for this purpose.

The effect of an electrical field on the mechanism and performance of the regeneration operation was tested with synthetic fluorinated water and with natural water contaminated by fluoride. Various experimental parameters were

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