Korean Chem. Eng. Res., 60(1), 80-85 (2022)
https://doi.org/10.9713/kcer.2022.60.1.80
PISSN 0304-128X, EISSN 2233-9558

Eosin Biosorption from Aqueous Solution on Two Types of Activated Sludge

Farsi Cherifa*, Cherifi Hakima*,† , Yous Radhia*, Hanini Salah* and Khalladi Razika**

**Laboratoire des Biomatériaux et des Phénomènes de Transferts LBMPT, Université de Médéa, Médéa, 26000, Algérie*
***Laboratoire des Matériaux et Environnement LME, Université de Médéa, Médéa, 26000, Algérie*
(Received 18 July 2021; Received in revised from 7 September 2021; Accepted 1 October 2021)

Abstract – In wastewater treatment processes huge quantities of sludge are produced continuously each year. This work investigated the reuse of two types of sludge as biosorbents of a toxic dye. The potential of granular and filamentous fungus dried sludge for the elimination of eosin from aqueous solution was studied in batch system. The effect of initial concentration and temperature was examined. Maximum uptake was observed at 100 mg l^{-1} and 30 °C. The maximum removal rate was 92% for the granular sludge and 90% for the filamentous one. Equilibrium was attained after 30 min for the studied dye concentrations. The equilibrium uptake increased with the initial eosin concentration. The Freundlich and Langmuir adsorption models were also investigated. The reuse of disposed sludge as adsorbent could be a solution for the valorization of such dangerous waste to resolve two environmental problems at the same time.

Key words: Biosorption, Eosin Y, Wastewater, Activated sludge

1. Introduction

Removal of harmful substances from liquid effluents is one of the preoccupations at present. Huge quantities of dyes are used by different industries to improve the appearance of their products. Eosin Y is applied in many industries for dyeing leather, biological stain, printing and fluorescent pigment [1-3]. It is a heterocyclic dye attached to bromine atoms as shown on Fig. 1. Eosin Yellow is an anionic acid dye that belongs to fluorescein class. It is a red crystalline powder, highly water soluble dye used frequently in textile dyeing, ink manufacturing because of its vivid color [4-6].

This dye may cause severe health problems in different organs like kidney, liver, lungs and cornea. Also, eosin incites damage in gastrointestinal DNA, and its metabolites are also highly toxic and carcinogenic [7]. Therefore, this compound is not completely removed by conventional wastewater treatment systems, such as activated sludge processes, due to their high resistance to biodegradation [5,7].

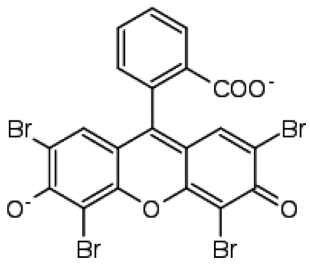


Fig. 1.Chemical structure of eosin.

Various techniques, such as chemical oxidation, froth flotation, adsorption and coagulation, have been applied for the removal of pollutants from wastewaters. Adsorption has the most potential due to its remarkable efficiency to remove a wide range of dangerous compounds [8].

It is a well-established method for treating industrial wastewaters, where the most used adsorbent is activated carbon [9]. However, its high cost makes it less economically practical as an adsorbent. Because of this, the use of cheap and efficient adsorbents for the elimination of dyes to substitute activated carbon is of great interest [10].

In sewage treatment processes huge quantities of sludge are produced continuously. In Algeria the estimated quantity of sludge produced in 2017 exceeded 90.000 tons per year [11]. Sludge disposal and carrying are becoming an economic and environmental concern. In this work, a solution to resolve this problem is proposed by the valorization of sludge used as biosorbent for the elimination of a toxic colorant. Using activated sludge as adsorbent represents a potential alternative to actual methods for wastewater treatment [12]. The micro-organism cell wall consisted essentially of a variety of organic compounds such as amino acids, lipids, chitin, could show a passive affinity towards reactive dyes [13]. Some studies have demonstrated that biomasses possess interesting adsorption properties for a variety of heavy metals, organics and dyes [5,14].

The toxic nature of eosin is still not quantified much but its high content in living systems has proved to be harmful. Many works have investigated the efficiency of low cost adsorbents to eliminate eosin, such as date palm seeds, goethite and their composite [6], rice husk [2], waste material of soya [7]. Compared to these materials, the present study proposes a lower cost adsorbent considered as harmful wastes for the environment: the sludge of wastewater processes used after a simple cleaning.

† To whom correspondence should be addressed.
E-mail: ha_cherifi@yahoo.fr
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