



# Removal of C.I. Basic Blue 3 dye by sorption onto cation exchange resin, functionalized and non-functionalized polymeric sorbents from aqueous solutions and wastewaters



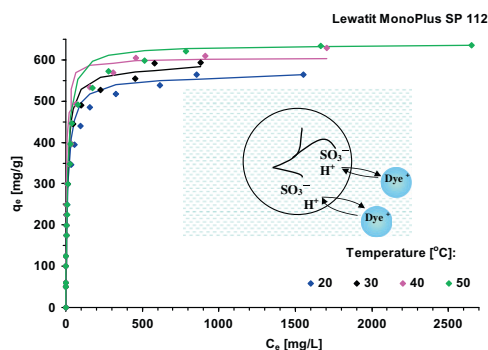
Monika Wawrzkiwicz\*

Maria Curie-Skłodowska University, Faculty of Chemistry, Department of Inorganic Chemistry, 20-031 Lublin, M. Skłodowska Sq. 2, Poland

## HIGHLIGHTS

- ▶ Cation exchanger and polymeric sorbents for Basic Blue 3 dye removal.
- ▶ Lewatit MonoPlus SP 112 is the most effective.
- ▶ Kinetic data were well described by the pseudo-second order model.
- ▶ Good adsorption characteristics of cation exchanger for basic wastewaters.
- ▶ Desorption using 1 M HCl in 90% methanol was quantitative.

## GRAPHICAL ABSTRACT



## ARTICLE INFO

### Article history:

Received 9 October 2012  
Received in revised form 23 November 2012  
Accepted 28 November 2012  
Available online 6 December 2012

### Keywords:

Dye  
Basic blue 3  
Sorption  
Cation exchanger  
Polymeric sorbent

## ABSTRACT

The adsorption behavior of the cationic dye C.I. Basic Blue 3 (BB3) from aqueous solution on the cation exchanger Lewatit MonoPlus SP 112 (SP 112), functionalized Dowex Optipore SD 2 (SD 2) and non-functionalized Amberlite XAD 1180 (XAD 1180) polymeric sorbents was investigated in order to identify the ability of these materials to remove textile dye from wastewaters. For this purpose a series of batch tests were carried out as a function of contact time (1 min–96 h), dye concentration (100, 500, 1000 mg/L), auxiliaries presence (NaCl, Na<sub>2</sub>SO<sub>4</sub>, surfactants) and adsorption temperature (20–50 °C). The adsorption capacity ( $Q_0$ ) determined from the Langmuir isotherm model at 20 °C was found to be 560.7 mg/g for SP 112, 270.9 mg/g for SD 2 and 35.7 mg/g for XAD 1180.  $Q_0$  increased with the temperature rise for the cation exchanger and non-functionalized polymeric sorbent. The inverse effect of the temperature on BB3 sorption on SD 2 was observed. Kinetic studies of the dye followed the pseudo-second order model rather than the pseudo-first order or intraparticle diffusion model. Total decolorization of basic dyes wastewater by means of SP 112 occurred after 1 h. Dye desorption from the cation exchanger reached 100% in four cycles of sorption–desorption using 1 M HCl in 90% CH<sub>3</sub>OH. The working ion exchange capacities calculated from the breakthrough curves were equal to 205 mg/mL for SP 112, 3.5 mg/mL for SD 2 and 6.5 mg/mL for XAD 1180. These sorption properties of the polystyrene cation exchange resin Lewatit MonoPlus SP 112 recommend it as effective sorbent in the removal of organic ionic species like BB3 dye from aqueous solutions and industrial wastewaters.

© 2012 Elsevier B.V. All rights reserved.

## 1. Introduction

Cationic dyes are quarternary salts whose cations have the positive charge most often on the atom N (ammonium salts), rarely on C (carbonium), O (oxonium) and S (sulfone) [1].

\* Tel.: +48 81 537 57 38; fax: +48 81 533 33 48.  
E-mail address: [m.wawrzkiwicz@op.pl](mailto:m.wawrzkiwicz@op.pl)