PA 13 - Removal of Cationic Dyes from Aqueous Solutions by Chitosan-based Adsorbent

O. Adam[(1)], G. Crini[(2)], B. Martel[(3)], Fe Degiorgi[(1)], G. Torri[(4)]

[(1)]Université de Franche-Comté, Laboratoire de Biologie Environmentale, EA 3184 USC INRA 25000 Besançon, France - [(2)]Université de Franche-Comté, Service de Ressources Analytiques et de Caractérisation 25030 Besançon cedex, France - [(3)]Université des Sciences de Lille, Laboratoire de Chimie Macromoléculaire, UMR 8009 59655 Villeneuve d'Ascq, France - [(4)]Istituto Scientifico di Chimica e Biochimica "G. Ronzoni", 81 Via Giuseppe Colombo, 20133 Milano, Italy

Chitosan and its derivatives exhibit numerous applications in a wide range of fields such as food, pharmacy, biomedicine, cosmetics, biotechnology and agriculture. These versatile materials are also widely applied in the textile, pulp and paper industries, and in clarification and water purification as coagulating, floculating, chelating and complexing agents. Different reviews have recently been reported for wastewater treatment purposes, including metal complexation, dye removal, complexing adsorbent matrices, and membranes.

Chitosan has widely been studied for pollutant adsorption from aqueous solutions. In particular, one of the major applications is based on its ability to bind strongly heavy metals. Chitosan is also known as an effective adsorbent for proteins, saccharides, drugs, oils, bacterial suspensions, phenolic derivatives, and also for dye wastewater removal. In recent years, numerous studies on chitosan-based biomaterials for dye removal demonstrated that these versatile biosorbents are efficient and have an high affinity for many classes of dyes, including acid, direct, mordant, reactive and disperse dyes. However, only a limited number of published studies can be found on the use of chitosan as an adsorbent for cationic (basic) dye removal.

In this work, we propose chemical grafting of sulfonate groups onto chitosan as a mean to confer the ability to adsorb basic dyes. Several adsorption and kinetic studies are presented and discussed here. Results of adsorption experiments showed that these adsorbents exhibited interesting sorption properties toward cationic dyes, depending on the presence of sulfonate groups. The experimental data were examined using different adsorption models and it was found that the Langmuir model represented the best fit of experimental data. The negative value of free energy change indicated the spontaneous nature of adsorption. The kinetic measurements showed that both processes were rapid and followed a pseudo-second order model.