Effect of Temperature on Brilliant Green Adsorption by Shrimp Shell: Equilibrium and Kinetics

Suchada Sawasdee and Prachart Watcharabundit*

Department of Chemistry, Faculty of Science and Technology, Thepsatri Rajabhat University, Lopburi 15000 Thailand

**Corresponding author. E-mail: prachartw@hotmail.com*

ABSTRACT

As the direct discharge of dying wastewater into the environment has adverse effects, there is a growing interest in using low-cost adsorbents or waste materials to adsorb dyes. In this study, the effect of temperature on the equilibrium and kinetic adsorption of brilliant green dye by shrimp shell (Macrobrachium rosenbergii) was studied using a batch process. The factors affecting the adsorption process, including contact time, initial dye concentration, and temperature, were investigated. The equilibrium data were analyzed by Langmuir, Freundlich, Temkin, and Dubinin-Raduskevich isotherm models. The Langmuir isotherm model fit the best, and the maximum adsorption capacity values were 8.13, 9.35, and 10.6 mg/g at 20, 30, and 40°C, respectively. The adsorption kinetic data corresponded to the pseudo-second order model at all temperatures. Thermodynamic parameters, such as ΔG, ΔH, and ΔS were calculated. Negative values of ΔG indicated that the overall adsorption was spontaneous. The characterization of surface adsorbent by FTIR confirmed that the shrimp shell can adsorb brilliant green dye and the proposed adsorption mechanisms were hydrogen bonding and $n-\pi$ interaction. Experimental results showed that the adsorption capacity increased with temperature and the shrimp shell was an effective adsorbent for removing brilliant green dye.

Keywords: Temperature, Adsorption, Kinetic, Brilliant green, Shrimp shell

INTRODUCTION

Dyes can be classified as anionic, cationic, non−ionic, or zwitterionic. They are widely used in various industries, such as textile, paper, leather, rubber, plastics, and dyestuffs. The effluents containing dyes can cause drastic damage to the environment. In addition, most dye molecules are stable under various conditions of light, heat, and chemicals, and thus difficult to degrade (Han et al., 2012). Brilliant green (BG) is a cationic dye that is an odorless yellow-green to green powder used for various purposes, including as a biological stain and dermatological agent, in veterinary medicine, and as an additive to poultry feed to inhibit the propagation of mold, intestinal parasites, and fungus. It is also extensively used in textile dying and paper printing (Nandi et al., 2009; Mane and Babu,