Dithiocarbamated *Symphoricarpus albus* as a potential biosorbent for a reactive dye

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**Highlights**

- *S. albus* was successfully modified with NaDDTC.
- Modification significantly enhanced biosorption performance of biosorbent.
- Modified biosorbent was reused for 10 cycles with 100% desorption yield.
- Biosorption efficiency of biosorbent is highly dependent on flow rate.

**Abstract**

In this study, the ability of *Symphoricarpus albus*, a natural biosorbent, to biosorb a reactive dye (RR45) after the modification with sodium diethyldithiocarbamate was examined. Batch experiments were carried out as a function of initial pH, biosorbent dosage, contact time, and temperature in order to model and optimize the biosorption process. Maximum dye removal was attained at pH 2.0 and with 0.08 g of modified biosorbent at room temperature. Temperature did not significantly affect the biosorption yield of RR45. Pseudo-second-order and Langmuir models were able to well describe the biosorption kinetics and isotherm, respectively. Continuous dye biosorption studies were conducted at a flow rate of 1.0 mL min⁻¹. Regeneration studies showed no significant decrease in the recovery of dye at the end of the 10 consecutive cycles. The dye biosorption mechanism was explored by FTIR and SEM-EDX analysis. From the practical point of view, dithiocarbamated *S. albus* could be used as an alternative and effective biosorbent for the elimination of RR45 from aqueous solutions.

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**1. Introduction**

The contamination of the water sources by synthetic dyes arises as a result of many industrial activities such as dye manufacturing, craft mills, tannery, textile, pulp, paper mill and other industries (e.g. food and cosmetic) [1]. There are several processes for decolorization of dye wastewaters typically include physical (nanofiltration, reverse osmosis, electrodialysis, etc.), chemical (coagulation, flocculation, precipitation, etc.) and biological treatments (biodegradation, biosorption, bioremediation) [2]. However, their use is restricted because of high cost, low selectivity, sludge production, operational difficulty and potential toxic by-products. Furthermore, the use of a treatment process alone may not completely remove dye from wastewater. For this reason a combination of these processes is necessary to achieve the desirable goal. For example, coagulation or flocculation combined with flotation and filtration, precipitation–flocculation with Fe(II)/Ca(OH)₂ are used for effectively removing dyes. But these methods are expensive and have a disposal problem due to accumulation of concentrated sludge. The high energy and chemical consumption and high cost restrict the use of advanced oxidation processes. Membrane