

STIR BAR SORPTIVE EXTRACTION OF ORGANIC DYES FROM WATER SAMPLE USING SILICA-BASED SOL-GEL HYBRID ADSORBENT

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INTRODUCTION

The first synthetic dye 'mauveine' was discovered in 1856. Since then, other types of synthetic dyes are massively produced and used in several industries including textiles. Even though dyes are not strongly hazardous, they are considered as potential water pollutants due to their solubility in water which are usually high. Some cases reported that they are cytotoxic and carcinogenic to human [1].

The common technique used in the analysis of dyes is solid phase extraction (SPE). It provides a simple and economical analysis compared to liquid-liquid extraction (LLE). However, SPE has some drawbacks which include the production of organic waste, time-consuming and complex set-up [2]. Therefore, a solventless technique namely stir bar sorptive extraction (SBSE) under the trade name TWISTERTM has been developed to overcome the limitations. However, commercial TWISTERTM is rather expensive and limited in the types of coating materials available. Thus this study attempts to synthesize new adsorbent materials based on silica for use in SBSE. Our successful hybridization of sol-gel materials [3, 4] have led us to the synthesis of another silica-based sol-gel hybrid adsorbent, mercaptopropyltrimethoxysilane-methyltrimethoxysilane (MPTMOS-MTMOS) as sorbent in the analysis of selected organic dyes namely crystal violet, methylene blue and methyl orange in water sample. The use of hybrid material as adsorbent enhanced the ability of the stir bar to extract polar compounds compared to the commercial stir bar [3], and reduced the production cost.

The parameters affecting the extraction efficiency of the selected dyes were studied and analytes analyzed using ultraviolet-visible (UV-Vis) spectrophotometer. The in-house produced glass encased stir bar was initially etched before coated with the synthesized sol-gel hybrid material which is responsible in extracting the targeted analytes. The stir bar was then desorbed to elute the extracted analytes and the resulting aliquot was subjected to UV-Vis measurement at 592 nm for crystal violet, 653 nm for methylene blue and 422 nm for methyl orange.

MAIN RESULTS

The extraction performance of the stir bar was evaluated from the absorbance response obtained from UV-Vis measurement. The optimum conditions obtained for the preparation of sol-gel materials were 3:1 mmol ratio of MPTMOS:MTMOS composition, 6 mmol of water as solvent, 2.5 mmol of trifluoroacetic acid as acid catalyst, 3 mmol of methanol as co-solvent, 1× dipping and 30 min coating time. The optimum conditions for the SBSE procedure were 60 min extraction time, 270 rpm stirring rate, 2.5 mL methanol as desorption solvent, 20 min desorption time and 2% w/v sodium chloride addition. The synthesized sol-gel hybrid MPTMOS-MTMOS successfully extracted the selected dyes and the developed method was successfully applied to the determination of dyes in river water samples. The new sol-gel hybrid MPTMOS-MTMOS-SBSE offers an alternative and inexpensive method for determination of polar dyes in water sample.

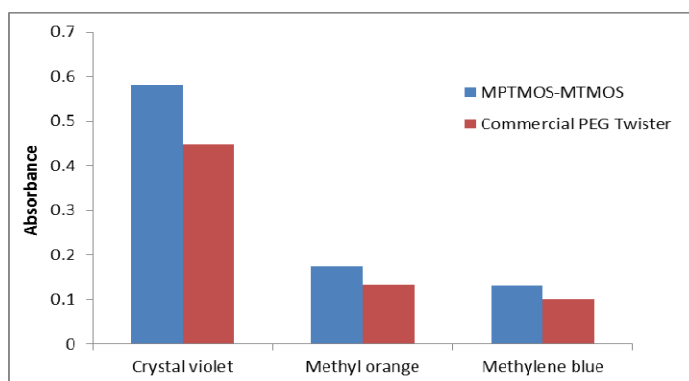


Figure 1. Comparison between the extraction performances of selected dyes using sol-gel hybrid MPTMOS-MTMOS and commercial ethylene glycol/silicone TwisterTM.

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