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RESEARCH ARTICLE

Synthesis of Molecularly Imprinted Polymers for the Selective Extraction /Removal of 2,4,6-trichlorophenol

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Abstract:

Background:

2,4,6-Trichlorophenol (2,4,6-TCP) is one of the most significant pollutants among chlorophenols due to its harmful effects. It has been classified as priority pollutants by the U.S. Environmental Protection Agency. Therefore, highly selective separation and sensitive recognition of 2,4,6-TCP from complex samples are in great demand.

Methods:

For this purpose , the preparation of MIPs selective for 2,4,6-TCP was carried out by precipitation polymerization. A non-covalent approach was employed to establish an interaction between template and monomer (methacrylic acid).

Results:

The resulted polymers were characterized by scanning electron microscopy (SEM), EDX, Fourier-transform infrared spectroscopy(FT-IR) and BET. The batch binding assay was carried out to select the most selective polymer in terms of binding efficiency towards the target template. The adsorption parameters such as initial concentration, dosage of polymer, pH effect and selectivity with structural analogues were determined . The selectivity of MIP towards the 2, 4, 6-TCP was higher as compared to its structural analogue melamine with a good adsorption efficiency. Furthermore, the MIP as an extracting material was applied for extraction of 2, 4, 6-trichlorophenol from the spiked blood serum (88%) and river water sample (94%). The results showed that the optimized MIP could successfully extract 2,4,6-TCP from the blood serum and river water.

Conclusion:

The molecularly imprinted polymers for 2,4,6-TCP have been prepared by precipitation polymerization with a non-covalent approach. The optimized MIP has been successfully used for the extraction of 2,4,6-TCP from blood serum and river water.

Keywords: 2,4,6-Trichlorophenol, Molecularly Imprinted Polymers, Removal, Extraction, Blood serum, River water, Toxicity.

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1. INTRODUCTION

Chlorophenols (CPs) are considered as uncontrolled environmental pollutants due to their toxicity, carcinogenicity, and bioaccumulation capability [1]. They have been extensively used in various industries and are disposed off in the form of various industrial processes [2]. Among CPs, 2,4,6-Trichlorophenol (2,4,6-TCP) is considered as one of the toxic pollutants because of its harmful effects [3 - 5]. The U.S. Environmental Protection Agency has also classified it as a priority pollutant [6].Chlorophenols are poisonous and possibly cancer-causing and can influence the smell and taste of drinking water even in very low concentrations (μgL^{-1}) , therefore, it is included by both the US Environmental Protection Agency (EPA), 1977 and the European Union (EU) in their lists of priority pollutants. EU Directive 2455/2001/EC sets the most extreme 0.5 μgL^{-1} concentration in drinking water and individual CPs concentration must not surpass 0.1 μgL^{-1}. This enrollment is due to the way that these compounds are found to be lethal and have extremely short and long-term impacts on humans and other living organisms [7]. Therefore, a highly selective method for the extraction and recognition of 2,4,6-TCP from complex samples is in great demand. Adsorption is the best technique amongst the analytical methods used for the determination and extraction of chlorophenols from various samples as postulated by various researchers in their studies [8 - 11].

Molecularly imprinted polymers (MIPs) can be easily

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