SELECTİVE REMOVAL OF DIRECT GREEN-6 FROM TEXTILE WASTEWATER USING MOLECULARLY IMPRINTED POLYMERS

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INTRODUCTION

The textile industry is one of the main sectors contributing to water pollution, with dyes being among the most significant pollutants in wastewater.

In this study, molecularly imprinted polymers (MIPs) were used for the removal of Direct Green-6 (DG-6), a dye commonly found in textile wastewater.

MIPs are artificially synthesized polymers that contain specific binding sites for target molecules. Due to this property, they stand out as an effective method for the selective removal of environmental pollutants.

METHOD

In this study, the synthesis was optimized for the DG-6 dye based on the method used in the work titled “Selective Removal of the Emerging Dye Basic Blue 3 via Molecularly Imprinting Technique” by M. Sadia et al. (2022), and as a result, the MIP with a ratio of 1:150:370 mmol (template molecule:monomer:cross-linker) was selected. The synthesis performed for the MIP was also carried out under the same conditions for the NIP, except without the template molecule.

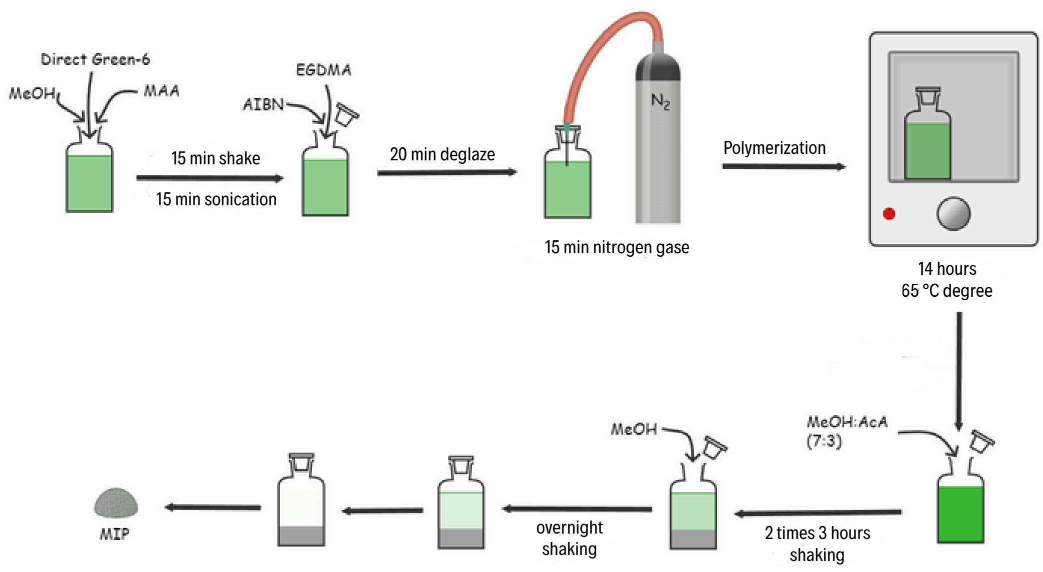

Figure 1. Illustration of MIP synthesis

RESULTS

CHARACTERIZATION

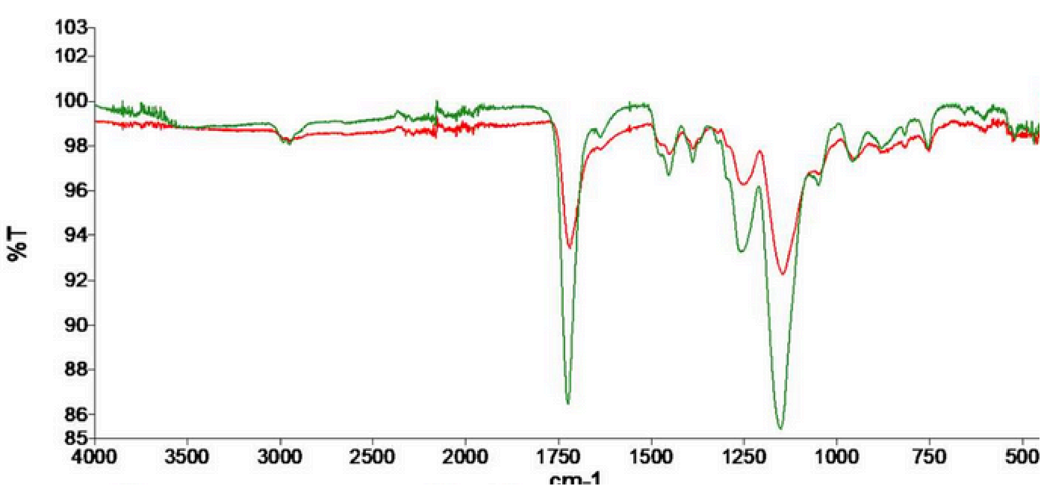

Figure 2. FT-IR spectra of MIP (red line) and NIP (green line)

TEMPLATE EXTRACTION

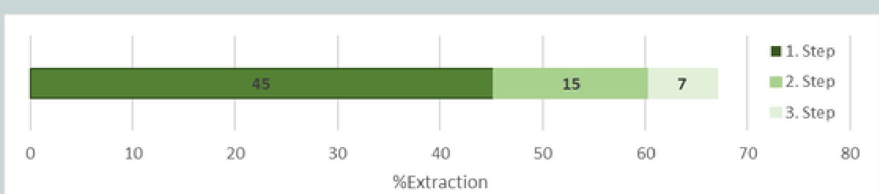

Figure 3. extraction of template molecule from MIP

ADSORPTION MEDIUM OPTIMIZATION STUDIES

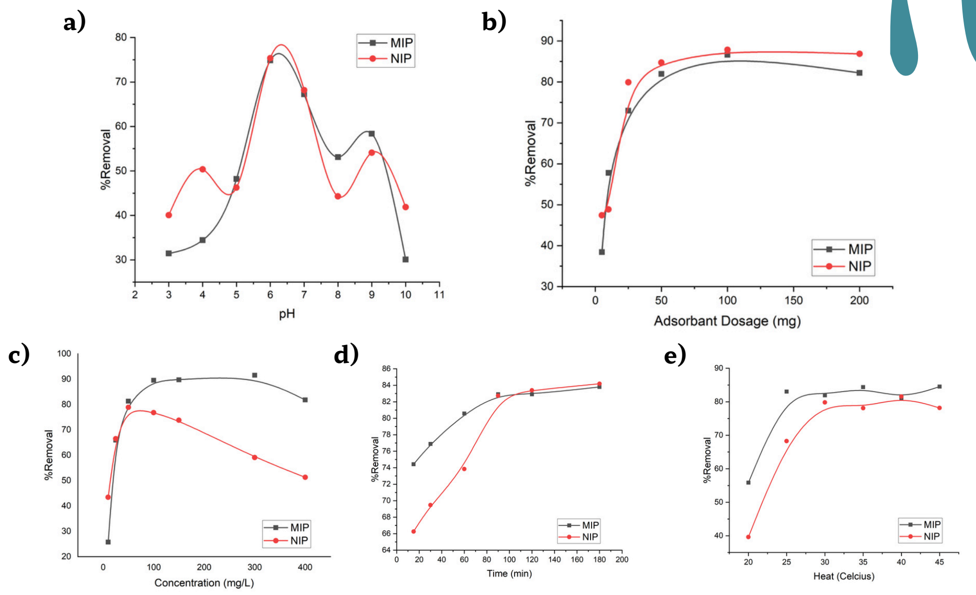

Figure 3. a) Effect of solution pH **b)** effect of Adsorbant Dose **c)** Effect of solution concentration **d)** Effect of adsorption time **e)** Effect of adsorption temperature

ISOTHERM MODELS

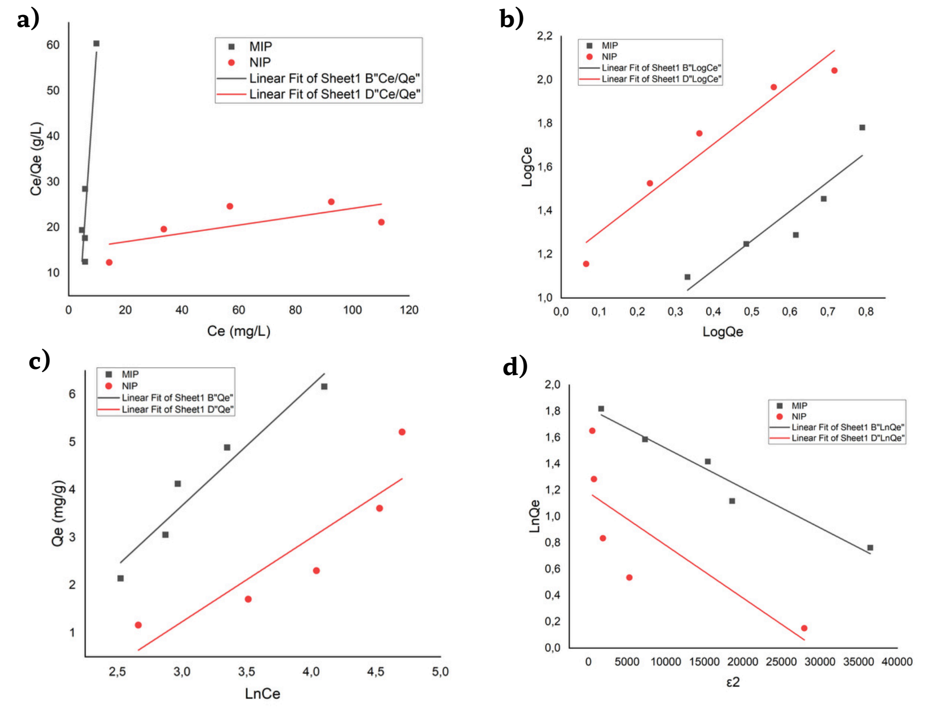

Figure 4. a) Langmuir Isotherms **b)** Freundlich Isotherms **c)** Temkin Isotherms **d)** Dubinin-Radushkevich Isotherms of MIP and NIP

Table 1. Isotherms Constants of MIP and NIP

	Langmuir Isotherm Constants				Freundlich Isotherm Constants		
	Q_m (mg/g)	b (L/mg)	R_L	R^2	K_f (mg/g)	N	R^2
MIP	10,5200	0,0253	0,6919	0,8593	3,8824	0,7426	0,9377
NIP	10,9327	0,0061	0,7464	0,4776	0,1640	1,4407	0,9377

	Temkin Isotherm Constants			D-R Isotherm Constants			
	B_T (J/mol)	K_T (L/g)	R^2	Q_m (mg/g)	β (mol2/kJ2)	E (kJ/mol)	R^2
MIP	2,5117	0,2146	0,9313	6,1910	0,00003	128,5073	0,9582
NIP	1,7612	0,1004	0,9313	3,2642	0,00004	111,7293	0,626482

CINETIC MODELS

Table 2. Pseudo-first order and Pseudo-second order cinetic models constants of MIP and NIP

	Pseudo-first Order			Pseudo-second Order		
	k_1 (min^{-1})	q_e (mg)g)	R^2	k_2 (g/mg min)	q_e (mg/g)	R^2
MIP	-1,3E-05	0,4972	0,6860	0,1740	1,7159	0,9987
NIP	-2,8E-05	0,6881	0,8403	0,0627	1,7881	0,9986

CONCLUSION

Molecularly Imprinted Polymers (MIPs) were successfully synthesized and characterized for the selective and effective removal of Direct Green-6 (DG-6) dye from textile wastewater. This study demonstrates that the synthesized MIPs possess high selectivity and adsorption capacity for the removal of DG-6, a common pollutant in wastewater.

Ref. Sadia, M., Ahmad, I., Ali, F., Zahoor, M., Ullah, R., Khan, F., ... Sohail, A. (2022). Selective Removal of the Emerging Dye Basic Blue 3 via Molecularly Imprinting Technique. Molecules, 27(10), 3276.

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