

Supplementary material

S1. Data from review pre fractional factorial design (5⁻¹).

Nanomaterials	Polutants	Variables	Removal capacity (q)	Ref.
Fe ₃ O ₄ @SiO ₂ -Congo Red	Methylene blue	Dye: 3- 27ppm pH: 2- 11 Time: 0- 200 min.	28 mg. g ⁻¹	Yimin, D. et al [1]
Fe ₃ O ₄ @graphene	Methylene blue	Dye: 25 mL NPs: 10 mg Time: 0- 120 min. Temp.: 25°C Stirring: 150 rpm	45 mg. g ⁻¹	Yao, Y. et al [2]
S-Fe ₃ O ₄ @poli (DA+ KH550)	Methylene blue	Dye: 60- 120 ppm NPs: 10 mg pH: 2- 12 Time: 0- 120 min. Temp.: 25, 35, 45°C	400 mg. g ⁻¹	Zhan, Y. et al [3]
Fe ₃ O ₄ @MCP	Methylene blue	Dye: 100- 250 ppm NPs: 0,2- 1 g pH: 3-8 Time: 0- 45 min. Temp.: 25°C Stirring: 150 rpm	70 mg. g ⁻¹	Tan, K. et al [4]
Fe ₂ O ₃ @clinoptilolite	Methylene blue	Dye: 25- 200 ppm NPs: 0,1- 1 g pH: 3- 9 Time: 0- 90 min.	52 mg. g ⁻¹	Badeenezhad, A. [5]
HA- Fe ₃ O ₄	Methylene blue	pH: 3- 11 Time: 0- 300 min.	0,291 mmol. g ⁻¹	Zhang. X [6]
MBF	Methylene blue	Dye: 5- 20 mg. L ⁻¹ NPs: 0,01 g. mL ⁻¹ pH: 2- 11 Time: 0- 60 min.	82,24 mg. g ⁻¹	Lou, Z. [7]
Fe ₃ O ₄ @C	Methylene blue	Dye: 0,01- 0,175 g. L ⁻¹ NPs: 5 mg pH: 2- 12 Temp.: 25°C Stirring: 100 rpm	117 mg. g ⁻¹	Wu, R. [8]
Fe ₃ O ₄ @MPG	Methylene blue	Dye: 20- 100 mg. L ⁻¹ NPs: 3 mg pH: 2- 9 Time: 1- 24h Temp.: 25° C- 50°C	152 mg. g ⁻¹	Wang, X. [9]
Fe ₃ O ₄ /AC	Rhodamine B	NPs: 0,02 g pH: 4- 10 Time: 0- 24h Stirring: 200 rpm	182,48 mg. g ⁻¹	Liu, X. [10]
Fe ₃ O ₄ HKUST-1	Methylene blue	Dye: 200- 1250 mg. L ⁻¹ NPs: 30 mg Temp.: 25°C	1277 mg. g ⁻¹	Kubo, M. [11]
Alg- Fe ₃ O ₄	Methylene blue	Dye: 10- 70 mg. L ⁻¹ NPs: 0,01- 0,1 g pH: 2- 12	47,84 mg. g ⁻¹	Mohammadi, A. [12]

		Time: 0- 120 min. Temp.: 0°C- 70°C Stirring: 120 rpm		
M Fe ₃ O ₄ /CS	X-3B	NPs: 0,4- 1 g. L ⁻¹ pH: 2- 10 Time: 0- 120 min. Temp.: 25°C- 45°C Stirring: 180 rpm	476 mg. g ⁻¹	Cao, C. [13]
Fe ₃ O ₄ @PAA	Rhodamine 6G	NPs: 5 mg pH: 4- 12 Time: 0- 90 min. Temp.: 30°C Stirring: 120 rpm	55,8 mg. g ⁻¹	Xu, Y. [14]
rGO-Fe ₂ O ₃ - Fe ₃ O ₄	Methylene blue	Dye: 20- 500 mg. L ⁻¹ NPs: 1 g. L ⁻¹ Time: 0- 180 min. Temp.: 37°C Stirring: 100 rpm	72,8 mg. g ⁻¹	Saiphaneendra, B. [15]
Fe ₃ O ₄	Methylene blue	Dye: 10- 20 mg. L ⁻¹ NPs: 0,005- 0,025 g pH: 3,5- 8.5 Time: 2- 6,8 min.	91,9 mg. g ⁻¹	Ghaedi, M. [16]
Fe ₃ O ₄ @GTP	Methylene blue	NPs: 0,25-1 g. L ⁻¹ pH: 3- 13 Time: 0- 18 min. Temp.: 280- 310 K Stirring: 150 rpm	7,25 mg. g ⁻¹	Singh, K.K. [17]
Fe ₃ O ₄ @C	Methylene blue	Dye: 10- 70 mg. L ⁻¹ pH: 3- 10 Time: 0- 250 min. Stirring: 250 rpm	44,38 mg. g ⁻¹	Zhang, Z. [18]
Fe ₃ O ₄ -CP (FMH-CP)	Methylene blue	Dye: 10- 1000 mg. L ⁻¹ NPs: 5 g. L ⁻¹ pH: 8 Time: 3 min. Temp.: 25°C Stirring: 200/ 6500 rpm	273,83 mg. g ⁻¹	Rakhshae, R. [19]
Fe ₃ O ₄ /lignin	Methylene blue	Dye: 10 µg. mL ⁻¹ NPs: 40, 100, 200 µg. mL ⁻¹ pH: 9 Time: 0- 90 min. Temp.: 30°C Stirring: 150 rpm	203,66 mg. g ⁻¹	Padilha, C. [20]
Fe ₃ O ₄ @UiO-66	Methylene blue	Dye: 20 mg. L ⁻¹ NPs: 20 mg Time: 0- 180 min.	205 mg. g ⁻¹	Ahmadipouya, S. [21]
Fe ₃ O ₄ @AC	Methylene blue	Dye: 50 mg. L ⁻¹ NPs: 0,01- 0,04 g pH: 2- 10 Time: 20- 120 min. Temp.: 27°C Stirring: 200 rpm	138 mg. g ⁻¹	Joshi, S. [22]
Fe ₃ O ₄	Methylene blue	Dye: 50 mg. L ⁻¹ NPs: 50 mg pH: 12 Time: 30 min. Temp.: 25°C	45,43 mg. g ⁻¹	Li, Z., et al. [23]

Fe ₃ O ₄ @AC	Methylene blue	Dye: 50 mg. L ⁻¹ NPs: 10 mg pH: 12 Time: 12 h Temp.: 25°C Stirring: 150 rpm	699.30 mg. g ⁻¹	Zhang, P., et al.[24]
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S2. Variables and levels defined.

Variables	Levels	Ref. (-)	Ref. (+)
Temperature (°C)	25, 45 °C	2, 3, 8, 11, 13, 19,23,24	3, 4, 9
pH	5, 9	1, 3, 4, 5, 6, 7, 8, 9, 10, 12, 13, 14, 16, 17, 22	1, 3, 5, 6, 7, 8, 10, 12, 13, 14, 17, 18, 22
Time	1, 20 min	1, 2, 3, 4, 5, 6, 7, 9, 10, 12, 14, 15, 16, 17, 18, 20, 21	1, 2, 4, 5, 7, 12, 14, 20, 21
Agitation	100, 1000 rpm	2, 17, 20	
Mass	10, 100 mg	2, 3, 7, 12, 15, 16, 19, 22	5, 13, 15, 17, 19

S3. Design matrix of fractional factorial (5⁻¹).

Test	Time (min)	Temperature (°C)	pH	Adsorbent (g)	Agitation (rpm)
1	1 (-)	25(-)	5	10	300
2	20(+)	25(-)	5	10	100
3	1 (-)	40(+)	5	10	100
4	20(+)	40(+)	5	10	300
5	1 (-)	25(-)	9	10	100
6	20(+)	25(-)	9	10	300
7	1(-)	40(+)	9	10	300
8	20(+)	40(+)	9	10	100
9	1(-)	25(-)	5	100	100
10		25(-)	5	100	300
	20(+)				
11	1 (-)	40(+)	5	100	300
12	20(+)	40(+)	5	100	100
13	1(-)	25(-)	9	100	300
)				
14	20(+)	25(-)	9	100	100
15	1 (-)	40(+)	9	100	100
16	20(+)	40(+)	9	100	300

S4. Design matrix of full factorial (2³).

Test	Time (min)	Temperature (°C)
1	1 (-)	20(-)
2	31(0)	20(-)

3	61 (+)	20(-)
4	1 (-)	30(0)
5	31(0)	30(0)
6	61 (+)	30(0)
7	1 (-)	40(+)
8	31(0)	40(+)
9	61 (+)	40(+)
10	31(0)	30(0)
11	31(0)	30(0)

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