Data in Brief 20 (2018) 903–908

Contents lists available at ScienceDirect

Data in Brief

journal homepage: www.elsevier.com/locate/dib

Data Article

Data on the alizarin red S adsorption from aqueous solutions on PAC, treated PAC, and PAC/γ ≈ Fe_2O_3

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ARTICLE INFO

Article history:
Received 13 July 2018
Received in revised form
18 August 2018
Accepted 27 August 2018
Available online 31 August 2018

Keywords:
Adsorption
Textile effluents
Dye
Aqueous solutions
Fe_2O_3

ABSTRACT

Three types of adsorbents of powdered activated carbon (PAC), treated PAC, and PAC/γ ≈ Fe_2O_3 nanocomposite were used. The adsorption experiments were performed in batch conditions. pH_{ZPC} of PAC/γ ≈ Fe_2O_3 was 6.7. As a result, at lower than pH_{ZPC}, acidic pH, the adsorption of alizarin red S on PAC/γ ≈ Fe_2O_3 was favourable. The maximum of alizarin red S adsorption of PAC, treated PAC, and PAC/γ ≈ Fe_2O_3 was 24.5 mg/g, 57.8 mg/g, and 112.56 mg/g, respectively. The models of Langmuir and pseudo-first-order were a fit model to describe the adsorption isotherm and the Kinetic, respectively. The PAC/γ ≈ Fe_2O_3 is a promising class of the adsorbents in the adsorption of various dyes from textile effluents.

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https://doi.org/10.1016/j.dib.2018.08.170

Specifications Table

Subject area	*Wastewater treatment*
More specific subject area	*Adsorption*
Type of data	*Table, figure*
How data was acquired	*Spectrophotometer RD-5000(UV-UVIS, 570 nm)*
Data format	*Analyzed,*
Experimental factors	*The adsorption experiments were performed in batch conditions. The main variables studied were initial dye concentration, pH, reaction time, and treated PAC and PAC/γ ≈ Fe_2O_3 dosage. An adsorbent of PAC, treated PAC and PAC-γ-Fe_2O_3 nanocomposite was added to 100 mL of alizarin red S solution. The residual dye was measured by a spectrophotometer DR-5000 (UV-UVIS, 350 nm).*
Experimental features	*In the first step, in order to prepare treated PAC. After separation, the dark-brown precipitate was washed several times with methanol to remove the residual matter.*
Data source location	*Khorramabad, Lorestan University of Medical Sciences, Iran (lums.ac.ir)*
Data accessibility	*Data are included in this article*
Related research article	*S. Golmohammadi, M. Ahmadpour, A. Mohammadi, A. Alinejad, N. Mirzaei, M. Ghaderpoori, A. Ghaderpoori. Removal of blue cat 41 dye from aqueous solutions with ZnO nanoparticles in combination with US and US-H2O2 advanced oxidation processes. Environmental Health Engineering and Management Journal. 3 (2016) 107-13*

Value of the data

- The data from the present study showed that the modification of conventional absorbents can be used to considerably enhance the ability to remove environmental pollutants.
- The data obtained can be used to complete the information in literature on the removal of dye compounds from water environments and industrial effluents.

1. Data

The XRD pattern and SEM for treated PAC and PAC/γ ≈ Fe_2O_3 nanocomposite are presented in Fig. 1. Based on BET, the surface area of PAC, treated PAC, and PAC/γ ≈ Fe_2O_3 were found to be 389 m^2/g, 550 m^2/g, and 400 m^2/g, respectively. Fig. 2 shows the effect of solution pH of PAC, treated, PAC and PAC/γ ≈ Fe_2O_3 nanocomposite on alizarin red S adsorption. The results of the study showed that the pH of the zero point (pH_{ZPC}) was 6.5. Fig. 3 shows the effect of adsorbent dose of PAC, treated PAC, and PAC/γ ≈ Fe_2O_3 nanocomposite on alizarin red S adsorption. Fig. 4 depicts the effect of initial concentration of PAC, treated PAC, and PAC/γ ≈ Fe_2O_3 nanocomposite on alizarin red S adsorption. The constants of isotherm models for PAC, treated PAC and PAC/ γ-Fe_2O_3 nanocomposite on alizarin red S adsorption are given in Table 1. As illustrated in Table 1, the isotherm model of Langmuir for PAC, treated PAC and PAC/γ-Fe_2O_3 nanocomposite has the highest R^2 (e.g. square correlation). Therefore, this model was the most suitable model to express alizarin red S adsorption onto the adsorbents. Also, the constants of kinetics models for PAC, treated PAC and PAC/γ-Fe_2O_3 nanocomposite on alizarin red S adsorption are summarized in Table 2. As illustrated in Table 2, the kinetic model of pseudo-second order for PAC, treated PAC and PAC/γ-Fe_2O_3 nanocomposite has the highest R^2. As a result, this model was the most suitable kinetics model for alizarin red S adsorption onto the prepared adsorbents.

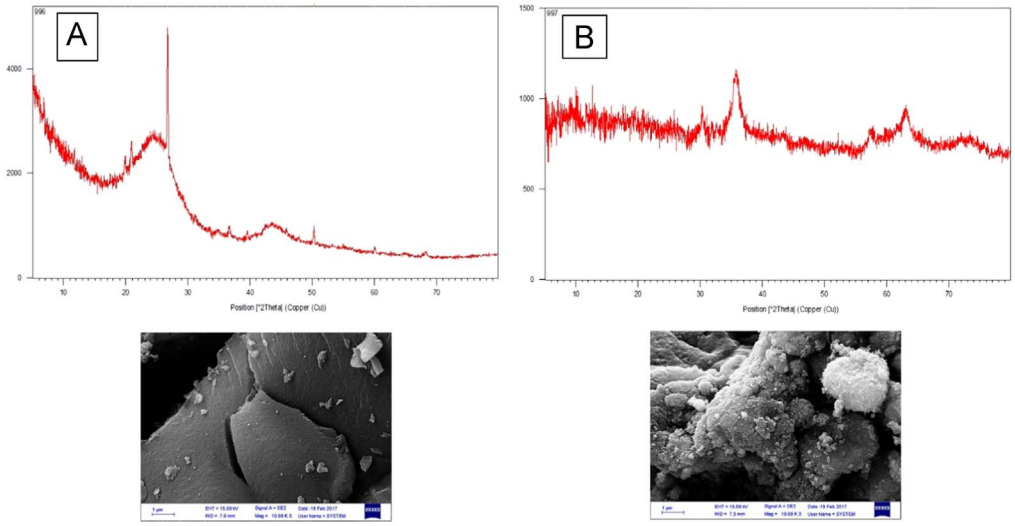

Fig. 1. The XRD pattern and SEM images of treated PAC (A) and PAC/γ-Fe_2O_3 nanocomposite (B).

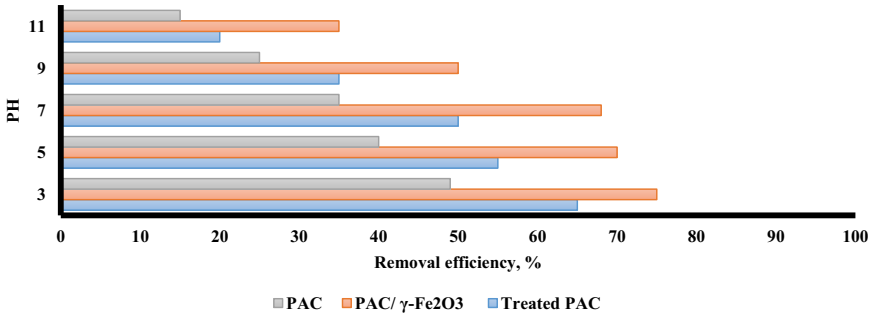

Fig. 2. The effect of solution pH on alizarin red S adsorption by PAC, treated PAC, and PAC/γ-Fe_2O_3 nanocomposite.

2. Experimental design, materials, and methods

2.1. Materials

The chemicals including hydrochloric, hydrochloric, powered activated carbon (PAC), iron chloride tetrahydrate, iron chloride tetrahydrate, and alizarin red S were used. These high purity chemicals were purchased from Merck and Sigma-Aldrich.

2.2. Preparation of treated PAC and PAC-γ-Fe_2O_3 nanocomposite

For PAC coatings by $\gamma \approx Fe_2O_3$, the methodology of previous studies were obeyed [1,2]. In the first step, in order to prepare treated PAC, this method was as follows: 20 g of PAC was added to a solution of 5 M nitric acid (Approximately 150 mL). The solution was placed at 70 ° C for 1 h. In the next step, in order to prepare activated carbon coated with γ-Fe_2O_3, this method was as follows: treated PAC [4.2 g], $FeCl_3$–$6H_2O$ [21.6 g, purity $>$ 99%], and $FeCl_2$–$4H_2O$ [8 g, purity $>$ 98%], were added to a solution of 2 M hydrochloric (Approximately 100 mL, purity 37%). The NH_3. H_2O solution a solution of 2 M NH_3. H_2O solution (Approximately 300 mL) was added to the previous solution for 2 h. Finally, the remaining precipitate was separated by a magnet. After separation, the dark-brown precipitate was

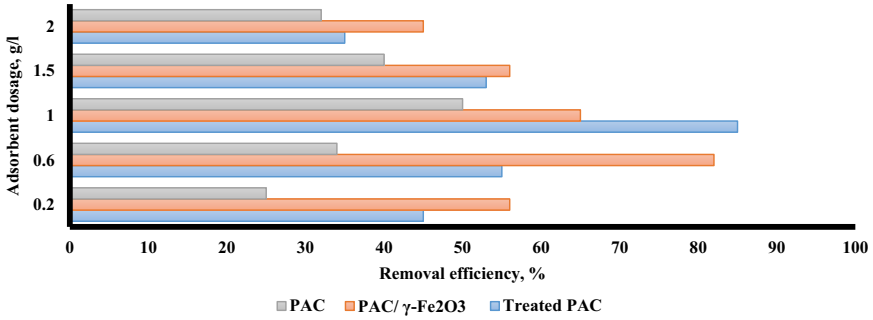

Fig. 3. The effect of adsorbent dose of PAC, treated PAC, and PAC/γ-Fe_2O_3 nanocomposite on alizarin red S adsorption.

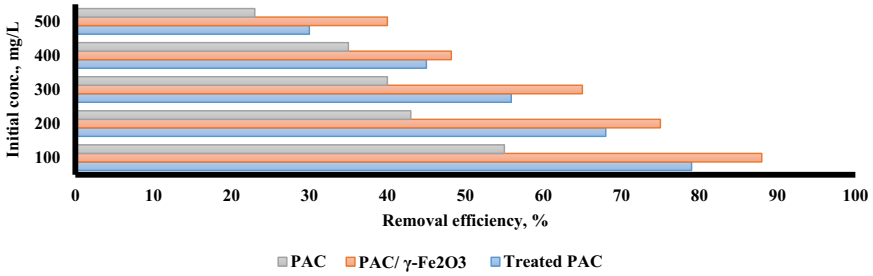

Fig. 4. The effect of initial concentration of dye on alizarin red S adsorption by PAC, treated PAC, and PAC/γ-Fe_2O_3 nanocomposite.

Table 1
The constants of isotherm models for alizarin red S adsorption by PAC, treated PAC, and PAC/γ-Fe_2O_3 nanocomposite.

		PAC	Treated PAC	PAC/γ ≈ Fe_2O_3
Langmuir	q_{max}	24.5	57.8	112.56
	KL	1.05	1.66	2.45
	R^2	0.88	0.89	0.89
Freundlich	K_F	1.43	1.68	2.04
	n	1.12	1.78	2.6
	R^2	0.64	0.77	0.87

Table 2
The constants of kinetics models for alizarin red S adsorption by PAC, treated PAC, and PAC/γ-Fe_2O_3 nanocomposite.

		PAC		Treated PAC		PAC/γ ≈ Fe_2O_3	
		100 mg/l	200 mg/l	100 mg/l	200 mg/l	100 mg/l	200 mg/l
Psudo-first-order	K_1	0.0164	0.0136	0.0234	0.0289	0.0235	0.0267
	R^2	0.845	0.876	0.985	0.896	0.976	0.979
	q_{cal}	22.54	28.92	39.63	47.16	61.45	90.20
Psudo-second-order	K_2	0.0198	0.0204	0.0342	0.0356	0.0435	0.0567
	R^2	0.845	0.876	0.985	0.896	0.976	0.979
	q_m	24.36	28.41	41.45	50.45	68.95	89.78

washed several times with methanol to remove the residuals. After washing, the final product was dried at 70 °C for 24 h. After preparation of treated PAC and PAC/γ ≈ Fe_2O_3 nanocomposite, their characterizations were determined using SEM, XRD, and BET techniques [1–16].

2.3. The adsorption experiments

The adsorption feasibility of Alizarin red S was studied by PAC, treated PAC, and PAC/γ ≈ Fe_2O_3 nanocomposite. The adsorption experiments were performed in batch conditions. The main variables studied were initial dye concentration, pH, reaction time, and treated PAC and PAC-γ-Fe_2O_3 dosage. At the first step, a stock Alizarin red S solution ($C_{14}H_8O_4$, 1000 mg/l, 240.21 g/mol, pK_a = 6.9) was prepared and stored under standard conditions. An adsorbent of PAC, treated PAC and PAC-γ-Fe_2O_3 nanocomposite was added to 100 mL of Alizarin red S solution. Equation $C_1V_1 = C_2V_2$ was used to prepare different concentrations of stock solution. The solutions of 0.1 N HCl and NaOH were used to adjust the desired pH. The residual dye was measured by a spectrophotometer DR-5000 (UV-UVIS, 350 nm) [3].

Acknowledgements

The authors of the study thanks Lorestan University of Medical Sciences to support.

Transparency document. Supplementary material

Transparency document associated with this article can be found in the online version at https://doi.org/10.1016/j.dib.2018.08.170.

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