

Supplementary material

Figure S1 Structure of (a) methylene blue and (b) kaolinite DD3.

Figure S2 Adsorption tests for the removal of MB on acid activated prepared materials, (C_0 (MB) = 250 mg/L, m/V = 1 g/L, contact time 24 h, $T = 25 \pm 3$ °C, and unadjusted pH).

Figure S3 Point of zero charge (pH_{pzc}) of DD3 and Treated-DD3.

Figure S4 Plots showing the variation in the amount of MB adsorbed on DD3 and Treated-DD3 in the time range 0–60 min for the PSO model (m/V = 1 g/L, $T = 25 \pm 3$ °C, and unadjusted pH), as a nonlinear expression.

Figure S5 Multicollinearity test

Figure S6 Residuals relating to the model established by the different techniques according to the estimated values: (a) Relationship between experimental data and the predicted data of samples, (b) Residue of errors, and (c) Instances distribution of errors, and (d) Frequency distribution of errors.

Figure S7 MATLAB Interface: prediction of the adsorption quantity with GPR-PSO model.

Table S1. Maximum adsorption capacity (Q_{max} (mg/g) of MB by various adsorbents in other reports.

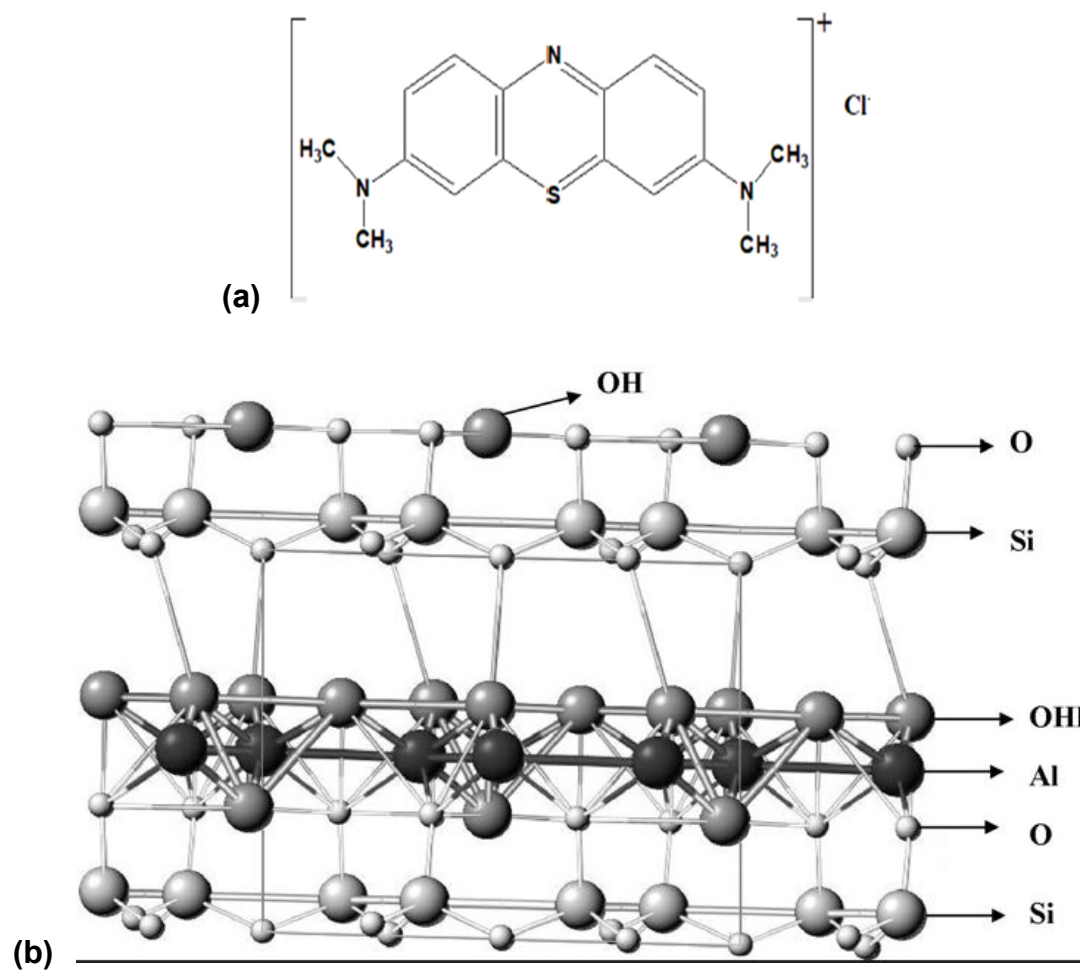


Figure S1

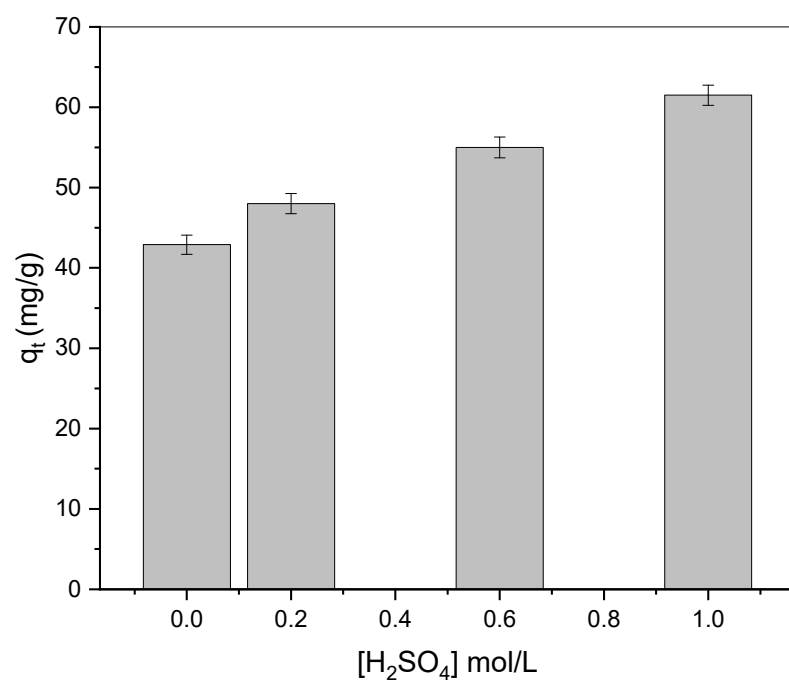


Figure S2

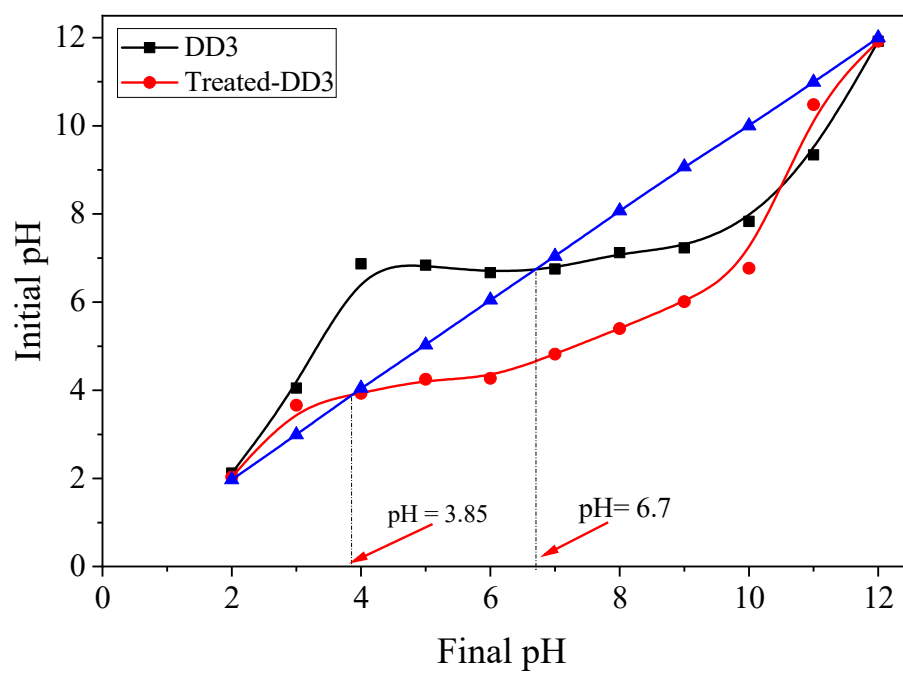


Figure S3

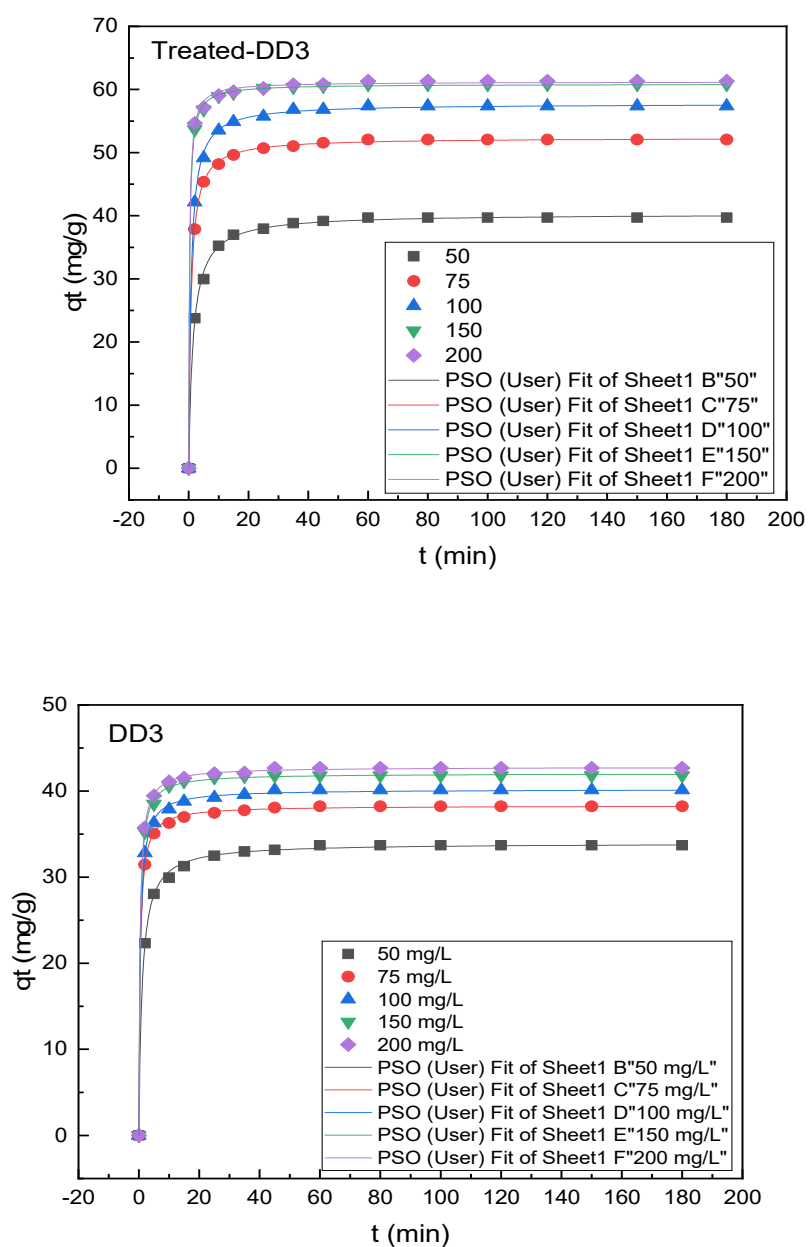


Figure S4

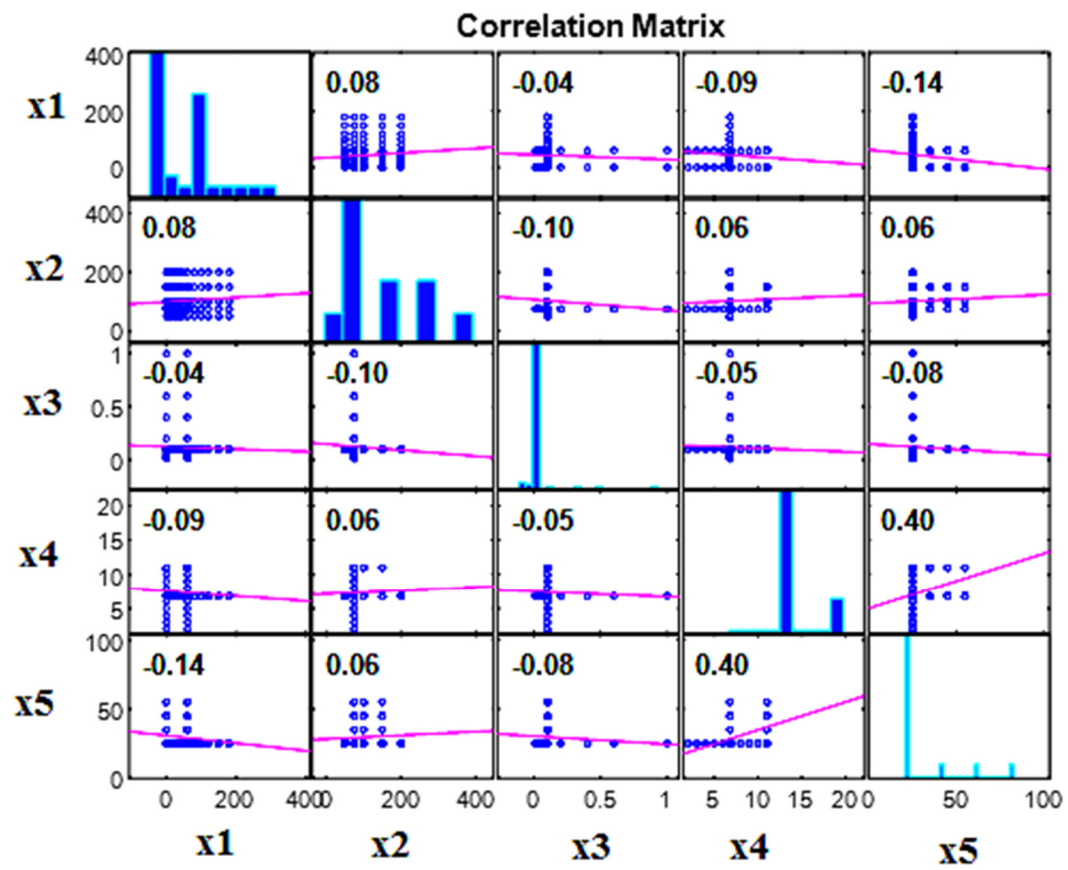
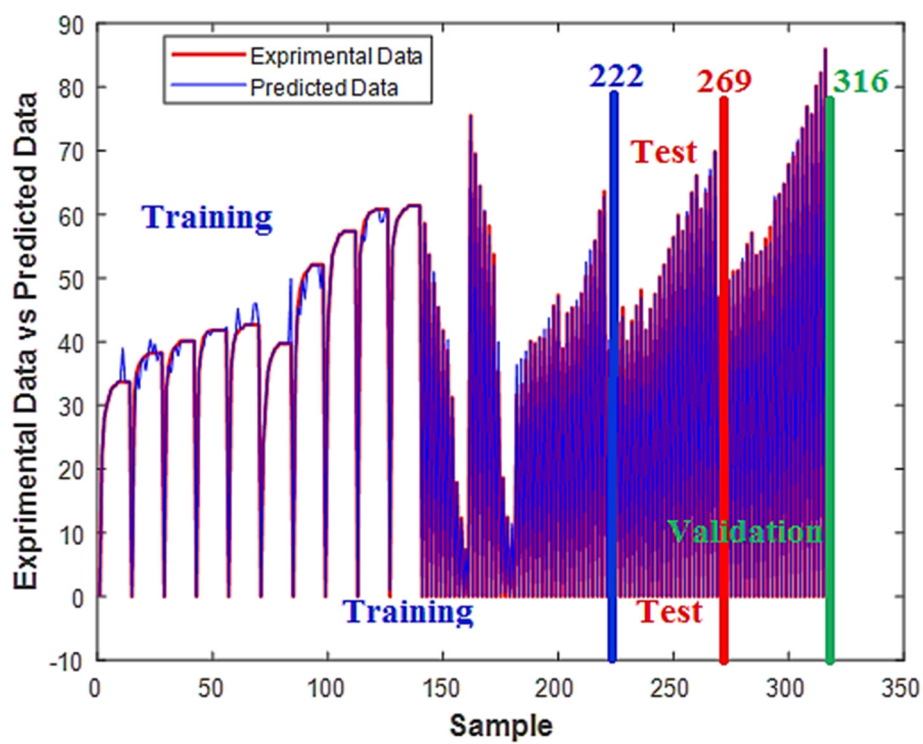
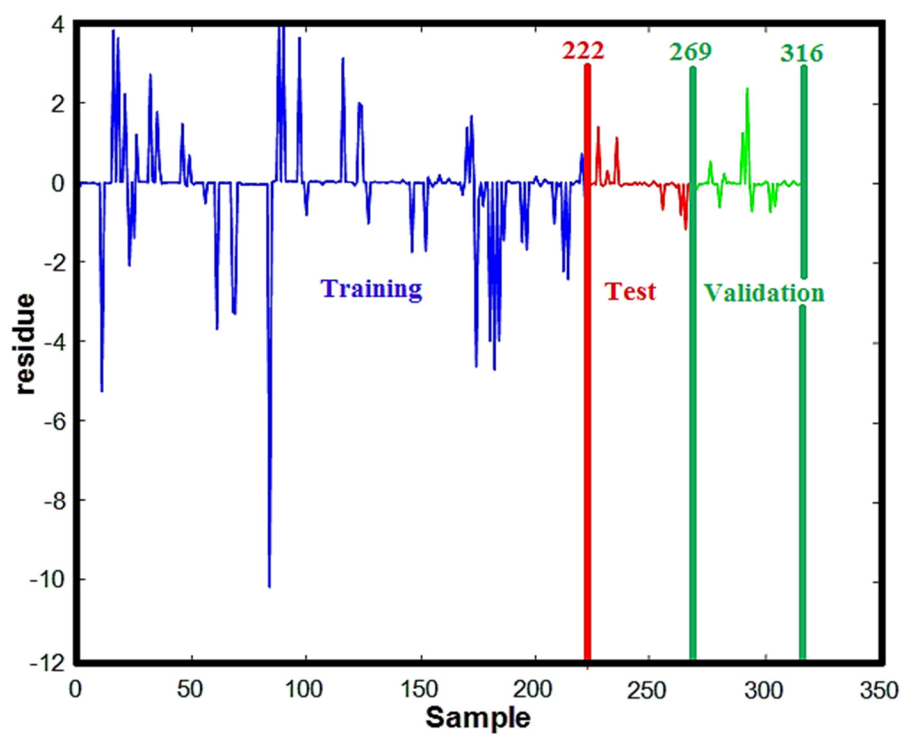


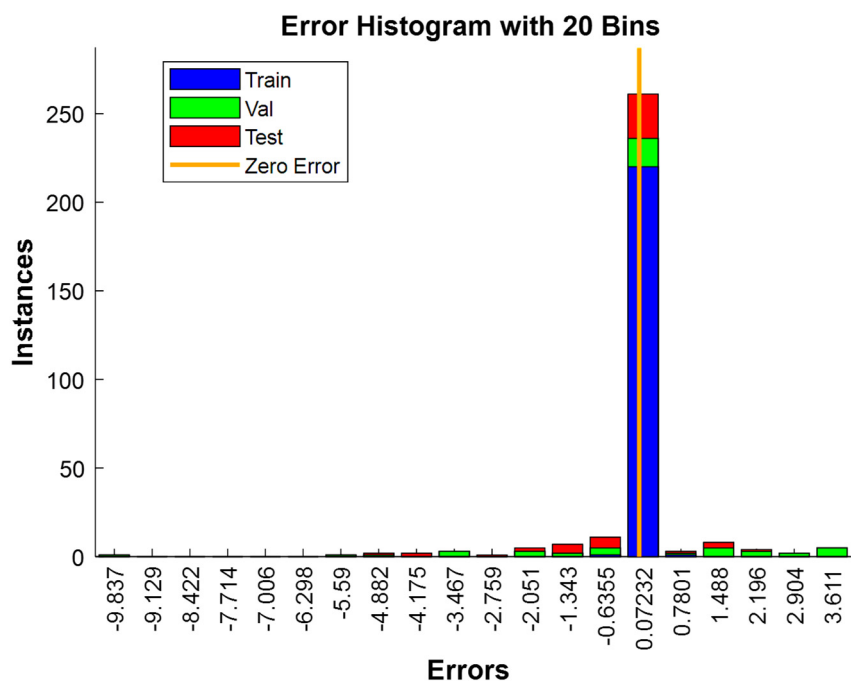
Figure 5



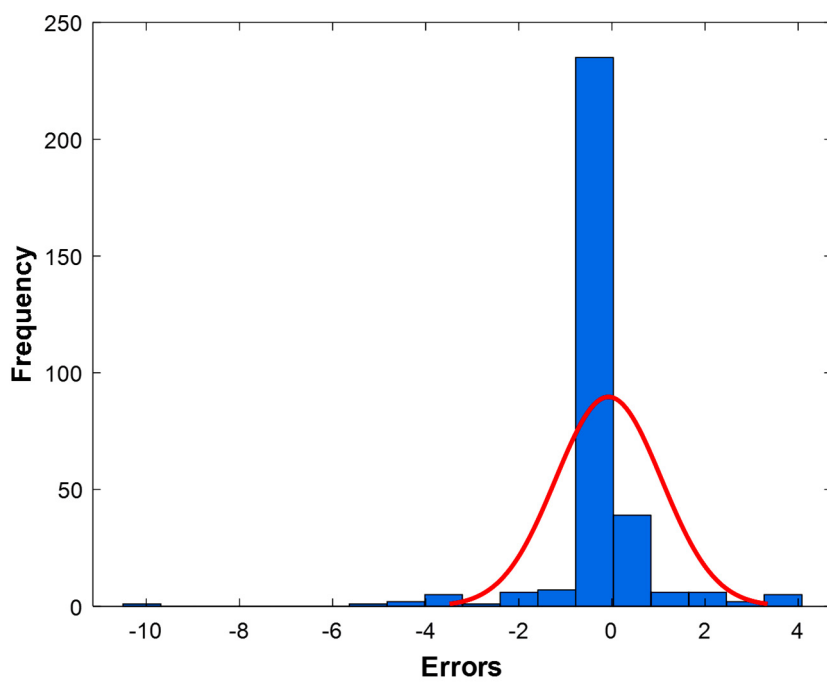
(a)



(b)



(c)



(d)

Figure S6

Application_DD3_and_AADD3_for_MB_uptake

Prediction using GPR_PSO model

Note:

X1: Contact time (min)
X2: Initial MB concentration (mg/L)
X3: Mass of adsorbent (g)
X4: pH
X5: Temperature (°C)
X6: Type of adsorbent :
 To choose DD3, put number "1"
 To choose AADD3, put number "2"

Inputs	
X1	60
X2	75
X3	0.1
X4	11
X5	25
X6	2

RUN

GPR_PSO

Delete all values

CLC

MB uptake (mg/g), predicted values

62.8512

Figure S7

Table S1

Adsorbents	Qmax (mg/g)	References
Kaolin KAFE-7	42.3	Fei, F et al. (2020)
Kaolin KT3B	52.76	Mouni, L et al. (2018)
Zeolite 4AZW	9.95	Imessaoudene A. et al (2022)
Persian Kaolin	29.85	Tehrani-Bagha, A.R. et al (2011)
Geopolymer	39.52	Candamano, S. et al (2023)
Zeolite	22.00	Rida, K. et al. (2013)
10% GK	28.02	Kai, He et al. (2018)
Treated-DD3	64.58	In this study