Application of Carbon Composite Adsorbents Prepared from Coffee Waste and Clay for the Removal of Reactive Dyes from Aqueous Solutions

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Figure S1. (a) Structural formula of RB-19 and pKa values of each acidic group; (b) optimised three-dimensional structural formula of RB-19. The physicochemical properties of the chemical molecule was calculated using MarvinSketch (version 14.9.22.0). Van der Waals surface area = 687.79 A^2 (pH 2.0-14.0); polar surface area = 229.96 A^2 (pH 2.0-14.0); dipole moment = 38.00 Debye.



Figure S2. (a) Structural formula of RV-5 and pKa values of each acidic group; (b) optimised three-dimensional structural formula of RV-5. The physicochemical properties of the chemical molecule was calculated using MarvinSketch (version 14.9.22.0). Van der Waals surface area = 783.50 A² (pH 1.0-6.0); polar surface area = 309.25 A² (pH 1.0-6.0); dipole moment = 17.87 Debye.



Figure S3. Preliminary experiments of sorption capacity of different carbon composite adsorbents for RB-19 and RV-5 dyes removal from aqueous solutions. Conditions: pH 2.0; adsorbent mass 50.0 mg; temperature 25 °C and dye concentration of 150.0 mg L^{-1} .



Figure S4. BJH pore radius distribution of CC-1.3 (a) and ACC-1.3 (b). Data are based on the desorption isotherm.





Figure S5. Scanning electron microscopy images of (a) $1,000 \times$ magnification CC-1.3; (b) $1,000 \times$ magnification ACC-1.3. Acceleration voltage, 15 kV.



Figure S6. FTIR (KBr) of (a) CC-1.3 and (b) ACC-1.3.





Figure S7. Effect of pH on the sorption capacity. (a) RB-19; (b) RV-5. Conditions: temperature 25 °C; adsorbent mass 50.0 mg and dye concentration of 150.0 mg L^{-1} .



Figure S8. pHpzc of (a) CC-1.3 and (b) ACC-1.3. Temperature 25 $^{\circ}$ C; mass of adsorbent 50.0 mg.



Figure S9. Intra-particle diffusion graphs of RB-19. Temperature 25 °C; mass of adsorbent 50.0 mg; initial pH 2.0; initial dye concentrations 100.0 and 200.0 mg L^{-1} of RB-19 dye.



Figure S10. Intra-particle diffusion graphs of RV-5. Temperature 25 °C; mass of adsorbent 50.0 mg; initial pH 2.0; initial dye concentrations 100.0 and 200.0 mg L^{-1} of RV-5 dye.