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*Article*

# Effective Adsorptive Removal of Coomassie Violet Dye from Aqueous Solutions Using Green Synthesized Zinc Hydroxide Nanoparticles Prepared from *Calotropis gigantea* Leaf Extract

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**Supplementary Materials**

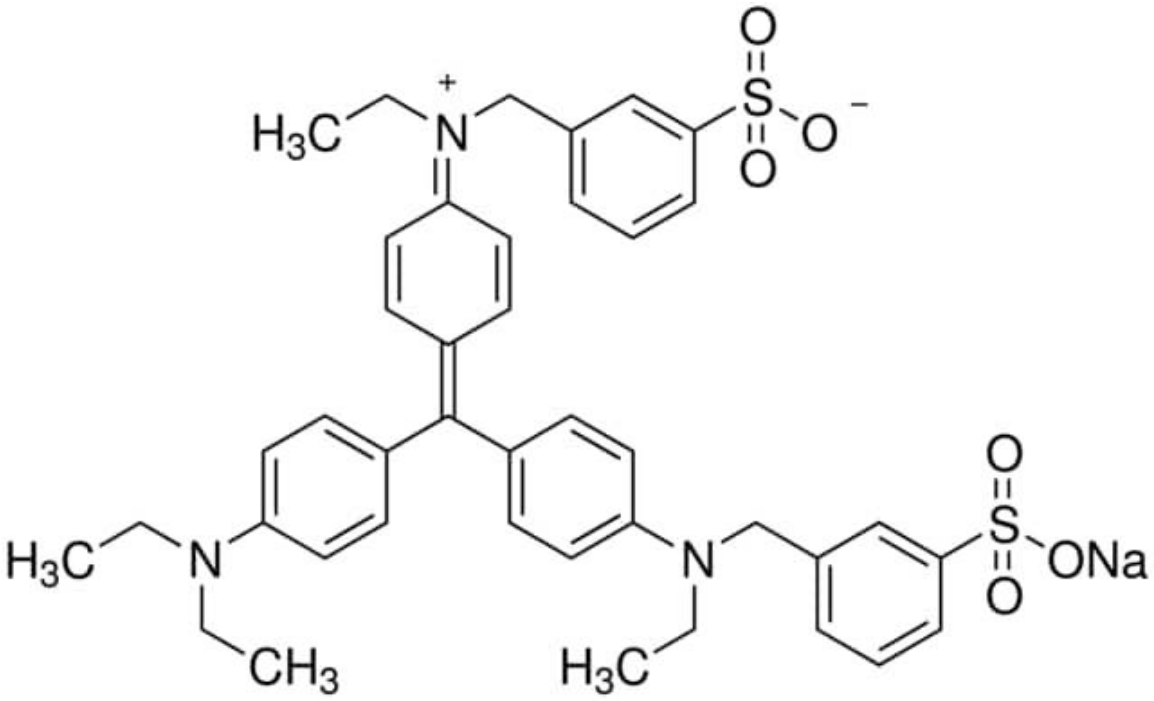


**Figure S1**. Chemical structure of Coomassie violet (CV) dye.

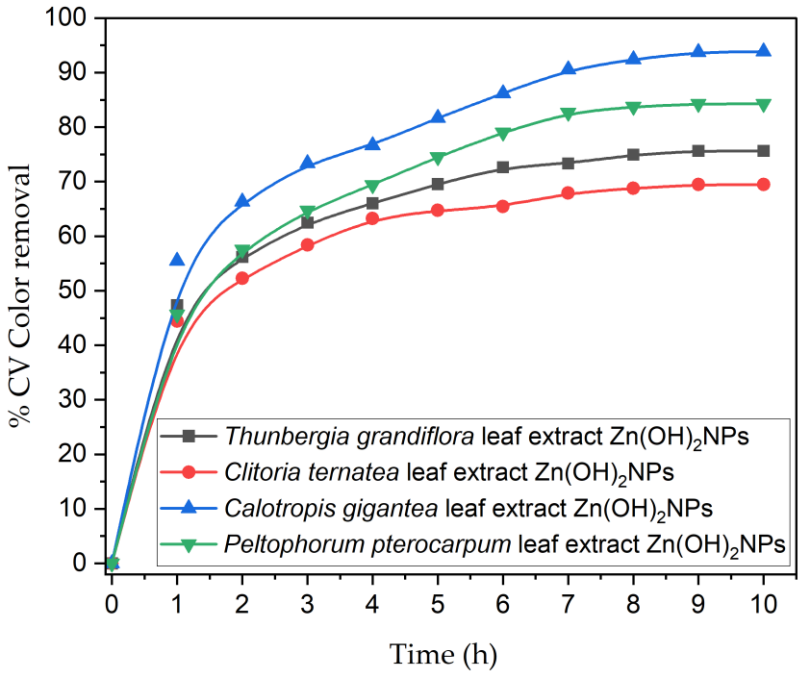


**Figure S2**. Selection of suitable plant leaf extract zinc hydroxide nanoparticles for the removal of CV dye from wastewater. (Initial pH: 2; initial dye concentration: 100 mg $L^{-1}$; plant leaf extract nanoparticle adsorbent dosage: 5 g $L^{-1}$; adsorbent particle size: < 150 μm; agitation speed: 150 rpm; contact time 10 h; temperature: 299 K

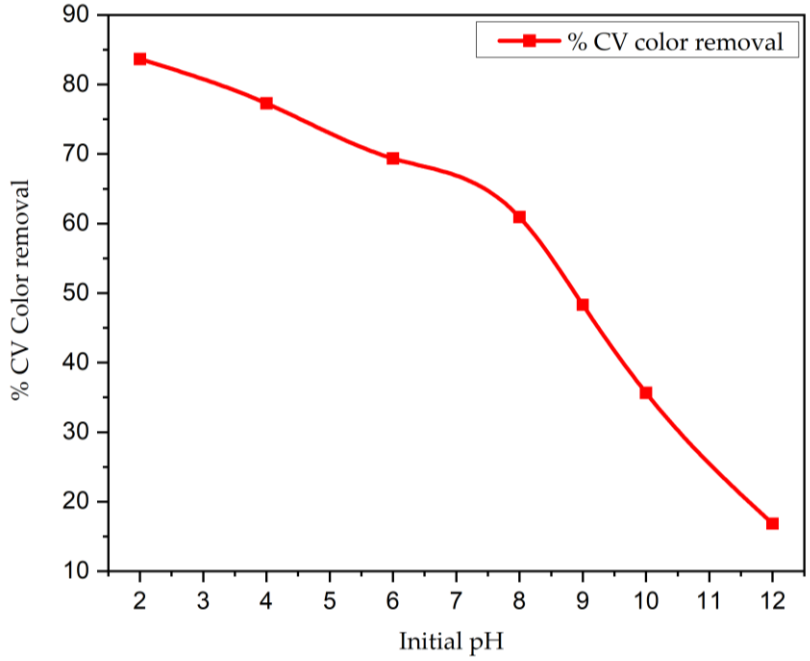


**Figure S3**. Effect of initial pH on decolorization of CV dye using *Calotropis gigantea* leaf extract zinc hydroxide nanoparticles (CG-$Zn(OH)_2$NPs) adsorbent. (Initial dye concentration: 200 mg $L^{-1}$; CG-$Zn(OH)_2$NPs adsorbent dosage: 6 g $L^{-1}$; adsorbent particle size: 65.38 μm; shaking speed: 150 rpm; temperature: 299 K; contact time: 8 h)

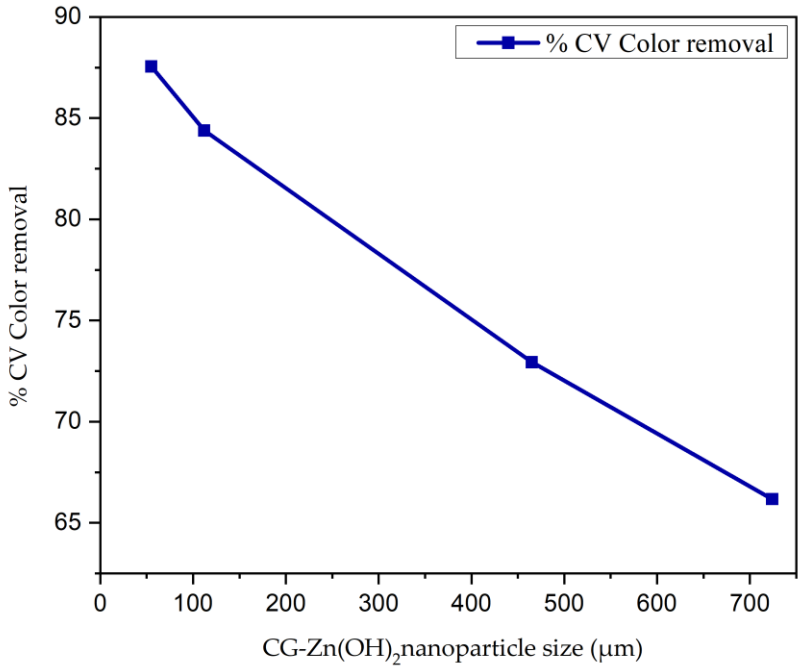


**Figure S4**. Effect of CG-$Zn(OH)_2$ nanoparticle size on CV dye decolorization. (Initial pH: 2; initial dye concentration: 200 mg $L^{-1}$; CG-$Zn(OH)_2$NPs adsorbent dosage: 6 g $L^{-1}$; shaking speed: 150 rpm; temperature: 299 K; contact time: 8 h)

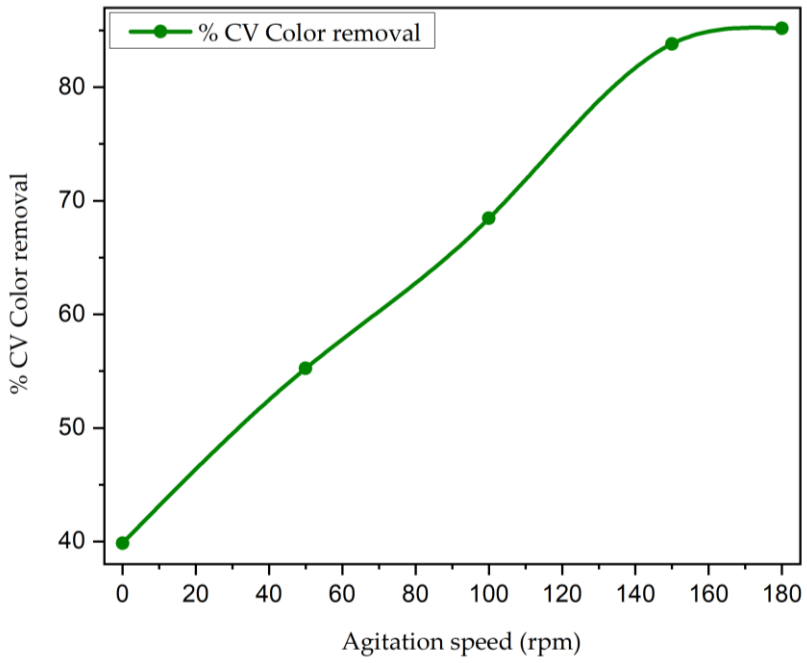


**Figure S5**. Effect of shaking speed on the decolorization of CV dye using CG-$Zn(OH)_2$NPs adsorbent. (Initial pH: 2; initial dye concentration: 200 mg $L^{-1}$; CG-$Zn(OH)_2$NPs adsorbent dosage: 6 g $L^{-1}$; adsorbent particle size: 65.38 μm; temperature: 299 K; contact time: 8 h)

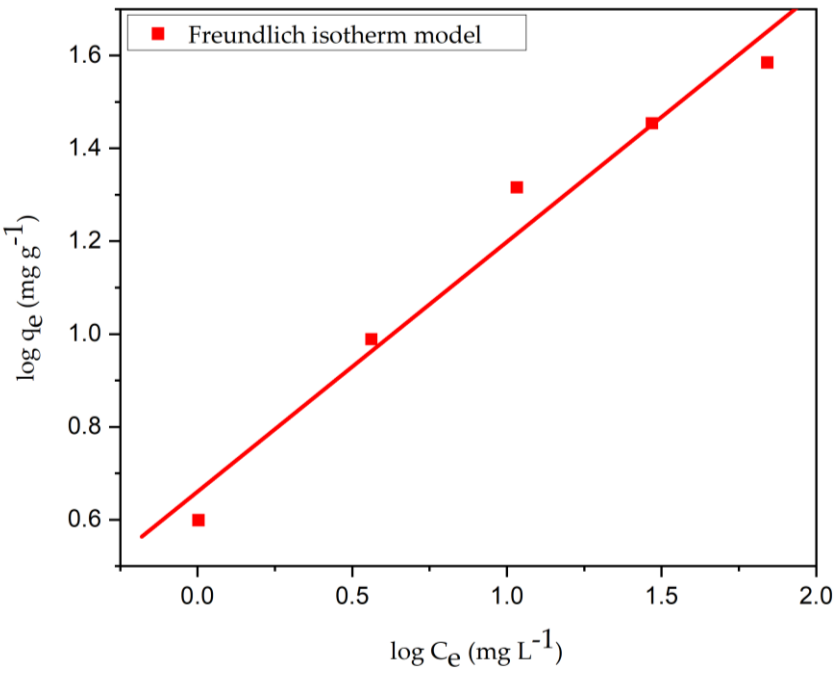


**Figure S6.** Freundlich isotherm plot for decolorization of CV dye using CG-$Zn(OH)_2$NPs adsorbent. (Initial pH: 2; initial dye concentration: 25–300 mg $L^{-1}$; CG-$Zn(OH)_2$NPs adsorbent dosage: 6 g $L^{-1}$; adsorbent particle size: 78 µm; shaking speed: 150 rpm; temperature: 299 K; contact time: 24 h)

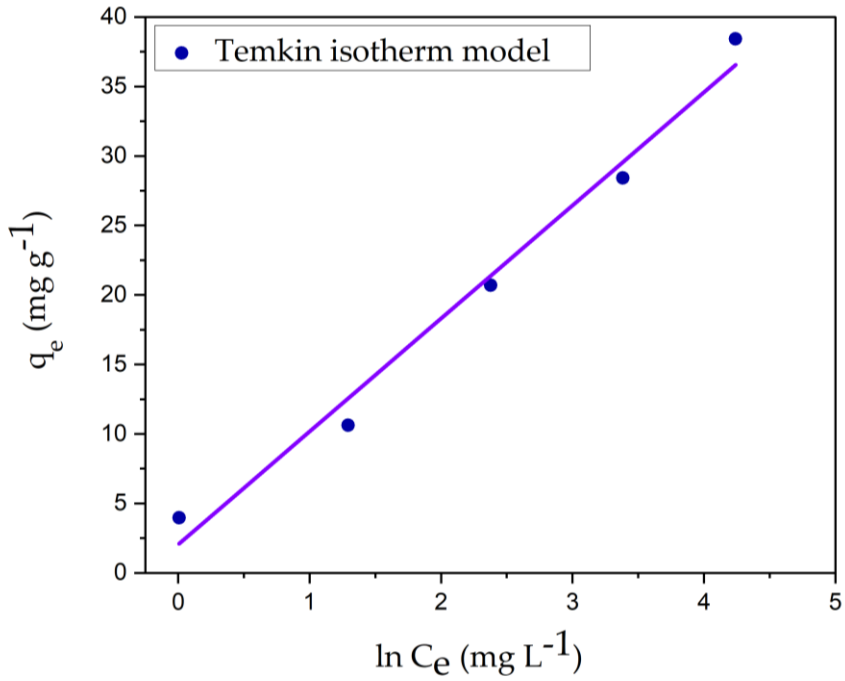


**Figure S7.** Temkin isotherm plot for decolorization of CV dye using CG-$Zn(OH)_2$NPs adsorbent. (Initial pH: 2; initial dye concentration: 25–300 mg $L^{-1}$; CG-$Zn(OH)_2$NPs adsorbent dosage: 6 g $L^{-1}$; adsorbent particle size: 78 µm; shaking speed: 150 rpm; temperature: 299 K; contact time: 24 h)

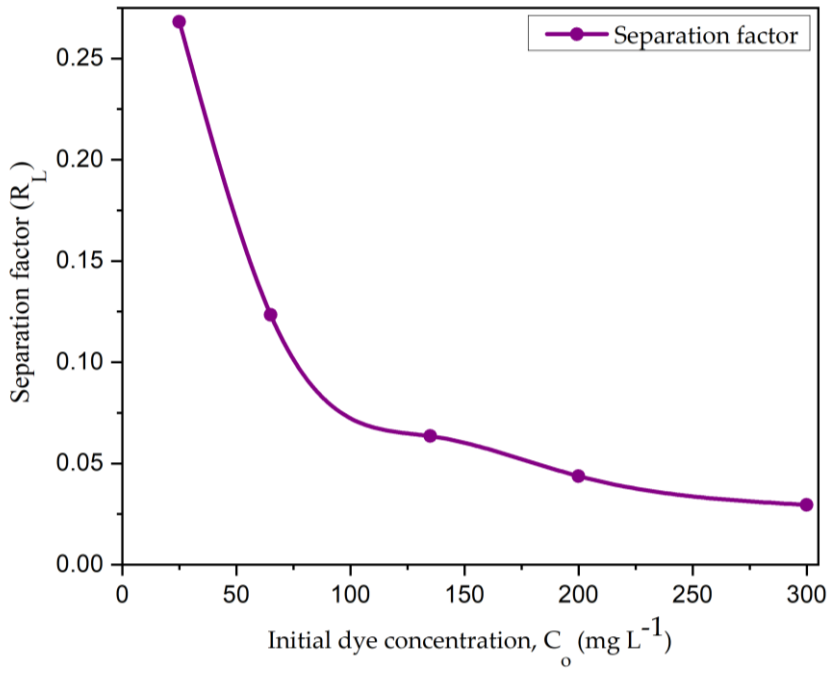


**Figure S8**. Separation factor for decolorization of CV dye using CG-Zn(OH)$_2$NPs adsorbent. (Initial pH: 2; initial dye concentration: 25–300 mg $L^{-1}$; CG-Zn(OH)$_2$NPs adsorbent dosage: 6 g $L^{-1}$; adsorbent particle size: 78 μm; shaking speed: 150 rpm; temperature: 299 K; contact time: 24 h)

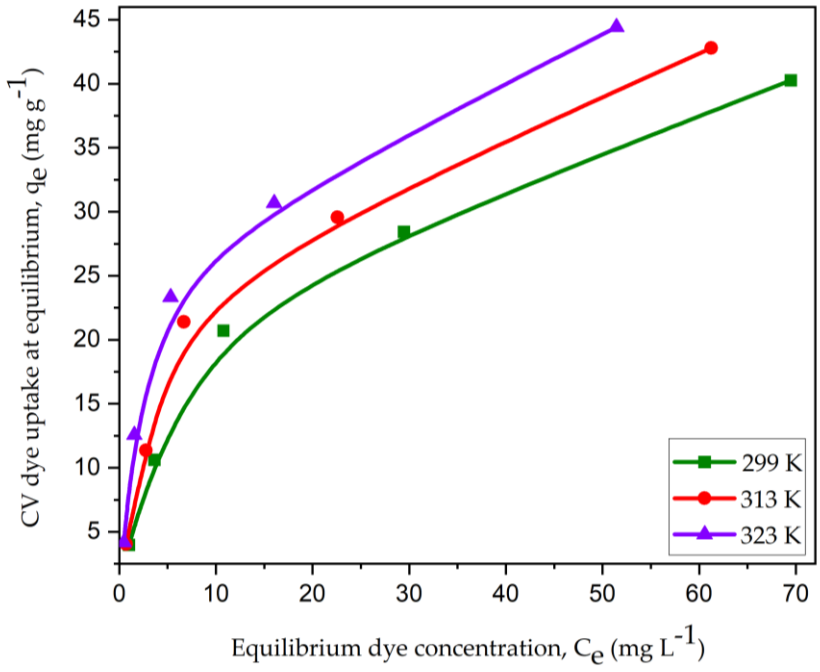


**Figure S9.** Effect of temperature on decolorization of CV dye using CG-Zn(OH)$_2$NPs adsorbent. (Initial pH: 2; initial dye concentration: 25–300 mg $L^{-1}$; CG-Zn(OH)$_2$NPs adsorbent dosage: 6 g $L^{-1}$; adsorbent particle size: 78 μm; shaking speed: 150 rpm; contact time: 24 h)

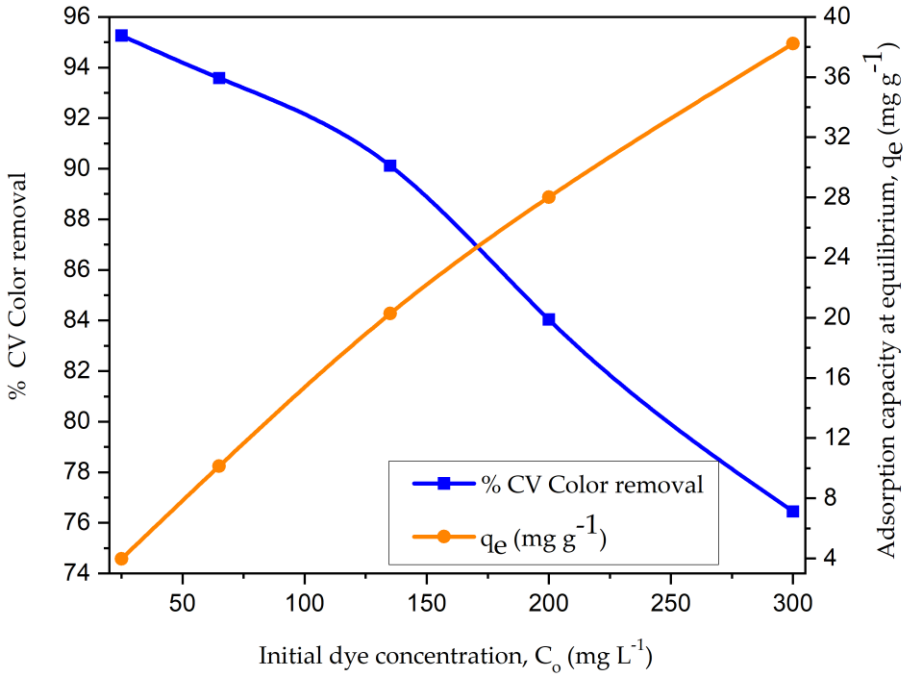


**Figure S10**. Effect of initial dye concentration on decolorization of CV dye using CG-$Zn(OH)_2$NPs adsorbent. (Initial pH: 2; CG-$Zn(OH)_2$NPs adsorbent dosage: 6 g $L^{-1}$; adsorbent particle size: 78 μm; shaking speed: 150 rpm; contact time: 24 h)

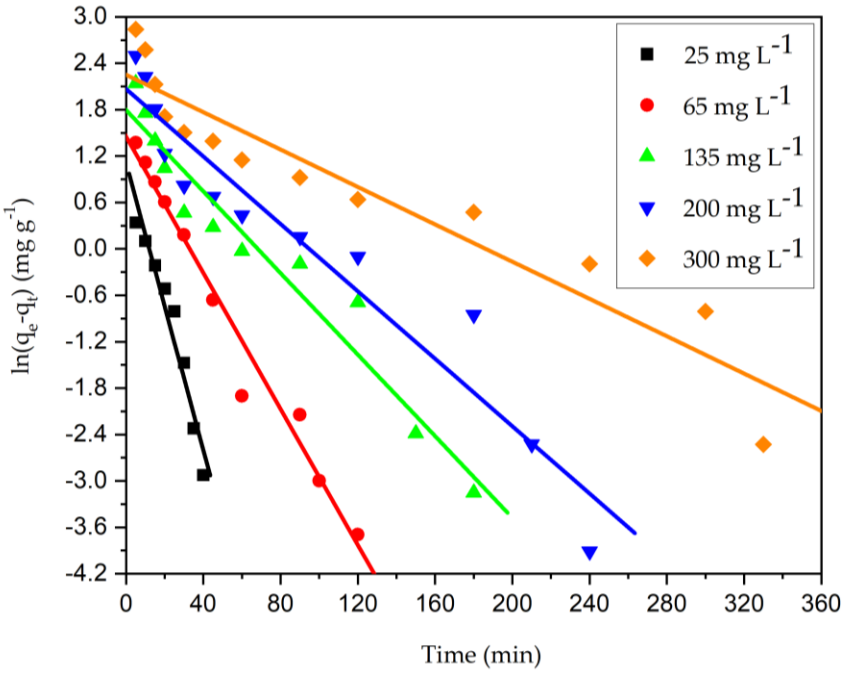


**Figure S11**. Lagergren pseudo-first-order kinetic plot for decolorization of CV dye using CG-$Zn(OH)_2$NPs adsorbent. (Initial pH: 2; initial dye concentration: 25–300 mg $L^{-1}$; CG-$Zn(OH)_2$NPs adsorbent dosage: 6 g $L^{-1}$; adsorbent particle size: 78 μm; shaking speed: 150 rpm; temperature: 299 K; contact time: 24 h)

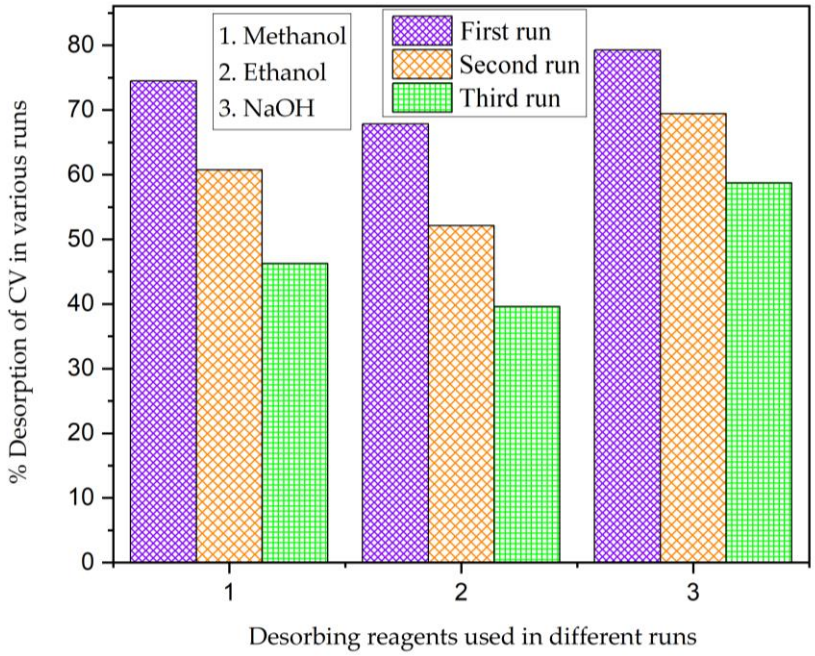


**Figure S12.** Desorption efficiency of CV dye from CG-Zn(OH)$_2$NPs loaded adsorbent in various runs. (Volume of desorbing reagent: 100 mL; shaking speed: 150 rpm; temperature: 299 K; contact time: 24 h)

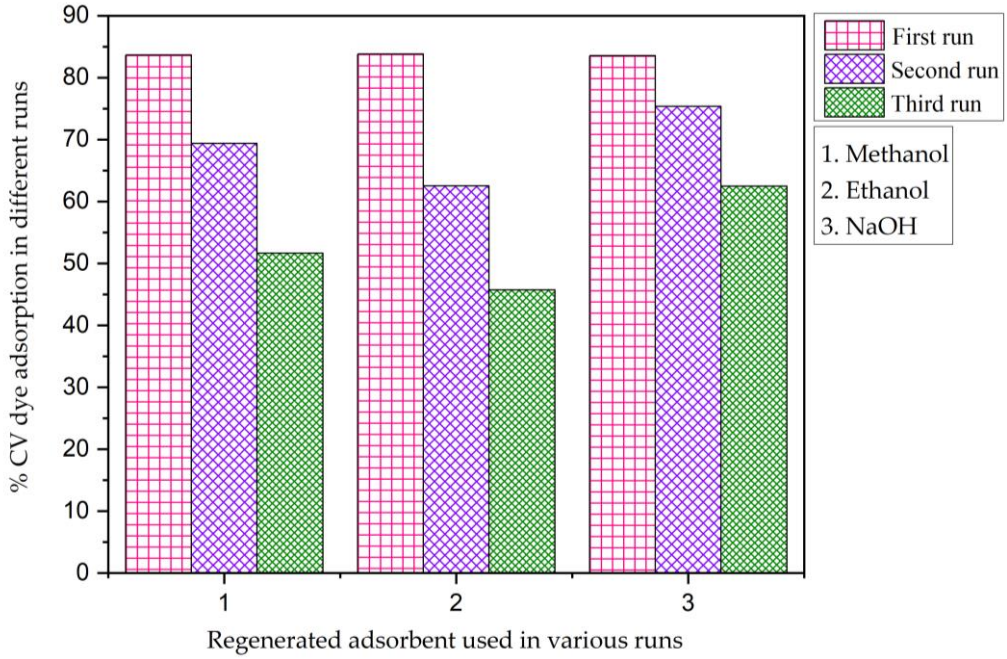


**Figure S13**. Reusability of CG-Zn(OH)$_2$NPs adsorbent for the decolorization of CV dye in various runs. (Initial pH: 2; initial dye concentration: 200 mg $L^{-1}$; volume of dye solution: 100 mL; shaking speed: 150 rpm; temperature: 299 K; contact time: 24 h)

**Table S1**. Activation energy for the decolorization of CV dye onto CG-$Zn(OH)_2$NPs adsorbent at various initial dye concentrations.

| **Initial dye concentration, $C_o$ (mg $L^{-1}$)** | **Activation energy, $E_a$ (kJ $mole^{-1}$)** |
|---|---|
| 25 | 45.927 |
| 65 | 44.432 |
| 135 | 43.836 |
| 200 | 40.826 |
| 300 | 40.089 |