



## Structural, Magnetic and Adsorption Characteristics of Magnetite Nanoparticles Prepared from Spent Pickle Liquor

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**Abstract :** From the spent pickle liquor, magnetite nanoparticles ( $\text{Fe}_3\text{O}_4\text{NPs}$ ) with high crystallinity and high saturation magnetization were prepared by hydrothermal process. The characteristics of the materials, prepared via different hydrothermal time durations, were investigated by X-ray diffraction (XRD), high-resolution transmission electron microscope (HR-TEM), Energy-dispersive X-ray (EDX), and vibrating sample magnetometry (VSM) techniques. The adsorption behavior for the prepared materials towards  $\text{Pb}^{2+}$  metal ions was also studied. Moreover, equilibrium data were modeled using Freundlich, Langmuir, Temkin and Dubinin–Radushkevich equations. On the other hand, the adsorption kinetics were tested by pseudo first-order and pseudo second-order rate equations. To sum up, a well crystalline face centered cubic structure superferromagnetic  $\text{Fe}_3\text{O}_4\text{NPs}$  was obtained. The adsorption of  $\text{Pb}^{2+}$  is a pseudo second-order rate process and follows Langmuir isotherm model with a relatively high calculated maximum adsorption capacity  $[(q)_{i, \text{max}}]$ . Therefore, the prepared  $\text{Fe}_3\text{O}_4\text{NPs}$  are considered as promising magnetic adsorbents and via this research, the pickle liquor waste can be transferred into valuable magnetite materials.

**Keywords:** hydrothermal treatment; adsorption; magnetically separable materials; heavy metals; wastewater treatment.

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