

## Mn<sup>2+</sup> ions retention onto agriculture waste: a statistical design analysis, estimation of equilibrium and kinetic parameters

Saeed Mirani<sup>a</sup>, Narges Samadani Langeroodi<sup>a,\*</sup>, Alireza Goudarzi<sup>b</sup>, Pouneh Ebrahimi<sup>a</sup>

<sup>a</sup>Department of Chemistry, Golestan University, Gorgan, Iran, email: s.mirani69@gmail.com (S. Mirani), nsamadani@yahoo.com (N.S. Langeroodi), epouneh@yahoo.com (P. Ebrahimi)

<sup>b</sup>Faculty of Polymer Engineering, Golestan University, Gorgan, Iran, email: goudarzi.alireza@gmail.com

Received 15 June 2016; Accepted 13 December 2016

---

### ABSTRACT

This paper describes the adsorption of Mn<sup>2+</sup> ions from aqueous solution by the Iranian oak-fruit shell as low-cost adsorbent. The effect of various parameters such as pH of solution, contact time, initial Mn<sup>2+</sup> concentration and adsorbent weight for the adsorptive retention process were investigated. SPSS software was employed for prediction and investigation of factor importance in determining of removal ratio of Mn<sup>2+</sup>. According to Beta-value the importance order of factors is: pH of solution, adsorbent weight, initial Mn<sup>2+</sup> concentration and time, respectively. In process optimization, removal ratio of Mn<sup>2+</sup> was achieved as 73.59% with a pH of 5.0, contact time of 210 min, initial Mn<sup>2+</sup> concentration of 10 mg/L, and adsorbent weight of 2.5 g. Also, the obtained results from this study show the good adaptation between experimental and prediction values of removal ratio of Mn<sup>2+</sup>. Equilibrium studies show that Mn<sup>2+</sup> adsorption data follow Freundlich model. Pseudo-second-order kinetic model agrees very well with the experimental data. The desorption and regeneration studies have proven that adsorbent can be potentially reused for further adsorption process. Fourier transform infrared spectroscopy (FTIR spectra) and scanning electron microscope (SEM) were used to characterize the biosorbent.

*Keywords:* Biosorbent; Oak-fruit shell; Statistical analysis; Manganese; Isotherm; Kinetics

---

\*Corresponding author.