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Enhanced Removal of Ni(II) from Contaminated Solutions by NaOH-modified Tea Waste

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Heavy metal contamination is a critical environmental issue, requiring efficient and low-cost removal techniques. Among various types of removal techniques, adsorption has achieved much consideration due to different aspects. The heavy metal Ni is one of the major toxic heavy metals, which is primarily released from the combustion of fossil fuel and can accumulate across different organisms, leading to severe health disorders. Use of biosorbents in raw and modified forms for the remediation of Ni has been attempted; however, the removal efficiency has not been satisfactory, partly due to the lack of the number of active adsorption sites. The study reported here is on the investigation of tea waste (particle size: 0.500 – 0.710 mm) modified with 0.10 mol L^{-1} NaOH solution for enhanced removal of Ni(II) through biosorption. Variation of one experimental parameter within a reasonable range while keeping the other parameters unchanged lead to the optimized conditions of 0.600 g dosage, 20 min shaking time, 20 min settling time and ambient pH and at ambient temperature, at which an excellent removal of 95% is achieved from 10 mg L^{-1} Ni(II) solution, based on the average values of triplicate measurements. This is a significant improvement when compared to unmodified biosorbent which shows only 69% removal. Further, NaOH treatment would form negatively charged functionalities leading to complexation with the positively charged adsorbate, Ni^{2+}. Since the Ni(II)–NaOH modified tea waste system establishes equilibrium so fast that it is not possible to investigate kinetics, further supporting the superior nature for biosorption of Ni(II). Increase in the initial concentration of Ni(II) from 10 mg L^{-1} to 25 mg L^{-1} does not significantly increase the time required to reach equilibrium, indicating that NaOH-modified tea waste is a promising biosorbent having strong capacity to remove Ni(II) from contaminated solutions within a short period of time.

Keywords:
Adsorption, dosage, Ni^{2+} remediation, shaking time, tea waste

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