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Sustainable remediation of Hg(II) from wastewater by combo humiresin-dry cow dung powder

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ORIGINAL RESEARCH ARTICLE

ABSTRACT

This research addresses an innovative application of dry cow dung powder (DCP), sustainable green biowaste, for the efficient remediation of toxic Hg(II) ions from aqueous medium. Batch equilibration experiments have been conducted employing radiotracer technique and the impact of various process parameters have been studied. The result indicated that 100 mg of DCP could effectively remove 80-82% of Hg(II) (1 mg/mL) within 10 min at pH 3. The thermodynamic parameters ΔG^o, ΔH^o and ΔS^o have been evaluated, and the values obtained were -4.242 kJ/mol, -10.421 kJ/mol and 35.672 J/mol K, respectively. These values suggest spontaneous and exothermic process with high affinity of Hg(II) for DCP. The pseudo- second order kinetic model proved to be the best fitting with adsorption capacity of 16.0 mg/g and it also indicate the chemisorptive mechanism of DCP. The mechanism involved in Hg(II) adsorption has been also supported by FTIR, EDAX and desorption studies. DCP has a great potential in the field of wastewater treatment, which is embossed by successfully fitting in to 3A's selection criteria of affordability, adaptability and acceptability. Thus, DCP proves to be one of the best contenders of green chemistry and the concept of zero waste.

KEYWORDS
biosorption; combo-humiresin; dry cow dung powder; green chemistry; remediation; zero waste

1. INTRODUCTION

Universal plethora of an industrial urbanization is the paradigm cause of Anthropocene, the eon of pollution. Hydrosphere, the greenest and renewable center of our ecosystem is most affected and hence has been highly attended by our environmentalists. According to green chemists, real solution for water pollution is not in the technological advances but to maximize the applicability and efficiency of naturally available resources. Present scenario strongly advocates utilization of the biological technologies that are eco-friendly alternatives over current synthetic complements, which pollute ecosystem during the course of manufacturing and handling process (Volesky, 2003).

Wastewater management and treatment technology has major concern towards mercury poisoning, the most notorious neurotoxin in the environment (Vallero, 2005). For the removal of mercury ions from wastewater effluent processes like sulphide precipitation, electrodialysis and ion-exchangers are employed (Das et.al, 2007). However, these methods have disadvantages like incomplete metal removal, high requirement of energy and reagents, generation of toxic sludge or other waste materials, which in turn require treatment for their cautious disposal and thereby questioning applicability. These challenging situations commanded fundamental shift towards bioremediation process, in particular biosorption. Biosorption process is most preferred due to metabolism-independent, passive and physico-chemical binding of metal ions involving biomass (Fomina and Gadd, 2014). Biosorbents have proven to be economical, less hazardous and functionally better than traditional or conventional options.

Literature survey, especially for Hg(II) removal, indicated that natural sorbents from biotic

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