



Short Communication

Kinetics and thermodynamics of heavy metal ions sequestration onto novel *Nauclea diderrichii* seed biomass

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HIGHLIGHTS

- ▶ *Nauclea diderrichii* seed biomass as a new biosorbent.
- ▶ Biosorption of Cadmium and Mercury ions.
- ▶ Kinetics and thermodynamics of biosorption.
- ▶ Biosorption feasible, spontaneous and endothermic.

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ABSTRACT

This study reports the sequestration of Cd(II) and Hg(II) using a new biosorbent, *Nauclea diderrichii* seed biomass. Experimental data obtained were fitted into kinetic and thermodynamic models. Experimental data fitted best into pseudo-second order kinetic model among others. Results obtained kinetically revealed that the biosorption of Cd(II) and Hg(II) using *N. diderrichii* seed biosorbent increased with increase in temperature. At the highest temperature, which was 333 K, the highest amount of metal biosorbed, q_e , for Cd(II) and Hg(II) obtained were 6.30 and 6.15 mg/g respectively. The biosorption of Cd(II) was kinetically faster than that of Hg(II), the highest initial biosorption rates for Cd(II) and Hg(II) were 56.19 and 4.39 mg/g min respectively. Thermodynamic parameters obtained by Eyring equation from this study revealed that the biosorption process was spontaneous, feasible, endothermic with a decrease in the degree of chaos in the biosorption system.

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1. Introduction

Environmental pollution is now a global problem due to its impact both on humans and the entire ecosystem. The availability of potable water is a paramount requisite for human existence and the ecosystem at large (Waseem et al., 2011). Cadmium (Cd) and Mercury (Hg) are two of the most commonly known micropollutants in domestic and industrial wastewater (Waseem et al., 2011).

Cadmium mainly accumulates in the kidneys and liver, hence leading to kidney failure, renal stone formation, bone disease and persistent proteinuria as a sign of kidney damage. Other effects from acute cadmium exposures may include muscle cramps, salivation, sensory disturbances, liver injury, convulsions, shock, renal failure (Iqbal et al., 2007). Mercury is generally considered as the most toxic metal in natural ecosystems (Clarkson, 1993).

Over the years, various biomasses had been chosen and utilized by researchers to sequester toxic heavy metal ions from industrial wastewaters. Some biosorbents recently used by researchers are defatted *Carica papaya* {Pb(II) and Cd(II)} (Adie et al., 2011), *Mansonia* wood sawdust {Cu(II) and Pb(II)} (Ofomaja et al., 2010), *Tamarindus indica* seeds {Cu(II)} (Chowdhury and Saha, 2011) and Mustard oil cake {Ni(II)} (Khan et al., 2012). Adsorbents of biological origin have gained excellent credibility because of their ubiquity, good efficiency and cost economics.

Nauclea diderrichii (De wild) is a deciduous tree and one of the few indigenous species available in Nigeria which thrives excellently under plantation management in the humid tropical rainforest zone of south-western Nigeria (Adeoye and Waigh, 1983).

This study reports the use of *N. diderrichii* seed biomass as a new low cost biosorbent for the sequestration of Cd(II) and Hg(II) from aqueous solutions in a batch system. Until now, there is no report on the use of *N. diderrichii* seed biomass for the biosorption of micropollutants.

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