

Sorption of cadmium, chromium, lead, and vanadium from artificial wetlands using *Lemna aequinoctialis*

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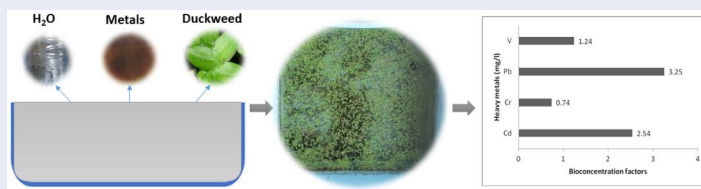
ABSTRACT

The efficacy of the lesser duckweed, *Lemna aequinoctialis* (Welw.), to remediate varying concentrations of cadmium, chromium, lead, and vanadium from an organo-metallic contaminated media was tested in artificial surface wetland mesocosm experiment. A 100 g of fresh-weight duckweed was introduced into each of the mesocosm, except for the control setup and monitored for 120 days while the metals removal rate was quantified using an atomic absorption spectrometer. A time-dependent and partial sorption of metals was observed with the highest removal rate recorded for cadmium (71.96%), followed by lead (69.23%), vanadium (55.22%), and chromium (41.64%). The uptake and bioaccumulation of metals were reflected in the increased plant biomass ($p < 0.05$, $F = 97.12$) and relative growth rate ($p < 0.05$, $F = 1214.35$) in duckweed. A coefficient (r^2) of 0.951, 0.919, 0.970, and 0.967 was recorded for cadmium, chromium, lead, and vanadium respectively, indicating that the remediation of metals followed the first-order kinetic rate model. This study highlights the efficacy of the lesser duckweed to preferentially remediate metals in an organo-metallic complex medium for potential wastewater treatment in the petrochemical industry.

NOVELTY STATEMENT

Applying ecological or nature-based solutions for the treatment of complex wastewater from the petrochemical industry in Africa remains a challenge due to the paucity of evidence-based science to support the implementation that is acceptable to regulators and the industry. Although laboratory and field-based demonstration of phytoremediation studies has shown the potential of macrophytes for the treatment of organic and inorganic pollutants, studies on the application of duckweed for complex organo-metallic wastewater treatment for heavy metals are few. This study demonstrates the efficacy of the lesser duckweed, *Lemna aequinoctialis* in the sorption of cadmium, chromium, lead, and vanadium from an organo-metallic complex with potential application in the petrochemical industry.

GRAPHICAL ABSTRACT



HIGHLIGHTS

- Oil spill releases hydrocarbons and associated metals into the environment.
- Hydrocarbons are degraded, but heavy metals remain in the environment.
- *Lemna aequinoctialis* demonstrated the partial sorption of metals in artificial wetlands.
- The phytoremediation of metal was time-dependent.
- The sorption rate fits into the first-order kinetic rate equation.

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 Supplemental data for this article can be accessed online at [publisher's website](#).