

PHYTOREMEDIATION OF LANDFILL LEACHATE: Removal of Heavy Metals and PAHs using Water Hyacinth

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OVERVIEW

Moisture in landfills accumulates pollutants as it percolates through the waste. These accumulated pollutants can include but are not only limited to Heavy Metals (Cd, Cr, Cu, Ni, Zn) and Polycyclic Aromatic Hydrocarbons. Because all landfills leak leachate, these accumulated pollutants can potentially enter ground and surface water bodies, and so leachate must be remediated to prevent pollution.

ABSTRACT

The Trinidad & Tobago Solid Waste Management Company (SWMCOOL) is always exploring novel methods and systems for the remediation of leachate generated in local landfills. This study examines the phytoremediation potential of one plant found in the country: water hyacinth - *E. crassipies*. Based on results of previous characterisation studies, leachate analogue solutions were made. Water hyacinth plants were then exposed to these analogue solutions to determine their remediation efficacies, as well as the optimal growth parameters and conditions. Analogue solutions of pure metals (Cd, Cr, Cu, Ni, and Zn) remediated by water hyacinth showed reductions in concentration of between 3% and 82%, while analogue solutions of mixed metals and organics (Cd, Cr, Cu, Ni, Zn, Anthracene, Fluorene, and Napthalene) showed reductions in metal concentrations of between 42% and 99% and PAH Translocation Factors of between 0.83 and 4.41. Following this, both wet and dry season leachate samples were collected from the Guanapo Landfill to determine the viability of the selected plant species. Based on the characterisation of these samples, water hyacinth would be an effective tool for the remediation of leachate generated in landfills in Trinidad & Tobago.

Keywords: Phytoremediation; Landfill Leachate; Heavy Metals; Polycyclic Aromatic Hydrocarbons (PAHs)



Figure 1
Plant extracts collected after Soxhlet Extraction. The extracts were then analysed for PAHs via GC. GC-MSMS will be used for further analysis

METHODOLOGY

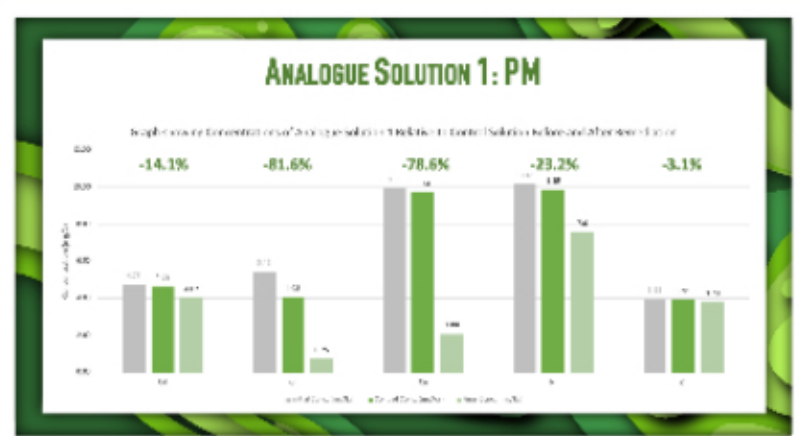
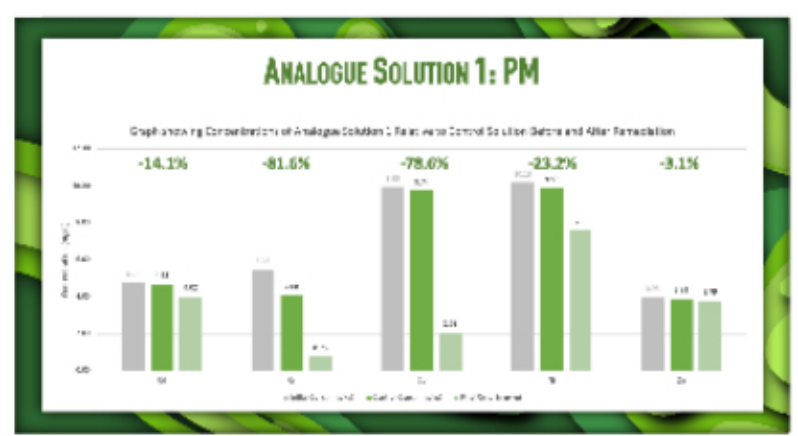
- Analogue Solution 1**
Metal Pollutants only (Cd, Cr, Cu, Ni, Zn)
Conc.: 10 mg/L
Growth Period: 7 days
- Analogue Solution 3**
Metal + Organic Pollutants
(Cd, Cr, Cu, Ni, Zn, Naphthalene, Anthracene, Fluorene)
Conc.: 10 mg/L
Growth Period: 7 days
- Extraction and Analysis**
Metal Pollutants:
Weighed, dried, reweighed -> 2hr Acid Digestion @130C
Digest made up to 50mL
FAAS Analysis
- Organic Pollutants:
Weighed, dried, reweighed -> 12hr Soxhlet Extraction
70:30 MeCN:H₂O
GC-FID

Figure 2

Plant sample (leaf) in Digest Solution post acid digestion. The sample digests were then analysed for heavy metals via FAAS



RESULTS



REMEDATION EFFICACY		
	3 Reduction Analogue Solution 1	3 Reduction Analogue Solution 2
Cd	14.10	99.80
Cr	81.62	79.30
Cu	79.64	80.03
Ni	23.15	60.29
Zn	3.07	60.56

TRANSLOCATION FACTORS PAHs	
	TF
Naphthalene	0.80
Fluorene	2.29
Anthracene	4.40

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