Summary

Some highlights of the system include:

1) The system is a semi-passive system.
2) Removes high hexavalent chromium & sulphate concentrations.
3) Hexavalent chromium is reduced and precipitates as chromium(III) oxide.
4) Sulfate precipitates as $BaSO_4$.
5) The fixed-film bioreactor can be used for the reduction of other contaminants such as nitrate, iron, manganese, selenium and uranium.
6) BDAS can be used as a pre-treatment for heavily polluted water.
7) The fixed-film bioreactor is based on the La Cienega Filtration project developed by Geosyntec Consultants, USA.
8) The BDAS technology is based on the DAS technology that was developed 10 years ago and is already upscaled to a full commercial scale plant in Spain.
9) Toxicity tests done on the effluent water proved that the treatment is not toxic to the environment.
10) Reverse Osmosis, Ion Exchange or (Ultra)filtration can be added as polishing steps to remove salinity and other contaminants.

About UFS/TIA SAENSE PLATFORM

The SAENSE Platform (Sotho for "Science") deals with Screening Applications and Exploring Novelty in Specialized Environments by studying the novel South African microbial diversity that gave rise to incredible functionalities that can be used to deal with contaminants.

Contact us

To learn more about other exciting (Bio) remediation strategies or the UFS/TIA Saense Platform, please contact Prof. Esta van Heerden.

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SAENSE PLATFORM

Hexavalent Chromium Leachate Treatment Plants

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technology innovation AGENCY

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Introduction

Through the joint effort of two companies and the UFS/TIA (University of the Free State and Technology Innovation Agency) SAENSE Group, new treatment systems for industrial effluents are developed. This system effectively treats contaminants such as hexavalent chromium, sulphate, calcium and hardness which occur in leachates. The efficacy and applicability of the research has been demonstrated on several sites where the team constructed pilot plants to meet each client's site-specific needs. This technology has treated fly ash leachate and excessive tannery salts storage with outflow hexavalent chromium and sulphate levels that are accepted by the South African National Standards (SANS) 241:2006 & 2015 regulation for drinking water as well as Resource Water Quality Objectives (RWQO's).

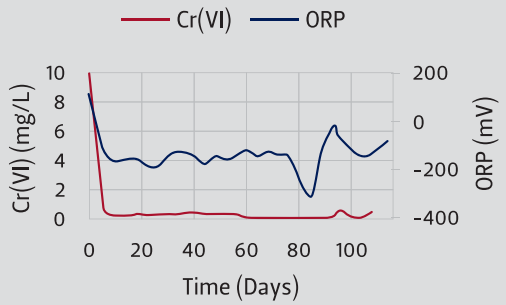
About the Biological pilot plant

The pilot plant consists of a biological fixed-film reactor for hexavalent chromium bioreduction. Dissimilatory chromate-reducing bacteria utilise Cr^{6+} as a terminal electron acceptor, ultimately precipitating it as insoluble chromium oxides, demonstrating the potential for bioremediation. Biological reduction of Cr^{6+} with the indigenous bacteria in semi-passive controlled systems can be an environmentally sound alternative or complimentary technology to active chemical or physical treatment technologies, but at comparatively lower lifecycle cost with less specialised labour requirements.

Two Case studies

Case study 1

According to the water analysis, the integrated fixed-film system has demonstrated the capacity to remove >99% of the hexavalent chromium. Chromium is precipitated as chromium (III) oxide.



Case study 2

Three pilot scale reactors were built previously at another site in Limpopo and similar results were obtained. This demonstrates that the data is reproducible with an environmentally sustainable solution.

Pilot Reactor 1
18 000 L Horizontal Reactor
Pilot Reactor 2
11 000 L Horizontal Reactor
Pilot Reactor 3
4 × 2 000 L Vertical Reactors

The data indicates that neither the effluent nor the solid wastes are toxic to the environment.

Cr^{6+} Pilot Scale Reactor(s)

- Source Cr^{6+} contamination: >5 mg/L
- >99% Cr^{6+} removal (24hr HRT)

References

DeFlaun MF *et al.* (2013) Pilot-scale Bioremediation of Hexavalent Chrome-contaminated Water – a South African First. Proceedings of the 2nd World Water Conference, 20-23 January 2013, Singapore.

Williams PJ *et al.* (2014) Effective bioreduction of hexavalent chromium-contaminated water in fixed-film bioreactors. Water SA 40(3): 549-554.