



**APPLICABILITY OF PHYTOREMEDIATION  
METHODS TO TREAT CHROMIUM  
CONTAMINATED WATERS**

MASTER OF SCIENCE (BY RESEARCH)

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2005

83466



## Abstract

Chromium is a hazardous metal available in both Trivalent (Cr +3) and Hexavalent (Cr+6) forms. Cr+6 is evidently toxic whereas Cr+3 is relatively less hazardous than Cr+6. Cr+6 and Cr+3 are extensively used in many industrial processes and causes industrial heavy metal pollution of surface and ground water. There are many already practiced methods to remove Chromium such as Chemical Precipitation and Ion Exchange etc. Very little research has been done on Phyto-remediation of Cr+6 and Cr +3

Currently there is a growing interest on research on the capacity of Ferns to extract heavy metals. The amazing uptake rate of *Pteris vitata* (Br. 'dk fern) gave the initial impetus to this study. *Nephrolepis exaltata* or Common Sword Fern is a commonly found hardy invasive fern. It is recorded to be a hardy plant with high moisture and acidity

In this study *N. exaltata* was comparatively assessed with few other species for the capability of chromium extraction. *N. exaltata* showed a good uptake rate. Ability of *Nephrolepis exaltata* to extract Cr+3 from an artificial solution was studied in detail separately under 'Hydroponic and Soil water systems. All the experiments were done in a controlled laboratory environment


*N. Exaltata* showed very high removal rates (about 91%) in a Hydroponic medium upto 50 ppm contamination of T-Cr. The mass balance shows that most of the Cr taken up by the plant is retained in the roots (about 75 % or 350 mg/kg). Little is translocated to above-ground tissues (4% or 120 mg/kg). Therefore the mechanism of removal is mainly Rizofiltration. The mechanism of uptake may be Bio-sorption or Active uptake by root cells. *N. Exaltata* hardly shows any symptoms of Phytotoxic affects upto 50 ppm of Cr +3, and 15 ppm of Cr+6.



But in a Soil water system mass balances show that 1110st of water soluble Cr<sup>+3</sup> is sorbed to soil (about 90%). *N. exaltata* is poor- in de-mineral izing, mobilizing and uptake of soil bound Cr <sup>+3</sup>. Sand has a remarkable capacity to immobilize Cr<sup>+3</sup> in water. More research should be done to identify the capacity of sand and gravel to bind chromium.

## DECLARATION

I hereby declare that this submission is my own work and that, to the best of my knowledge and belief, it contains no material previously published or written by another person no material which, to substantial extent, has been accepted for the award of any other degree or diploma of a university or other institute of higher learning, except where an acknowledgement is made in the text.

  
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## ACKNOWLEDGEMENT

The assistance and able guidance afforded by a number of persons immensely helped me to complete this thesis within the stipulated period. I regret the inability to mention all of them by name.

At the outset I would like to record with deep respect and gratitude the valuable guidance given by my main supervisors namely Dr. Shiromi Karunaratne and Dr. Kithsiri Dissanayake, from the commencement of the study. The support and the most willing assistance extended by my supervisors Dr. Mahesh Jayaweera and Dr. Suren Wijaykoon is acknowledged with utmost gratitude.

Professor L W L Fernando and Dr. D R I B Werellagama would be remembered with utmost gratitude for sacrificing their valuable time in correcting the manuscripts of this report and being in the panel of examiners.

A special mention is also due to Dr Puswewala the head of the Department of Earth Resources Engineering (ERED) and his staff for providing all necessary facilities and advice during my research. Help and assistance given by Ms. Dilani de Seram the technical officer in charge of the Mineral Analysis Laboratory and Ms. Shyamali Siriwardane the chief chemist of Geological Survey and Mines Bureau of Sri Lanka are remembered with respect for invaluable support given to me. A special mention should be made of the staff technical officers Mr. Harsha Waidyasekara and Mr. G P Perera of ERED.

My dear parents and my cousin Mr. Amila Lokupilawatte deserve a big thanks for the unreserved support given to me during the period of my research.

I am also grateful to my colleagues Mr. L P S Rohitha and Ms. U I Illangakoon and others for the motivating and encouraging me thought the programme.

Finally may I record with sincere gratitude the sponsorship afforded by the Asian Development Bank which is solely responsible for funding this study.

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## LIST OF ABBREVIATIONS

ANOVA	- Analysis of Variation
ASTM	- American Standard Testing Methods
CW	- Constructed Wetland
DO	- Dissolved Oxygen
HDPE	- High Density Poly-Ethylene
IRZ	- Insitu Reaction Zones
MCL	- Maximum Concentration Limit
MNA	- Monitored Natural Attenuation
NAPL	- Non-Aqueous Phase Liquid
PAH	- Poly-Aromatic Hydrocarbons
PCB	- Poly-Chlorinated Bi-phenyls
PCE	- Poly-Cyclic Ethanes
ppm	- Parts Per Million
SOM	- Soil Organic Matter
T-Cr	- Total Chromium
TNT	- Tri-Nitro Toluene

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