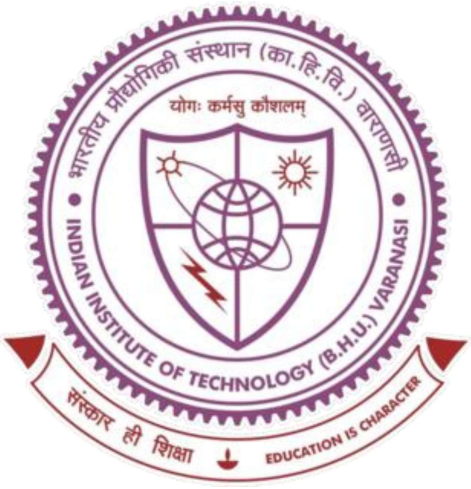
A Study on Bioremediation of Arsenic and Chromium Under Different Conditions



Thesis submitted in partial fulfilment for the Award of Degree

DOCTOR OF PHILOSOPHY

by

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It is certified that the work contained in the thesis titled "**A Study on Bioremediation of Arsenic and Chromium Under Different Conditions**" by "**Rohit Kushwaha**" has been carried out under our supervision and that this work has not been submitted elsewhere for a degree.

It is further certified that the student has fulfilled all the requirements of Comprehensive Examination, Candidacy and State of the Art (SOTA) for the award of Ph. D. Degree.

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I, **Rohit Kushwaha**, certify that the work embodied in this thesis is my own bonafide work and carried out by me under the supervision of **Professor Devendra Mohan** and co-supervision of **Professor R. S. Singh** from 29/07/2019 to 09/10/2024, at the **Department of Civil Engineering, Indian Institute of Technology (BHU) Varanasi**. The matter embodied in this thesis has not been submitted for the award of any other degree/diploma. I declare that I have faithfully acknowledged and given credits to the research workers wherever their works have been cited in my work in this thesis. I further declare that I have not willfully copied any other's work, paragraphs, text, data, results, etc., reported in journals, books, magazines, reports, dissertations, theses, etc., or available at websites and have not included them in this thesis and have not cited as my own work.

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(Rohit Kushwaha)

Dedicated to my
Parents

List of Abbreviations

AAIH&PH	All India Institute of Hygiene & Public Health
AMRIT	Arsenic and Metal Removal through Indian Technology
AQGP	Aquaglyceroporin
AR	Aqua Regia
ARUBA	Arsenic Removal Using Bottom Ash
As(III)	Arsenite
As(V)	Arsenate
ATSDR	Agency for Toxic Substances and Disease Registry
BET	BrunauerEmmett-Teller
BI	Bioluminescence Inhibition
BIS	Bureau Indian Standards
BLAST	Basic Local Alignment Search Tool
CLA	Chemolithoautotrophs
CTAB	Cetyltrimethylammonium Bromide
CW	Constructed Wetland
DMA	Aimethyl Arsonic Acid
DMA(III)	Dimethyl Arsenite
DMA(V)	Dimethyl Arsinate
DMSO	Dimethyl Sulfoxide
DNA	Deoxyribonucleic Acid
DPHE	Department of Public Health Engineering
DW	Distilled Water
EDTA	Ethylenediaminetetraacetic Acid
EDX	Energy-Dispersive X-ray
FMN	Flavin Mononucleotide
FTIR	Fourier Transform Infrared Spectroscopy
FW	Fresh Weight
GAPDH	Glyceraldehyde 3-phosphate dehydrogenase
GI	Germination Index
G1pF	Glycerol uptake facilitator protein
*i*As	Inorganic Arsenic

IB	Bacteria Immobilized on Biochar
IBK	Beads of Biochar Immobilized with Strain K7Pb
IBT	Beads of Biochar Immobilized with Strain TY6
LB	Luria Bertani
MAs	Methylated Arsenics
MAs(III)	Methyl Arsenite
MEGA	Molecular Evolutionary Genetics Analysis
MIC	Minimum Inhibitory Concentration
MMA(III)	Monomethyl Arsenite
MMA(V)	Monomethyl Arsenate
MPSB	Modified Peanut Shell Biochar
NADPH	Nicotinamide Adenine Dinucleotide Phosphate
NCBI	National Center for Biotechnology Information
NCMR	National Centre for Microbial Resource
*o*As	Organic Arsenic
PBBR	Packed Bed Bioreactor
PC	Phytochelation
PCR	Polymerase Chain Reaction
PI	Phytotoxicity Index
PS	Peanut Shell
PSB	Peanut Shell Biochar
PUF	Polyurethane Foam
PVA	Polyvinyl Alcohol
RL	Root Length
RPBBR	Recirculating Packed Bed Bioreactor
ROS	Reactive Oxygen Species
RRG	Relative Root Growth
RSG	Relative Seed Germination
SA	Sodium Alginate
SAH	S-adenosylhomocysteine
SAM	S-adenosylmethionine
SEM	Scanning Electron Microscope
SORAS	Solar Oxidation and Removal of Arsenic

TCCL	Tamil Nadu Chromates and Chemicals Limited
TGA	Thermogravimetric Analysis
TMA	Trimethyl Arsine
TMAO	Trimethylarsine Oxide
USEPA	United States Environmental Protection Agency
WHO	World Health Organization
XRD	X-ray Diffraction

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