A DECISION SUPPORT SYSTEM FOR APPROPRIATE TREATMENT TECHNOLOGY SELECTION FOR INTEGRATED WATER AND WASTEWATER MANAGEMENT

A thesis submitted in partial fulfillment for the

Award of Degree

Doctor of Philosophy

By

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DECLARATION BY THE CANDIDATE

I, **RIA RANJAN SRIVASTAVA**, certify that this thesis contains my own authentic work and I have accomplished this work under the guidance of **Prof. Prabhat Kumar Singh** from June 2018 to April 2023, at the **Department of Civil Engineering**, Indian Institute of Technology (BHU) Varanasi. This work has not been submitted for the award of any other degree/diploma. I declare that I have truthfully cited the scientific collaborators whose work has contributed to this thesis. I further declare that I have not intentionally copied work, paragraphs, text, data, results, etc., of other articles published in journals, books, magazines, reports, dissertations, etc., or available on websites, and that I have not included them in this work or cited them as my own work.

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Dedicated to my Parents

Mr. Ranjan Srivastava and Mrs. Seema Srivastava

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(Ria Ranjan Srivastava)

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NOMENCLATURE

Abbreviations	Full Form
A2O	Anaerobic Anoxic Oxic process
ABC	Inventory Measurement Method
AHP	Analytic Hierarchy Process
AL + SP	Anaerobic Lagoon + Stabilization Pond
ASP	Activated Sludge Process
bCOD	Biodegradable Chemical Oxygen Demand
BIOFOR	Biological Filtration and Oxygenated Reactor
BIOFOR-F	High Rate Activated Sludge BIOFOR Technology
BNR	Biological Nitrogen Removal
BOD	Biochemical Oxygen Demand
BP	Bardenpho Process
BWM	Best Worst Method
C	Construction
C + F	Coagulation + Flocculation
C.Tech	Cyclic ASP process
COD	Chemical Oxygen Demand
CODAS	Combinative Distance Based Assessment
CPCB	Central Pollution Control Board
CW	Constructed Wetland

Cr	Crore
DC	Dust Control
DPS	Duckweed Pond System
DSS	Decision Support System
EF	Environmental flow
F	Fire Protection
FAB	Fluidized Aerated Bed
FC	Faecal Coliform
FUCOM	Full Consistency Method
GR	Groundwater Recharge
H	Horticulture
Ha	Hectare
I	Irrigation
IC	Industrial Cooling
ISM	Interpretive Structural Modelling
IWWM	Integrated Water and Wastewater Management
kWh	Kilo-Watt hour
kl	kilo liters
L	Landscape
LCA	Life Cycle Assessment
LW	Laundry Washing
MARCOS	Measurement Alternatives and Ranking According to

	Compromise Solution
MBBR	Moving Bed Bio-film Reactor
MBR	Membrane Bioreactor
MCDM	Multi-Criteria Decision Making
MF	Microfiltration
mg/l	milligrams per liter
MICMAC	Matrix of Cross Impact – Multiplications Applied to Classification
MLD	million liters per day
MLE	Modified Ludzack-Ettinger process
MPN	Most Probable Number
MWh	Mega-Watt hour
OB	Outdoor Bathing
OD	Oxidation Ditch
PROMETHEE	Preference Ranking Organization Method for Enrichment Evaluation
RC	Road Cleaning
RO	Reverse Osmosis
Rs	Rupees
Rs in Cr	Rupees in Crore
RSF	Rapid Sand Filter
RW	Rail Washing
SAFF	Submerged Aerated Fixed Film reactor

SBR	Sequencing Batch Reactor
SBT	Soil Biotechnology
SP	Stabilization Pond
STP	Sewage Treatment Plant
TDS	Total Dissolved Solids
Tech	Technology
TF	Toilet Flushing
TN	Total Nitrogen
TSS	Total Suspended Solids
UASB + EA	Up-flow Anaerobic Sludge Blanket reactor + Extended Aeration
UF	Ultrafiltration
VIKOR	VlseKriterijuska Optimizacija I Komoromisno Resenje
VW	Vehicle Washing
WP	Wuhrmann Process
WSP	Waste Stabilization Pond
WWTP	Wastewater Treatment Plant
WWTT	Wastewater Treatment Technology