BIOELIMINATION MECHANISMS OF AQUEOUS WASTE COMPOUNDS THROUGH VASCULAR PLANTS

by

H. S. BHATIA

Thesis Submitted in fulfilment of the
requirements for the award of the degree of

DOCTOR OF PHILOSOPHY

DEPARTMENT OF CIVIL ENGINEERING
INDIAN INSTITUTE OF TECHNOLOGY, DELHI
July, 1985

TO THE MEMORY OF

MY INSPIRING & LOVING FATHER

WHO LEFT FOR HEAVENLY ABODE

WHILE I WAS PURSUING THIS STUDY

C E R T I F I C A T E

This is to certify that the thesis entitled "Bioelimination Mechanisms of Aqueous Waste Compounds through Vascular Plants" submitted by Mr. H.S. Bhatia to the Indian Institute of Technology, Delhi, for the award of Degree of DOCTOR OF PHILOSOPHY is a record of the bonafide research work carried out by him.

Mr. H.S. Bhatia has worked under my guidance for the submission of this thesis, which to my knowledge has reached the requisite standard.

The thesis or any part thereof, has not been submitted to any other University or Institution for the award of any degree or diploma.

(DR. P.K. JAIN)
Assistant Professor
Department of Civil Engineering
Indian Institute of Technology, Delhi

BIOELIMINATION MECHANISMS OF AQUEOUS WASTE COMPOUND THROUGH VASCULAR PLANTS

ABSTRACT

Waste disposal problems have been the focus of attention particularly with increase in population and industrialisation. The primary goal of waste treatment management hence is to develop an effective, low energy, low cost systems. The present work is aimed in such direction only. Vascular plant such as water hyacinth has assumed importance once it was discovered that it can be used for such treatments. The growth of water hyacinth (Eichhornia Crassipes) under N limiting conditions can be worked out based on certain mathematical models. In this study the various kinetic constants required to predict its growth rate, growth potential, area required for minimum standing crop, harvesting frequencies etc. have been worked out to predict optimum growth for its best usage in terms of nutrient removal under varying temperature conditions. The practical application of these constants has been illustrated by selecting a particular pond receiving 100 million litres of waste water annually. Curves have been plotted to allow immediate prediction and design of such growths and their subsequent harvestings. Water hyacinths are considered quite capable of not only solving the eutrophication problem by controlling the algal mass

but at the same time removing the much desired load at an improved efficiency. However, to make such system fully reliable under various conditions and to finally develop a well designed system the various bioelimination mechanisms have to be fully understood. Accordingly multistage cascading system, multicell hyacinth algal system and natural eco systems have been devised to understand such mechanisms. These studies provide significant informations as illustrated through scores of observations recorded in each of these systems. The conclusions drawn could be a thorough base for developing proper design criteria for such low cost but reliable treatment technology. An attempt has also been made to mathematically correlate some important parameters so that they can be used in a generalised way while designing such low energy systems.

ACKNOWLEDGEMENTS

The author expresses his deep sense of gratitude to his Supervisor, Dr. P.K. Jain, B.S.E. (Mich), M.S.E. San. Engg. (Mich.), Ph.D. (Lond.), MIE, M.A.S.C.E. M.Chi., EpS. (U.S.A.), Department of Civil Engineering, Indian Institute of Technology, New Delhi for his immense help and valuable guidance extended throughout the course of this study.

The author is extremely grateful to the Head of the Department, Professor (Dr.) T. Ramamurthy and Professor (Dr.) Subhash Chander, but for their constant encouragement and help, this work would not have been completed.

The author is highly indebted to Professor R.C. Singh of the Civil Engineering Department, Indian Institute of Technology, Delhi who was always willing to help in any matter or discussions concerning the research work.

The author feels very happy to place on record his sincere thanks to the authorities of the Flood Wing of Delhi Administration, the Principal, Delhi College of Engineering and the Head of the Civil Engineering Department, for sponsoring the author under the Quality Improvement

Programme with all facilities to carry out his work and also to all the laboratory staff of Environmental Engineering Section of Civil Engineering Department of Indian Institute of Technology, New Delhi, for extending liberal help and cooperation during the progress of this work.

The author's thanks are due to all his co-research especially to Mrs. S. Jindal who helped from time to time through the exchange of ideas during the progress of this work.

The author wishes to express his heartfelt thanks to Professor (Dr.) A.F.S.A. Aowal of the Civil Engineering Department, Delhi College of Engineering for his constant help, guidance and encouragement during the course of the present work.

The author especially thanks his wife, Mrs. Jasbir Bhatia for the encouragement, cooperation and patience shown during the period of study.

(H.S. BHATIA)

CONTENTS