

**CONTAMINATED WATER TREATMENT BY AQUATIC PLANTS:
STUDIES ON
Azolla pinnata R. Br. AND Lemna minor L.**

by
S. K. JAIN

Thesis submitted
in fulfilment of the requirements
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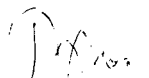
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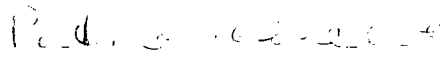
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CERTIFICATE

This is to certify that the thesis entitled, "CONTAMINATED WATER TREATMENT BY AQUATIC PLANTS : STUDIES ON Azolla pinnata R. Br. AND Lemna minor L. "being submitted by Mr. S. K. Jain to the Indian Institute of Technology, Delhi for the award of the degree of DOCTOR OF PHILOSOPHY, is a record of bonafide research work carried out by him. Mr. Jain has worked under our guidance and supervision and has fulfilled the requirements for the submission of the thesis.

The results contained in this thesis have not been submitted, in part or in full, to any other University or Institute for the award of any degree or diploma.


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—DEDICATED —
TO MY
FATHER

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ABSTRACT

Life on earth depends on availability of water for drinking and other purposes. With rapid industrialization, intensive agriculture practices and proliferation of densely populated human habitats, the problem of water pollution is increasing day by day. The presence of fluoride, salinity, toxic heavy metals, inorganic nutrients and organic and biological contaminants have deleterious effects on public health and also lead to eutrophication.

A number of physical and chemical methods of waste water treatment have been advocated and are in practice. Recently, attention has been focussed on the possibility of utilizing aquatic plants to strip off such pollutants. Many of these aquatic plants exhibit prolific growth in the natural environment. They not only produce a huge amount of biomass but can help in removal of nutrients and heavy metals. However, before systematic application of this at field level becomes feasible, individual plant species have to be screened under control conditions for evaluating their pollutant removal efficiency. Also full scale utilization of these plants for the purposes of food, fuel etc. have to be examined to ensure that the biomass generated in the above waste water treatment system itself does not become an environmental menace.

Keeping this in view, water velvet and duckweed were selected and evaluated for contaminated water treatment. The main objective was to study their potential for the removal of nutrients [nitrogen (ammonia and nitrate both), phosphorus, potassium, calcium and magnesium (both in single or mixed groups)] and heavy metals [iron, copper, cadmium, nickel, lead, zinc, manganese and cobalt (both in single or mixed groups)] from contaminated waters. Exploitation of aquatic biomass generated in the water treatment system for the production of edible mushroom Pleurotus sajor caju (food) and biogas (fuel) was also considered. The effect of heavy metals contamination in the substrate both on the production of fresh fruit bodies of Pleurotus and their subsequent translocation from contaminated substrate to fruiting bodies of Pleurotus sajor caju, were evaluated. Further, the influence of heavy metals contained in biomass on its fermentation to biogas was studied. It was seen that Cd-Ni-contaminated biomass produced biogas at higher rate with much higher methane content than what is obtained from non-contaminated biomass.

Before applying the proposed method of water treatment at the field level, the quality of water at source has to be tested. Hence field level sampling and testing was conducted in selected areas. The quality of ground water occurring in some villages of Gurgaon district, Haryana and effluent

samples, from Okhla Sewage Disposal Works were assessed based on the quantification of various major and micro constituents. The heavy metal content of ground water (saline) and effluents were analysed by atomic absorption spectrophotometry. The direct use of AAS for heavy metal analysis in ground water containing high concentration of dissolved solids lacks reproducibility and sensitivity because of scattering effects and clogging of the burner. On the other hand, samples containing metal-ions at ppb level have to be pretreated before feeding into AAS for analysis. To overcome these difficulties an analytical method was developed for the quantitative separation and analysis of manganese, copper, nickel, cobalt, iron, zinc, cadmium, and lead based on the adsorption of their N-methyl piperazine dithiocarbamate complex on micro crystalline naphthalene followed by dissolution in acid and analysis by AAS. The method was also applied for the quantitative analysis of these metals in some standard alloys of known composition to assess its suitability and selectivity.

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