ABSTRACT

Industrial pollution has spoiled the three wealth of life, namely water, air and soil. The industrial effluents have caused havoc for human living on earth and therefore there is a need for the treatment of industrial effluents before their disposal. The traditional physico-chemical processes employed for treatment involve high energy and large capital investment. The use of plants, for cleaning up contaminated water, has tremendous effect on bioaccumulation of both inorganic and organic pollutants. In the present study an attempt has been made to develop a phytoremediation process for the removal of both inorganic and organic pollutants from the paper mill effluent, before it is being discharged to the nearby river, employing six hydrophytes like Eichhornia, Hydrilla, Jussea, Lemma, Pistia and Trapa as phytoremediators.

The phytoremediation of effluent of Pulp and Paper mill, using the above mentioned six hydrophytes has been assessed in terms of reduction in pH, Conductivity, TDS, TSS, DO, BOD, COD, Chlorides, Nitrite-Nitrogen, Nitrate-Nitrogen, Phosphate, Sulfate, Potassium, Mercury and Copper. The effluent has been treated for a period of 20 days.

A significant reduction in all the selected physico-chemical parameters except pH and Temperature was observed in all water samples (Treated, Upstream and Downstream river water) over untreated sample. TDS, TSS, BOD and COD of all three samples were decreased in comparison to untreated sample. So also Nitrate and Nitrite Nitrogen, Chloride, Phosphate, Sulfate, Potassium, Mercury and Copper. But DO concentration increases after phytoremediation and also in downstream river water.

All the six hydrophytes used for phytoremediation studies are efficient in removing the pollutants including heavy metals. Out of six hydrophytes, Lemma and Eichhornia were found to be the efficient species and Trapa being the least efficient. When grown in the untreated effluent some species like Pistia and Trapa could not grew for even a period of seven to ten days but some species like Eichhornia, Lemma, Hydrilla and Jussea thrive for a period of 20 days after that plants withered. Lemma, Pistia, Trapa and Jussea showed symptoms like shedding of roots, chlorosis and wilting of leaves.
The hydrophytes when grown in a medium containing 1, 3 and 5 mg/l of either Copper or Mercury they grew well at lower concentrations. All growth parameters like leaf size, root size, wet weight and dry weight, total chlorophyll and carotenoids increased at 1mg/l of metal but decreased later on when grown for a period of 12 days. During this experimental duration some species grew well in copper or mercury concentration at higher concentrations.

Assessing phytoaccumulation of metals in various parts of the hydrophytes it was observed that in all cases metal was accumulated in the roots maximally than in leaves and the left out medium in which the hydrophytes were growing.

The phytoremediated biomass was used as manure in growing *Phaseolus* L. The three soil types, like garden soil (F₀), garden soil mixed with compost (F₁) and garden soil mixed with phytoremediated biomass (F₂) were used to see the growth and yield of *P.aureus*. The plant yield in terms of height, root length, leaf size, pods and number of seeds per pod was found to be maximum in F₂ soil type followed by F₁ and F₀.

From the above experiments it is well felt that aquatic plants (submerged, emerged and floating) are capable of cleaning organic contaminants from Pulp and Paper mill effluent. Moreover, inorganic contaminants (including metals) can also be treated and the phytoremediated biomass can well be used as manure for the increased growth and crop yield.