MUNICIPAL WASTEWATER TREATMENT USING ALGAE

PROJECT REFERENCE NO.: 38S0422

COLLEGE : SIR M. VISVESVARAYA INSTITUTE OF TECHNOLOGY, BENGALURU
BRANCH : BIOTECHNOLOGY ENGINEERING
GUIDE : PROF. SUDEVI BASU
STUDENTS : MS. TANMAYEE JAHAGIRDAR

Keywords: Nutrient pollution, microalgae, wastewater treatment, biomass productivity, lipid extraction

Introduction
Over the years, nutrient pollution in wastewater has become a severe problem, adversely affecting the quality of environment. Excess of nitrogen and phosphorus from the waste bodies stimulate growth of algae and rooted aquatic plants in shallow streams. This leads to depletion of dissolved oxygen in receiving water body consequently affecting the aquatic life. It also reduces the aesthetic value and the usefulness of the water. This in turn adversely affects the human health and the economy. Hence, the removal of nutrient load like nitrogen and phosphorus has become an integral part of wastewater treatment.

Objectives-
1) Photo bioreactor design
2) Isolation of algae from lakes and it’s cultivation in domestic wastewater
3) Scale up of the process
4) Nutrient removal from wastewater by algae culture
5) Crude lipid extraction from the algal biomass

Methodology
1) Equipment Design
A photobioreactor has been constructed from glass aquarium having a capacity of 10L. A CFL bulb of 11 watts is attached to this. An automatic timer adjusting a light/dark period of 12hrs/12hrs is attached to this bulb. A stirrer is attached to the bioreactor to provide continuous agitation as also to avoid algal sedimentation. A tap having diameter of 15mm is attached to the reactor for wastewater outlet.

2) Isolation of algae
Lake water containing algae was collected from Ulsoor lake, Bangalore. It was pelleted down by centrifugation and inoculated in algae culture broth after sterilization. The flask was kept in 12 hrs light/ 12 hrs dark period and shaken manually to avoid algal sedimentation.

3) Spectrophotometer analysis and algal species characterization
Spectrophotometer analysis was carried out at 670 nm for determination of growth rate of algae. The growth curve for algae was thus obtained. Algal species was studied using light microscope at 10X and 40X focus. The morphology of the algal species was studied and the color, shape of cells and motility was observed.

4) Inoculation of algae in wastewater
Wastewater was obtained from the Boy’s hostel, Effluent Treatment Plant, SMVIT after initial grit removal and screening. The algae isolated in algae culture broth was pelleted down by centrifugation and inoculated under sterilized condition in the autoclaved wastewater. This flask was kept under 12 hrs light/ 12 hrs dark period and shaken manually to avoid algal sedimentation.

5) Scale up of wastewater treatment
The wastewater treatment was scaled up to 6L in the photobioreactor and the same parameters of 12 hrs light/ 12 hrs dark period was provided. Continuous stirring was provided by the stirrer thus facilitating aeration and avoiding algal sedimentation.

6) Wastewater analysis
The wastewater analysis was carried out every 15 days and the following parameters were analyzed- Biological Oxygen Demand, Chemical Oxygen Demand, Total Suspended Solids, Nitrate nitrogen, Total Phosphates.

7) Algal biomass study
The algal biomass at the end of the treatment was air dried and kept in oven. The dry biomass was measured using the gravimetric method. Biomass productivity was also calculated.

8) Lipid extraction
Lipid extraction was carried out using the Folch method (1959) and chloroform: methanol mixture with a ratio of 2:1 was used. Crude lipid was thus extracted.

Results

1) Isolation of algae
Algae was successfully isolated and algal growth was observed from 14th day.

2) Spectrophotometer analysis and algal species characterization
Growth curve for algae was obtained and algal growth was seen to be exponential from 15th day. The algal cells were found to be single celled, spherical in shape and green in color. The cells were motile, but flagella was not present. Preliminary studies indicate the algae might belong to the *Chlorella* species.
3) Inoculation of algae in wastewater
The growth of algae in wastewater was seen from the 8\textsuperscript{th} day.

4) Scale up of wastewater treatment
Algal growth was observed from 2\textsuperscript{nd} day in the photobioreactor.

5) Wastewater analysis
Reduction in the pollutant and nutrient load was observed as follows-

![Graphs showing reduction in pollutant load and nitrate-nitrogen](image)

6) Algal biomass studies
The algal biomass was found to be 1.078gm/L. The biomass productivity of the algae was calculated to be 24.5 mg/L/d.

7) Crude lipid extraction
The crude lipid extracted weighed 0.243gm/L. The percentage of lipid content from dry biomass was found to be 22.54%. This lipid still contained impurities like algal pigments and cell suspension.
Scope for future work

- The parameters required for growth of microalgae can be optimized to give a better yield of biomass and further reduce the period of lag phase.
- Crude lipid can be further processed to give pure lipid.
- Lipid and FAME analysis can be studied to give a lipid profile.
- The potential to use the isolated microalgae as a biofuel can be studied and analyzed.