DEVELOPMENT OF UNIVERSAL TUBULAR MICRO ALGAE PHOTO-BIOREACTOR TO MEET HIGH YEILD

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Introduction: Micro algae have found its importance in production of biofuels which are the alternatives for the fossil fuels which we are using in the present day. These micro algae can be grown both in outdoor and indoor conditions where it needs sufficient light and carbon dioxide, but in most of the cases the outdoor conditions for the algae growth is not suited. For this purpose the photo-bioreactors are used wherein the suitable conditions for the algae growth are achieved and the algae yield is increased. Although we have more than 6 types of photo-bioreactors, tubular type of reactor is the most common one because of its simplicity and easy handling.

PROCESS:

Fig 1: Process of extracting biodiesel from Algae

Objectives:

- To develop a tubular photo-bioreactor for growing almost any kind of micro algae for the production of biofuel in homes as well as industries.
- To make the system simple and efficient so that it can be used and handled easily by a common man.
- To extract more yield of micro algae biofuel in less space in comparison to open pond culturing technique.
- To develop the model which can be scaled for large biofuel extraction plants also.
- To develop affordable system for common people.

Methodology: The algae samples chosen for cultivation were Chlorella Vulgaris and Nannochloropsis for their high lipid contents. Suitable media for growing algae was prepared and the culture was added to the media. Initially the culture was grown in conical flasks kept under artificial lighting with continuous air supply. After 10 days the culture was shifted to 20 liter capacity transparent tanks and kept under sunlight. The culture was shaken for every one hour interval to expose the algae to sunlight and to make it suspend in media.

Fig 2: Initial culture of Algae
Fig 3: Culture after 10 days
Fig 4: Culture after 25 days
The cultures were fed with Nitrogen and sodium carbonate which helps the algae to grow and accumulate the lipids. The algae cultures were exposed to sunlight for 8 hours and kept in shade for 16 hours (i.e., 8:16). Daily the Ph was tested and it was maintained for the values of 8-8.5.

**Fig 5:** Culture in 20 litres tanks after 15 days

As discussed earlier the technique of growing the algae in outdoor conditions has found difficult so the suitable photo bioreactor (PBR) was developed for growing the Algae.

The main aim of developing the PBR was to use the daily use materials and the second objective was to have a common PBR with controlled environment which can be used to grow any kind of Algae according to requirements (fig ).

The PBR was designed (fig) for the capacity of growing 25 litres of algae. The PBR included glass, plywood, acrylic tubes, pvc pipes as materials to fabricate. The ply wood box is made and the tank made of glass was kept inside the box. Above the plywood box acrylic tubing is given to expose the algae for sunlight. A mini pond pump is used to pump the algae to the reactor tubing from the glass tank. A circulator was used to circulate the algae in the glass tank which resembled the open pond raceways. Multicolor LED lighting was given inside the reactor to simulate the sunlight and also some Algae have tendency to grow only for a particular light. PVC piping was given inside the reactor chamber to harvest algae when it is completely grown.

**Fig 6:** Fabricated photo bioreactor

The presently designed PBR is able to produce about 15 kg of algae which may give up to 25 litres of biodiesel. It was clearly studied and understood about the Algae culturing techniques and the PBR was designed and fabricated to satisfy all the requirements and the conditions to grow almost any kind of algae.

**EXPECTED OUTCOMES**

- Extraction of about 10 litres of algae biofuel.
- More yield of algae's in less space.
- Energy efficient system.
- Manufactured, used and maintained easily by anyone.
- It can be used at homes, institutions and industries for cleaning their exhaust emission and recycling of water for growing algae's.