Proximate Analysis of Biomass Algae sample found in Dal lake,Srinagar.

PROJECT REPORT

Submitted by:

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Report Question:

Employing experimental techniques, determine the fixed carbon, volatile matter, moisture content and ash present in algae collected from two points in the Dal Lake: (i) Near the STP (Fore Shore Road) – Section A (ii) Near Char Chinari – Section B. Submit a report on the same, clearly showing all the involved calculations. In addition, evaluate the potential of the Dal Lake based algae as a fuel, making comparisons between the differences of algae obtained from the two points. Report must cite literature based on the same,also drawing parallels between the calculated calorific value and that reported previously.

1.Introduction:

The purpose of this report is to study the proximate analysis of biomass derived from algae found in Dal lake,Srinagar.

Proximate analysis of biomass obtained from algae is used to determine various parameters of algae such as moisture content,volatile matter,ash content and Fixed carbon.Determination of these various parameters in proximate analysis helps us to understand the chemical composition of algae as well as the potential applications of algae such as a source of fuel and nutrients.

The biomass sample derived from algae that has been analyzed in this report,is the one which was found and collected from near the Sewage Treatment Plant (STP) located on Fore Shore Road within Dal lake,Srinagar.

The increasing demand for clean and sustainable energy has brought algae to the forefront as a promising option for biofuel. Algae, which come in a wide range of forms from tiny single cells to larger seaweeds, thrive in various aquatic environments, including freshwater lakes like Dal Lake in Srinagar. However, when algae grow uncontrollably, they can create serious ecological problems such as disrupting nutrient cycles, obstructing water flow, and increasing the risk of waterborne diseases.

Fortunately, research indicates that we can turn these unwanted algae into valuable resources. This study focuses on exploring the potential of algae from Dal Lake as a source of biofuel. Through a series of experiments, we aim to measure key parameters of fuel quality in algae samples collected from two different areas of the lake: near the Sewage Treatment Plant(STP) on Fore Shore Road and near the Char Chinari area. Specifically, we will analyze the fixed carbon content, volatile matter content, moisture content, and ash content of the algae samples. These parameters provide important insights into the fuel's characteristics such as how easily it ignites, how efficiently it burns, how stable it is for storage, and how much energy it produces overall.

By carefully comparing our results with existing scientific literature on algal biofuels, we can thoroughly assess whether Dal Lake algae could be a viable renewable energy source, offering a sustainable solution for the future.

2.Methodology:

The moisture content was assessed by measuring the weight reduction during the drying process, while the volatile matter and fixed carbon were determined using established proximate analysis methodologies.

Sample collection

Algae samples were collected from two designated points within Dal Lake:

- **Section A**: Near the Sewage Treatment Plant (STP) located on Fore Shore Road.
- **Section B**: Near the Char Chinari area.

Sample preparation:

The algae samples underwent an additional 24-hour sun-drying procedure to reduce their moisture content. During this process, the samples were spread out on dry paper and exposed to direct sunlight. Afterward, the collected samples were subjected to proximate analysis using standardized ASTM procedures. This analysis aimed to identify the essential properties of the algae constituents for potential biofuel applications.

a).Determination of Moisture Content of Algae:

To determine the moisture content, a pre-weighed, dry Petri dish containing a sun-dried algae sample(2.5624g) was placed in a digital hot air oven set at 105°C. The sample was oven-dried following the ASTM E871-82 standard until its weight remained constant, indicating complete moisture removal.

$$\%\boldsymbol{Moisture\ Content} = \frac{\boldsymbol{initial\ weight\ of\ sample(W_i) - dry\ weight\ of\ sample\left(W_{dry}\right)}}{\boldsymbol{initial\ weight\ of\ sample(W_i)}} \times \mathbf{100}$$

%Moisture content calculations:

Initial weight of sample(W_i)=2.5624g

Dry weight of sample(W_{dry})=2.0885g

$$\%\text{Moisture content} = \frac{2.5624 - 2.0885}{2.5624} \times 100$$

=18.894%

b).Determination of Volatile Matter of Algae:

The %Volatile matter was determined by placing 2.0885g of the algae sample and kept in a furnace for 7 minutes,at a temperature of 900 degreee Celsius and weighed after cooling.

$$\%\boldsymbol{Volatile\ Matter} = \frac{\boldsymbol{dry\ weight\ of\ sample(W_{dry}) - final\ weight\ of\ samle(W_{final})}}{\boldsymbol{initial\ weight\ of\ sample(W_i)}} \times \mathbf{100}$$

%Volatile Matter calculations:

Dry weight of sample(W_{dry})=2.0885g

Fianl weight of sample(W_{final})=0.7908g

$$\%\text{Volatile matter} = \frac{2.0885 - 0.7908}{2.5624} \times 100$$

=**50.643%**

c).Determination of Ash content of Algae:

We took 2.5624 grams of algae and burned it all in a closed furnace. Then, we weighed the leftover residue using a precise balance. The percentage of residue weight tells us how much ash is in the sample.

$$\%\boldsymbol{Ash\ content} = \frac{\boldsymbol{residue\ weight(W_{ash})}}{\boldsymbol{initial\ weight\ of\ sample(W_i)}} \times \mathbf{100}$$

%Ash content calculations:

Residue weight(W_{ash})=0.398g

Initial weight of sample(W_i)=2.5624g

$$\%\ \text{Ash content} = \frac{0.3968}{2.5624} \times 100$$

=**15.48%**

d).Determination of Fixed Carbon of Algae:

The Fixed Carbon of algae sample can be determined from the following equation:

$$\boldsymbol{Fixed\ Carbon}(\%) = \mathbf{100} - (\boldsymbol{moisture\ content} + \boldsymbol{volatile\ content} + \boldsymbol{ash\ content})$$

$$Fixed\ Carbon(\%) = 100 - (18.494 + 50.643 + 15.48)$$

$$Fixed\ Carbon(\%) = \mathbf{15.383}\%$$

3.Proximate Analysis Results and Discussions:

3.1 Moisture Content

Initial weight of sample(W_i)	Dry weight of sample(W_{dry})	%Moisture content=(loss in weight)/(initial weight) ×100	Literature value(%)
2.5624g	**2.0885g**	**18.494%**	**12.4%**

%Moisture content=((2.5624-2.0885)/2.5624) ×100=**18.494%**

3.2 Volatile Matter

Initial weight of sample(W_i)	Final weight of sample(W_{final})	%Volatile Matter=(loss in weight)/(initial weight) ×100	Literature value(%)
2.0885g	**0.7908g**	**50.643%**	**53.5%**

%Volatile matter=(2.0885-0.7908)/2.5624) ×100=**50.643%**

3.3 Ash Content

Initial weight of sample(W_i)	Final weight of Residue(W_{ash})	%Ash content=(Residue weight)/(initial weight) ×100	Literature Value(%)
2.5624g	**0.3968g**	**15.48%**	**11.2%**

%Ash content=(0.3968/2.5624) ×100=**15.48%**

3.4 Fixed Carbon

%Fixed Carbon	Literature value(%)
15.383	**21.5%**

%Fixed carbon=100-(18.494+50.643+15.48)=**15.383%**

3.5 Calorific Value Calculation:

Calorific value was calculated using CFRI empirical correlation,which is based on percentage of moisture content.

When moisture content ≥2%,then

$$\boldsymbol{GCV = \left(85.6 \times \left(100 - (1.1A + M)\right) - 60M\right)}$$

Where A=%Ash content

M=%Moisture content

GCV=Gross calorific value

$$\mathrm{GCV} = \left(85.6 \times \left(100 - (1.1 * 15.48 + 18.494)\right) - 60 \times 18.494\right)$$

=**4409.67 kcal/kg**

Results Tabulation:

Parameters	Section A (Near STP, Fore Shore Road)	Section B (Near Char Chinar)	Literature	References
Moisture Content	18.494%	19.20%	12.4%	Ross et al. (2008)
Volatile Matter	50.643%	57.05%	53.5%	
Ash Content	15.48%	17.03%	11.2%	
Fixed Carbon*	15.383%	6.72%	21.5%	

(* Calculated by difference)

Based on the literature values from "A.B. Ross et al. / Bioresource Technology 99 (2008) 6494–6504," the proximate analysis of the aquatic algal bloom samples indicates lower levels of moisture and ash content, as well as a greater proportion of volatile matter in Section A compared to Section B. Consequently, the fixed carbon content is higher in Section A. This implies that the algae in Section A have a lowe concentration of moisture, ash, and volatile compounds, leading to a higher amount of fixed carbon compared to the algae from Section B.

Potential as a fuel:

Impact on the Environment: The ash content significantly influences combustion systems, affecting factors like slagging and fouling. The lower ash content observed in Section A indicates potentially fewer operational issues during combustion compared to Section B.

Calorific Value: Higher fixed carbon and lower ash content generally indicate better fuel quality. The fixed carbon values suggest that both types of algae hold promise as biofuels, with Section A algae slightly superior due to its higher fixed carbon and lower volatile matter content.

The calculated calorific value for the **Section A** sample is **4.409 MCal/kg (18.447 MJ/kg)**, while the **Section B sample's** calculated calorific value is **4.160 MCal/kg (17.405 MJ/kg)**, demonstrating a difference between the two samples.

Previous studies on algae as biofuels suggest that they can possess calorific values ranging from 15-20 MJ/kg, depending on species and cultivation conditions (Demirbas et al., 2011). The fixed carbon and volatile matter results obtained here indicate that Dal Lake algae fall within this range, highlighting their potential as a renewable bioenergy source.

4.Inferences and conclusion:

Dal Lake Algae and its potential as a Biofuel

Examination of algae samples collected from two different points in Dal Lake, Section A (near the Sewage Treatment Plant) and Section B (near Char Chinar), unveiled notable differences in composition. Algae from Section B showed elevated levels of volatile matter content, whereas Section A exhibited higher levels of fixed carbon and ash content. Remarkably, both sections demonstrated promise for biofuel applications. Nonetheless, Section A held a slight advantage due to its higher fixed carbon content, typically linked to superior fuel quality.

Enhancement of the potential of Algae as a Biofuel

We can enhance the potential of algae as a biofuel source through various technologies. These encompass photobioreactors, open ponds, advanced harvesting techniques, efficient oil extraction methods, transesterification processes, and integrated biorefinery systems (Chisti et al., 2007).

5. References:

1. ASTM E872-82. (2013). "Standard Test Method for Volatile Matter in the Analysis of Particulate Wood Fuels." ASTM International.

2. ASTM D1102-84. (2013). "Standard Test Method for Ash in Wood." ASTM International.

3. Demirbas, A. (2011). "Algae as a source of biofuel." Energy Conversion and Management, 52(1), 163-170.

4. ASTM (2013), Standard Test Method for Moisture Analysis of Particulate Wood Fuels, ASTM E871 - 82(2013). ASTM international, Pennsylvania

5. A.B. Ross et al. l Bioresource Technology 99(2008) 6494-6504

6. Chisti, Y. (2007). Biodiesel from microalgae. Biotechnology advances, 25(3), 294-306.