Potential of Macro Algae for Biomass Energy Source and Green House Gas Emission Carbon Capture

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Marine Algae have thousands species, that have various application of today's needy biotechnology material, it has a big potential to solve energy problem. Marine algae have the largest carbon energy content compare to other biomass energy sources. Marine algae can capture large amount of CO_2, another big potential to solve climate change problems. Various species of marine algae also act as filters to clean the ocean. Macro-algae plantation system has not been tried in many places due to lack of offshore technology usage in aquaculture industry. In order to maintain the competitiveness in macro-algae production in global market, novel cultivation system that will provide large scale production currently need to be developed and the development include conceptual design work already performed on the study is integrated integration into industrial design and testing required for full commercialization. Biological work for ocean water test to determine algae species for Difference Ocean areas is conducted in conjunction with the development of the aquaculture technology platform require for the ocean plantation. This paper describes the biological work on the system.

Key words: Macro algae, Biomass, Energy, Seaweed.

Background

Biomass production from macro algae has been viewed as important mainly because of the need for pollution abatement. Environmental considerations will increasingly determine product and process acceptability and drive the next generation of economic opportunity. Bomass represent renewable energy resource that is available where the climatic conditions are favorable for plant growth and production. Biomass is considered as an attractive alternative to fossil fuels as a source of energy. Macroalgae found application for use as food for production of useful compounds, as bio filters to remove nutrients and other pollutant from wastewaters, to maintain water quality, as indicators of environmental change, in space technology, and as laboratory research systems. Algae can be used for biodiesel and biobutanol. It's used can mitigate the use of sizable amounts of vegetable oil, compared terrestrial crops grown for same purpose. It also can be grown to produce hydrogen that is sometime switch from the production of oxygen to the production of hydrogen.

Marine macro algae are receiving increasing attention as an attractive renewable source for producing fuels and chemicals. Macro algae species have high caloric energy value compare to other biomass sources. Biomass can also use for carbon capture and subsequencial mitigate of the global warming by capturing the carbon dioxide from the large point sources such as fossil fuel power plants and storing it instead of releasing it into atmosphere.

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In order to increase sustainable production of microalgae, a group of researcher form UMT, embark in design of ocean platform for open water cultivation. Cucurently, the species study for spatial analysis of habitat for different macro algae is being study to identify the types of biomass that can grow in Malaysia water. The project hope to deduce the amount of caloric value and carbon dioxide capture that can be derive from the species in Malaysia. Global effort is underway at many fronts to reduce the impact of global warming and climate change. The increase of greenhouse gas emission such as carbon dioxide has impact on climate change. Based on estimation in 2000, more than 20 metric ton of carbon dioxide was release to the atmosphere every year[1]. Biomass is the neutral carbon in the life cycle, the use of macro algae as the marine biomass energy sources, can reduce the net emission of carbon into atmosphere through carbon capture may reduce. The research also considers the need to estimate carbon and energy value of offshore aquaculture system. Figure shows trend in production of brown Algae.

The production of green algae remains limited (compared with red and brown algae production). Once again, these algae are mainly grown in Asia. The production of this group reflects the involvement of China in their culture. The beginning of Spirulina production can be seen on the graph, these blue-green algae serve not only for the pharmaceutical industry but also as a means to counter malnutrition in Africa.

Producing biomass by marine macro algae

As world energy demand continues to rise and fossil fuel resources are depleted, marine macro algae (i.e., seaweed) is receiving increasing attention as an attractive renewable source for producing fuels and chemicals. Marine plant biomass has many advantages over terrestrial plant biomass as a feedstock. Recent breakthroughs in converting diverse carbohydrates from seaweed biomass into liquid biofuels (e.g., bioethanol) through metabolic engineering have demonstrated potential for seaweed biomass as a promising, although relatively unexplored, source for biofuels[2].

A marine biomass energy system in Japan was proposed consisting of seaweed cultivation (*Laminaria japonica*) at offshore marine farms, biogas production via methane fermentation of the seaweeds, and fuel cell power generation driven by the generated biogas. The estimated CO_2 mitigation is equivalent to about 0.9% of the required CO_2 mitigation for Japan per annum under the Kyoto Protocol framework[3]. Brown macro-algae that can be commonly found around the British coasts are mainly used as a source of many useful industrial chemicals such as phycocolloids (e.g. alginates). Conversion of macro-algae into biofuel has largely focused on the production of biogas by anaerobic digestion. Some recent studies have focused on the utilization of the sugars present in seaweed (mannitol and laminarin for brown algae) in order to produce bio-ethanol by fermentation[4].

Marine macro algae are one such source of aquatic biomass and potentially represent a significant source of renewable energy. The average photosynthetic efficiency of aquatic biomass is 6–8% (Renewable biological systems for alternative sustainable energy production, 1997) which is much higher than that of terrestrial biomass (1.8–2.2%). Either microalgae or marine macro algae (kelp or seaweed) could be used for solar energy conversion and biofuel production. (A.B. Ross, 2007).

Biomass, either terrestrial or aquatic, is considered a renewable energy source with quasi zero-emission. Among alternative energy sources, biomass represents the most ready to be implemented on a large scale without any environmental or economic penalty. The photosynthetic efficiency of aquatic biomass results to be much higher (6– 8%, average) than that of terrestrial (1.8–2.2%, average). This makes the former more adapt for an enhanced CO2 fixation to afford a high biomass production. Also, aquatic biomass presents an easy adaptability to grow in different conditions, either in fresh- or marine-waters, and in a wide enough range of pH .The pond culture of algae presents the advantage of assimilating carbon dioxide emitted by electric power plants, using wastewater that may supply the amount of required nutrients .Either marine micro-algae or seaweed could be used for solar energy conversion and biofuel production. Micro-algae have received so far more attention with respect to macro-algae as agents for enhanced CO_2 fixation due to their facile adaptability to grow in ponds or bioreactors and the extended knowledge on several strains used for fish feeding. Macro-algae are extensively grown and used as food in Asiatic Countries, or as source of chemicals. They are usually collected from natural water basins where they are seasonally available. Only recently they have been considered for energy production, and the potential of some Pacific Ocean strains has been preliminarily studied. (M. Aresta *et al*, 2005).

Environmental Issues

The major environmental issues associated with biomass production and utilization are the commitments of land, water and fertilizer[1]. The greatest potential impact is the competition for, and the over-exploitation of, resources also required for production of food and fiber. More specific environmental issues include soil erosion, nutrient depletion, water quality degradation and air pollution (J.L. Trimble, 1984). Potential environmental benefits to be derived from the

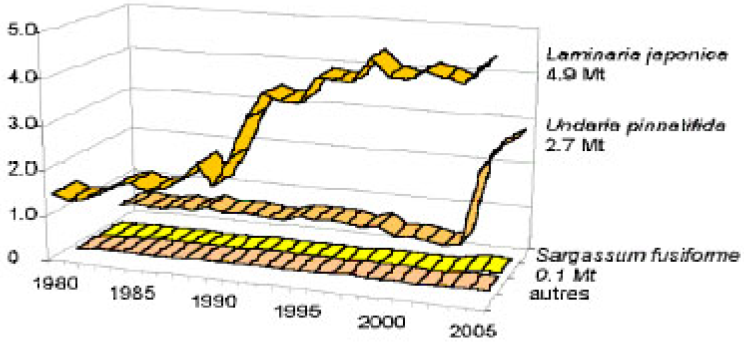
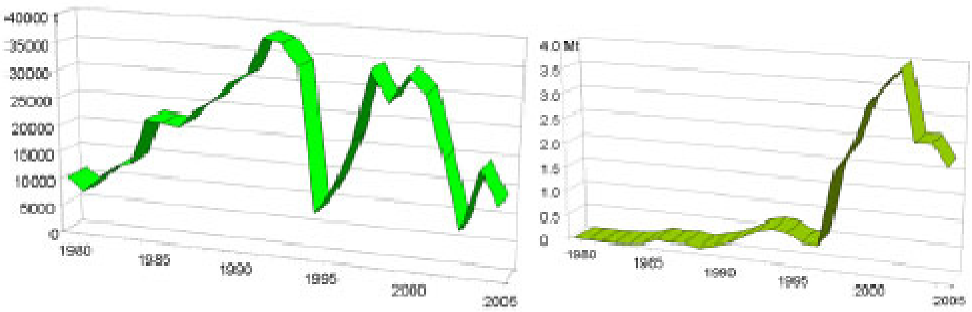


Fig. 1. Algae production

Porphyra sp *Euchema sp* *Gracilaria sp*

Fig. 2. Types of Red Algae



Green algae Blue algae

Fig. 3. Types of Algae production

local production and use of biomass resources and biofuel production include offsetting GHG emissions associated with burning fossil fuels, waste utilization, and erosion control. Clearly, biomass technology may benefit the environment while at the same time it may help solve some pressing environmental problems. It is reported that using biomass to produce energy is carbon-neutral because it releases roughly as much carbon dioxide (CO_2) as it takes in. For instance, for every MWh of power generated using biomass, approximately 1.6 tonnes of CO_2 are avoided. Also, the use of biomass resources, managed in a sustainable way, could reduce CO_2 emissions and thus help tackle global warming[5]. Fig. 1 shows Alage production, Algaculture of brown algae concerns two principle species: *Laminaria japonica* and *Undaria pinnatifida*.

Fig. 4. Algae Oil Extraction

Red Algae cultivation involves three main species, mostly grown in Asia but with a more balanced distribution. Small level production is also conducted on other continents. Fig. 2 shows types of red algae. Fig. 3 shows trend of Green and Blue algae production.

Method and Material

The research being conducted to identify the biomass species that can be grown in Malaysia water and to estimate the caloric energy value among carbon dioxide capture. The research access the species of biomass in Malaysia and geographical location of where to find the macro algae species and quantify the amount of caloric energy value of biomass species and the amount of net emission carbon and carbon sink of biomass speciesn as well test planting and testing of the the caloric energy value of net efficiency and emission is also being carried out. The methododlogy for the reerach focus on four main elements which is sea water analysis, testing planting,, calorific energy value , carbon sink estimate and test for power and energy efficiency and emission from biomass species on machineries.

Sea water analysis

The water analysis was deducted by mapping the biomass species and identifies

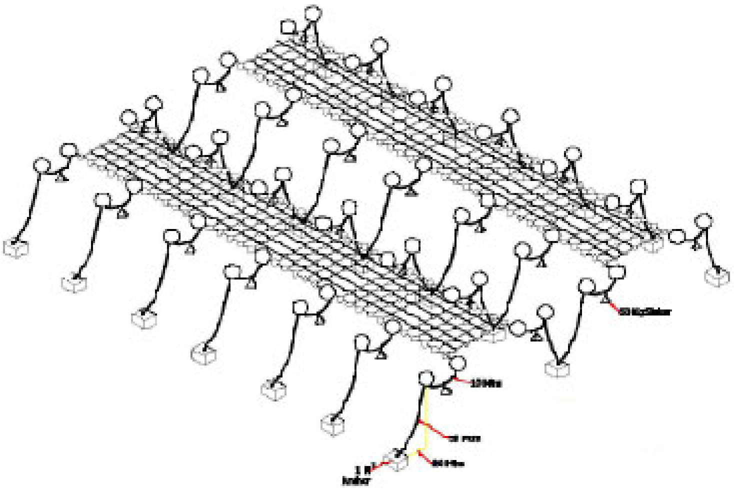


Fig. 5. Shows the drag force increase proportional with the percentage of growth.

the location of their growth. Water samples were collected during the same month from different location that is Bidong Island, Tioman Island and Redang Island. Since several places were visited, each water sample analysis was conducted at different time.

Caloric energy value and carbon sink: involve quantitative analysis

Test planting of the species on ocean structure developed

Test for power, efficient and emission from biomass species on marine machinesries.

Water sample was analyzed for nutrient content with the high sensitivity multipara metric analyzer Micromac (SYSTEA, Italy), using calorimetric standard methods according to the manufacturer methods (Fig. 4).

Biomass energy source from Culture Operations

Each culture block measure 100 m x 100 m = 1 Hectare where each culture block is estimated to plant 30,000 seedlings (avg 100 gm/seedling = 3000kg total seedling weight). • Each culture block is projected to harvest 24 mt of fresh macro-algae per crop (80% yield @ avg 1 kg/plant). Each culture

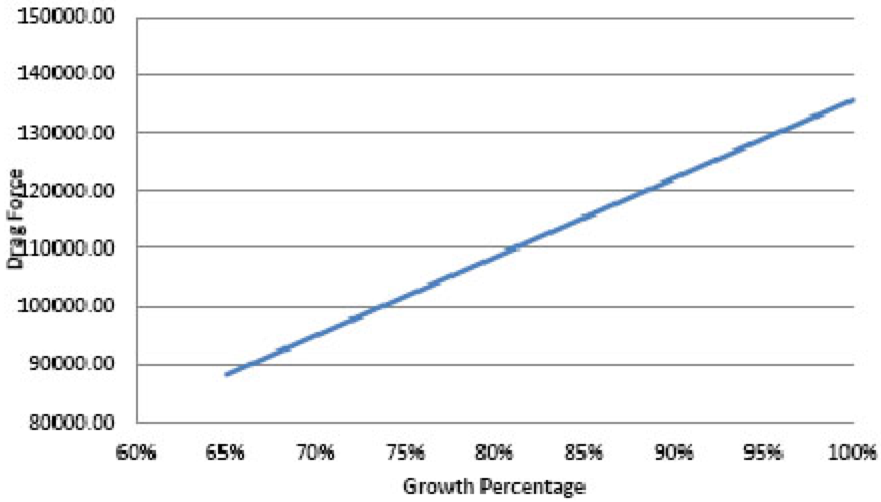


Fig. 6. Drag Force with 5% Seaweed Growth

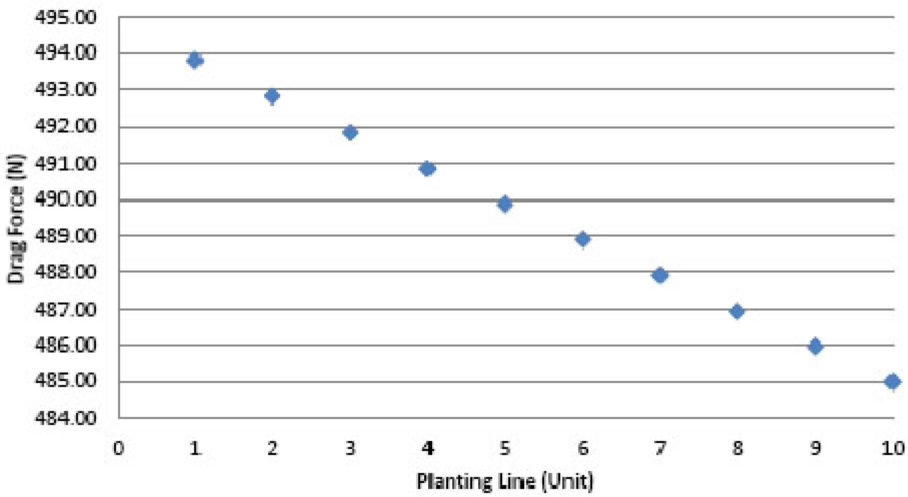


Fig. 7. Drag Force Pattern Acting on the Planting Line

block is projected to yield 2400 kg of dry macro-algae of 38% moisture containt.estimated yearly turn-over of 4 crops for the project. The seedling for each culture block is to be 3 metric tons (100 kgsper planting line, total 30 planting per block). There are 500 seedling tying points per planting line (The size of each seedling is app 100 gram) I matured frond is 540g, The projected mature tonnage at the end of culture period of 2 months is 25-30 metric tons (The estimated growth rate is between 2-5 % per day). Best-OASe of Macro-algae can generate 11000 MJ/dry algae & micro-algae 9500 MJ/T.

The (Fig. 5) shows the drag force increase proportional with the percentage of growth. The growth of seaweed is unlimited, but due to the operational matters, farmers usually harvest seaweed after 8 weeks they being planted. Therefore, this figure assuming the seed is represented as 65% of its growth and grow constantly about 5% during the period.

This (Figure 6) shows 10 planting lines as consideration to represent the system in order to analyse the reduction of drag force passing through each of them. Let's take 0.2% of reduction of the force that passes through each planting line. The drag force at the first line is yet to be reduced since the current are not passing any line. Understand the reduction is very important to estimate the total amount of drag force that will be experienced by the whole structure.

Drag Force (N)

Planting Line (Unit)

Performance estimation

The algae oils are tested with the engine to determine the best quality of macro algae which can be use to the engine. Heat rate is estimated by

$$HR= QB/W$$

Overall efficiency is estimated using:

$$hO = W/Qfuel$$

Where:

Q Fuel = Fuel mass flow rate × calorific value

It is known that seaweed tissue composition (proteins, alginic acid, agarose and carbohydrates) changes according to the season, the environmental conditions and the species. Moreover, a wide range of variability and diversity in carbohydrates structure exists among species and even within a single species, depending on environmental conditions. The algae yields and carbohydrates content of seaweed isolated from natural populations are lower than those recovered from algae cultured under controlled conditions. When photosynthetic activity increases, the carbohydrate content increases, while the ash, protein and alginic acid content decrease.

CONCLUSION

This study involves comparison of the characteristics of the water samples to determine macro algae species that can grow in different sea water area. The use of macro algae as the marine biomass energy sources has the potential to offset substantial use of fossil fuels and the net emission of carbon into the atmosphere can be reduced due to use the macro algae as biomass energy sources. The study estimate the carbon capture energy value from deployment of offshore aquaculture system for seaweed farming.

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