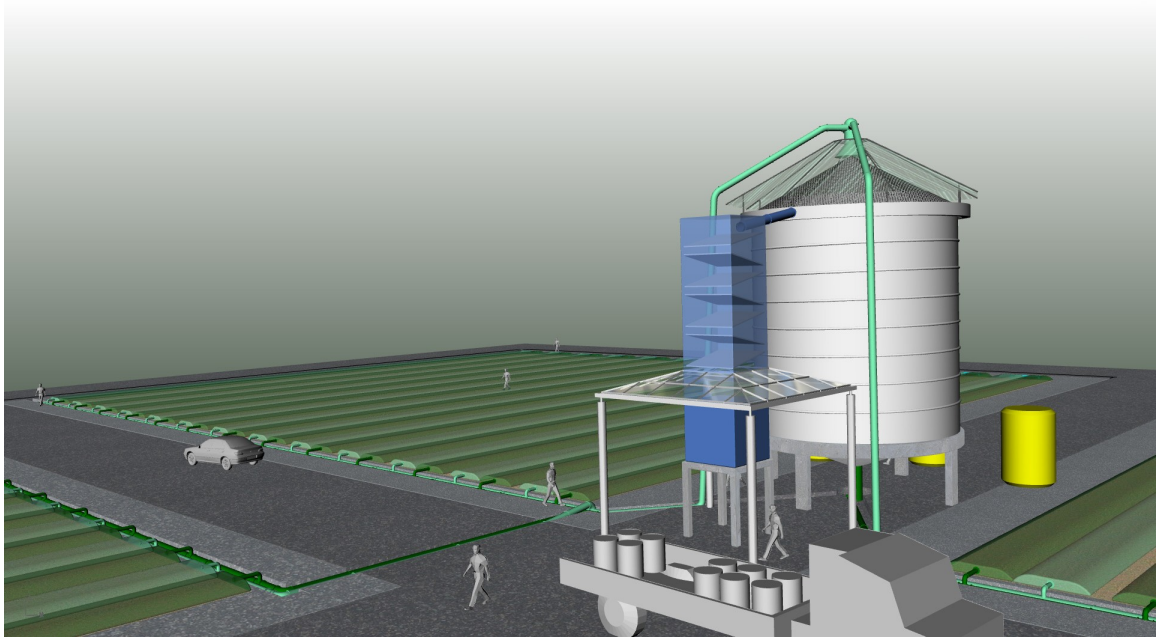
ALGAE

SINGAPORE



Introduction

The simple algae organism has been credited to a large part with the oxygenation of our once carbon dioxide rich atmosphere. Its rapid growth rate means that in one day, a hectare of algae could produce as much renewable fuel as a hectare of oil-palm can produce in a year (life cycle computation).

There are thousands of strains of algae. In this summary a common strain of algae will be mentioned. A moderately oil rich variety where when fully dried, contains about 10% oil, 9% carbohydrate (starch) and 20% protein.

The following information is derived from outdoor trials in an all terrain algae containment vessel of 12 metres by 1.6 metres.

The algae system proposed uses high levels of carbon dioxide, sewage, and a computer controlled system which measures and controls the input and output of all essential elements. It also harvests the mature algae selectively thus keeping the algae in the highest growth profile. The system has proven to have a growth rate was much higher than previous laboratory growth rates. Also important is that the all terrain algae system was designed to be deployed in non-arable land or on water.

Algae production will out perform any oil crop currently operating . Algae can be used to feed certain animals as it is. It can yield 200 times more oil per hectare than palm more which can also be used to make renewable plastics. Algae can yield massive amounts of

protein and the starch can be further processed into alcohol. Methane is a by product of the processing which can be used to run electric generators.

Early Experimental Algae System.

The Yield of Algae Per Hectare

Under ideal conditions of nutrition, direct sunlight, carbon dioxide and water flow rate, the 70,000Kg of algae can multiply many times in a day. Mushrooms and certain fungi can grow over a thousand times in weight in one night so even 40 times growth is still considered slow. Far greater growth rates have been recorded.

Issues regarding the computation of growth rate versus production rate.

If a growth rate of 10 times is chosen then the total amount of algae extracted could reach 700,000 kg per day. This assumes that the algae is allowed to grow in the containment vessel until it has multiplied 10 times and then extracted. If this were to happen the algae would soon form into a solid mass in the vessel and clog the system.

The process of extraction is continuous and selective and ensures that there is no interruption to the continuity of the growth process. It is safe to say that on average it would be difficult to envisage an extraction of less than 100,000 kg of algae per hectare per day. Under ideal conditions, this should be repeated two to 4 times in a day depending on the weather. Therefore computation will be restricted to one hectare unit(HU) of production or 1 HU, where 1 HU being 100,000 kg raw algae or 10,000Kg of dried algae.

In the even that there are several continuous days of intense direct sunshine and all growth factors are at optimum, it is conceivable that 8 HU's could be extracted from 1 hectare. Then again on stormy days there may be almost no algae extracted.

OIL for Fuel or bio-plastic, protein meal for animal feed, and ethanol:

This variety is cultivated mainly for bio-fuel. Algae cultivated for oil or straight algae oil (SAO) which is an edible vegetable oil has the following products derived from the dried algae.

The following shows a broad approximation of the yield of its derived products.

From 1 HU of algae production the following could be extracted:

1. About 1,600 Kg of algae oil.
2. About 350 Kg of Ethanol.
3. About 1,300 kg of protein meal.
4. About 30,000 cubic metres of bio-gas.

Stages of the Process:

Process Control: The control of the growth process is proprietary and is computer controlled. It is a black box concept which will regulate the flow of the slurry, the carbon dioxide levels and the nutrient content. This process control is critical to achieve the accelerated growth rates in such a concentrated slurry.

Extraction: The extraction process is automated and depends on density of the algae slurry. When the slurry reaches the limit of concentration, the flow is directed to a separator in the control tank. The separator is simply a vibrating net which filters out the algae of a certain size.

Drying: The drying process is an industry standard process and is designed for the climate at hand. In desert climate, the driers recycle the water which condenses in condensing columns. In equatorial climatic conditions, the drying process is a two step process. The first step employs sun drying in a "hot house" and is sufficient for animal feed. The second step is a gas fired drier which is only employed only when the algae is intended for bio-fuel extraction.

Animal feed: Processing for certain animal feed is quite straight forward. For example, ducks, goats and certain fish variety can feed on algae pellets formed after a process of cleaning, drying, and compress forming into pellets. Chickens and pigs require further steps of processing. The further steps include a longer cooking process and a two step blending process before compressing into pellets and a final cooking step before packing.

Bio-Fuels: This is a far more involved process. The oil and protein is contained mainly in the cell wall of the algae which is not accessible directly. The extraction process is lengthy and takes several days.

It involves heating the algae slurry in a pressure vessel. The oil is extracted in a way similar to that of oil palm.

The residual starch is processed for ethanol in a time tested industry standard method.

The protein is extracted using a well established industry standard method. Enzymes are introduce and a coagulating agent. The protein coagulates and is scooped out with a fine net.

The excess “sludge’ is pumped into a tank for the manufacture of bio-gas. This is also an industry standard method which has gained popularity in India and Bangladesh. It is also catching in rural China. The bio-gas is recycled in the gas fired driers and any excess gas can be used in homes as cooking gas.

Carbon Credits: It is possible that algae bio-fuels could yield carbon-credits. This requires an expert to advise on.