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MAKING ALGAE BIODIESEL AT HOME

Building Open Ponds

Learn How To Make…

Biofuels
Health Food supplements
Organic Fertilizer
Animal Feed

Building Open Ponds

By David Sieg

Building Open Ponds

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Short version: Keep this to yourself – otherwise I’ll have to unleash my lawyer (and man I hate paying that guy ☺)

Dedication:

To Damien and Lenny. For showing me the way back home.

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mailto:rex@process.co.za
http://www.process.co.za

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Introduction

Rising fuel costs. Fuel tax. Pollution. Carbon credits. . . Now more than ever it is time to master alternative fuel sources. Because biofuel is sustainable, you just struck liquid gold. Now you hold the ability to create this fuel for yourself and others; powering your future and making going green a slogan that means more than just words.

And make no mistake this technology is still in its very infancy.

Big Oil is now diving head deep into what has been going on in experimental "labs" all over the world. Some investments are being made now but the mass production technology is still years away.

What they are trying to scale up are many simple, proven systems and designs that create this fuel done by novices. who have pioneered this area.

Over the years experimental enthusiasts have created and actively use biofuels to power just about any kind of engine. Best of all it doesn't take true rocket science to figure out how water, chemical composition due to a breakdown of minerals, plant life and bacteria will create algae that will then give you fuel. What parts that DO require some limited rocket science, we have included in this book in a fashion that doesn't require a degree in science to understand.

Fuel from algae is a proven reality – even grown in open ponds. That is what this book will show you. Exactly how you can build an open pond has been kept secret. Imagine never having to buy fuel again. Laughing as you pass the gas station.

Imagine using this technology to help people all over. That is what we hope you will do. Show the world your genius and fuel tomorrow with algae biofuel.

As humanity struggles to find more and more energy, which exhaust our already depleted natural resources, we have to make smarter choices for the future. In order to co-habituate with the earth and all living things, we will have to become more creative about the natural supply of fuels available to us all.

After many long months of research and a great interest in biofuel I have put together what I think may be able to help anyone who is reaching out for better ways to explore alternative fuels into our future.

It is imperative that humanity become more environmentally conscious and aware that our earth

is going through some not so gentle changes at this time.

This is in part due to mankind's insensitive ways of drilling and exploring the earth. While I do not wish to inject politics into this book, both sides of this debate have constantly caused human suffering; the more liberal side has prevented drilling when necessary, and the use of fossil fuels that are needed now, and the other side that goes to the other extreme causing pollution and excessive contamination of our biosphere and an atmosphere where greed is more important than humanity.

All of this could END tomorrow if biofuels and sustainable products made from algae becomes mainstream.

We as human caretakers of the earth have a responsibility to future generations of children to make better, sustainable, ecologically sound choices and teach them more environmentally and productive ways to produce food, fuel and animal needs while still providing for our current energy needs in a way that can respect the earth and people.

This book will of course, focus on bio-fuel products and the production of algae species that can produce this type of oil product. The above was food for thought – making biofuel is a wonderful thing.

Biofuels only scratches the surface of algae can accomplish.

Thank you for your contribution to making the world a better place for us all.

David Sieg
Des Moines, IA, USA
August, 2010
December, 2012

Forward

This book also makes a number of assumptions about you, the reader. It assumes that you already know how to grow algae, understand basic inputs, know what algae strain you want to work with as well as other basic algae related details. It assumes you have tested growing the algae in a test bioreactor and are ready to start scaling your project up to backyard/pilot scale and/or commercial scale. This book doesn't go into the basics of growing algae.

If you DON'T know how to do these things, you would better served getting one of my other books, "Making Algae Biofuels at Home" for example at
www.making-biodiesel-books.com

I'm going to give you a lot of ideas here. Some of them will work for you and some won't. Not every idea is perfect for every person, but you should be able to find techniques and approaches that can significantly boost your knowledge and algae production if you apply them.

Algae, while mankind has been growing it for centuries in open ponds, only recently has that knowledge been written down and widely shared. Growing algae for biofuels is a recent innovation. As such, in many instances, there are no road maps, there is no GPS. to find your way. You take the knowledge of others and modify it to your situation.

You strike out on your own armed only with the knowledge the pioneers that came before you. That is what makes this field so exciting, as well as frustrating.

That said, no one can promise the result you'll get. I can just tell you what's worked for me and other people and some ideas you might try. I don't know you. I don't know if you'll do the work, or the quality of parts you'll buy, if you have the talent, or the tools, or if there are things I couldn't foresee that might prevent you from making this system work effectively.

I can guarantee that if you don't put the ideas to use, it won't do you any good at all.

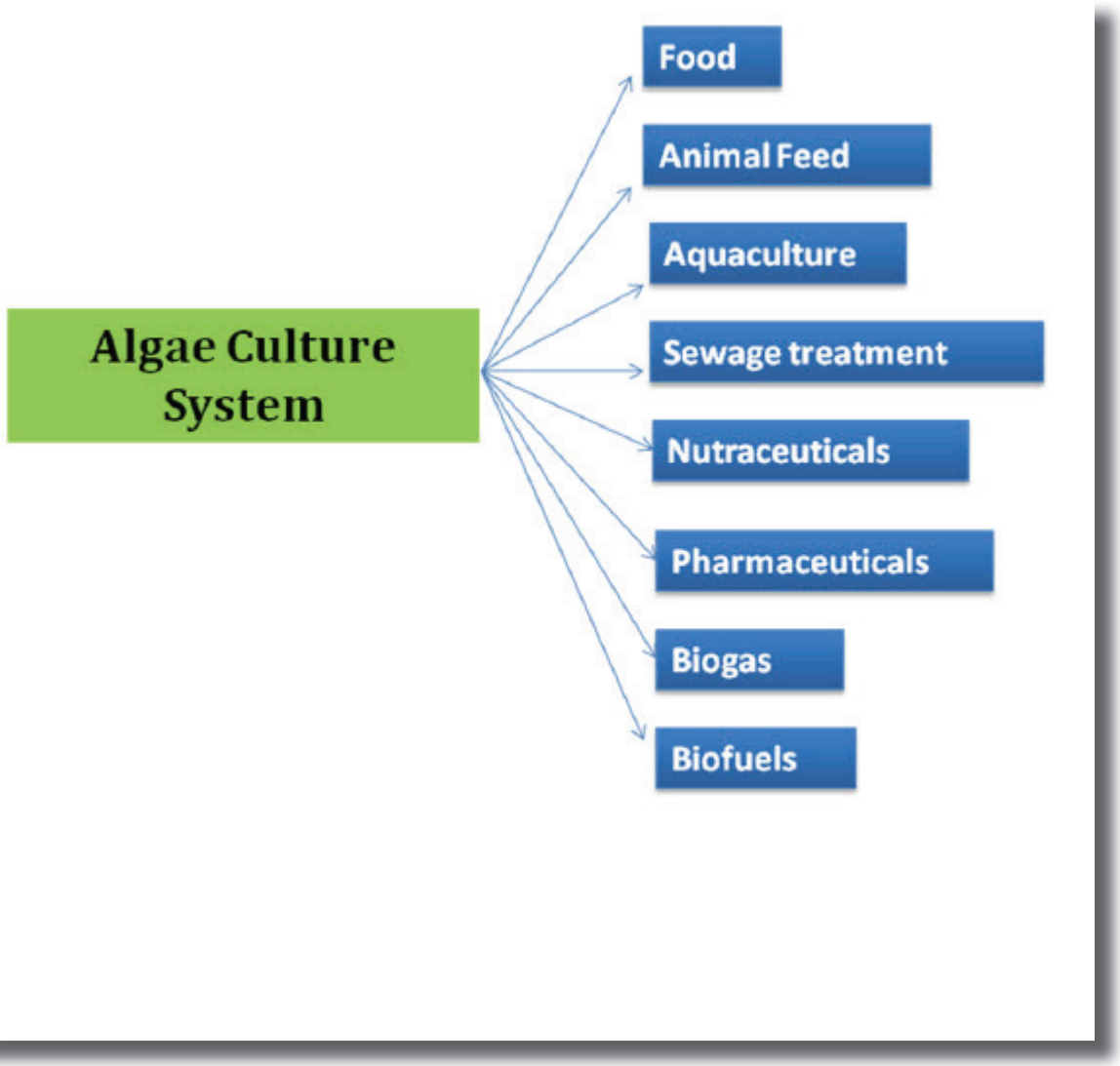
The purpose of this book is to make open ponds available to anyone, anywhere. How you implement and use them is entirely at your own risk. I'm not a doctor, lawyer, psychiatrist or Indian chief, so nothing in this book should be construed as professional advice in any of those fields.

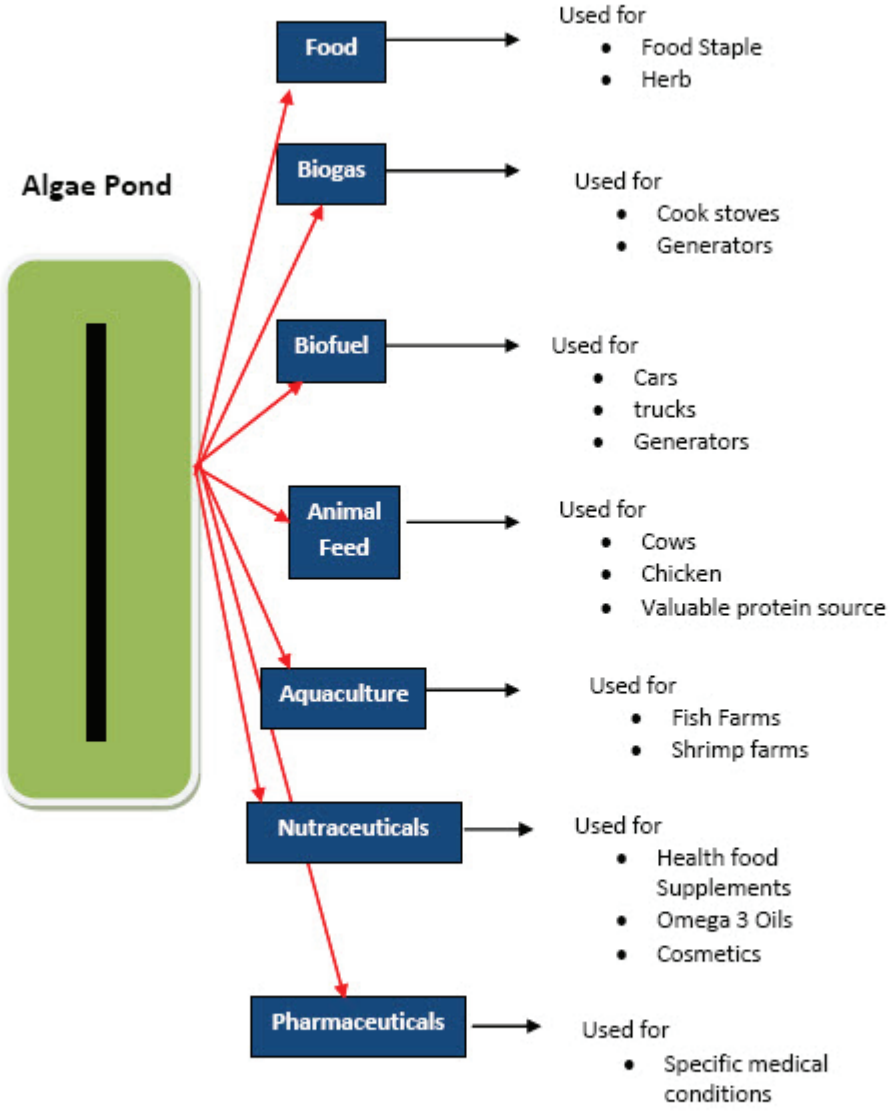
Building Open Ponds

BOOK ONE

What are some of the things we can do with algae?

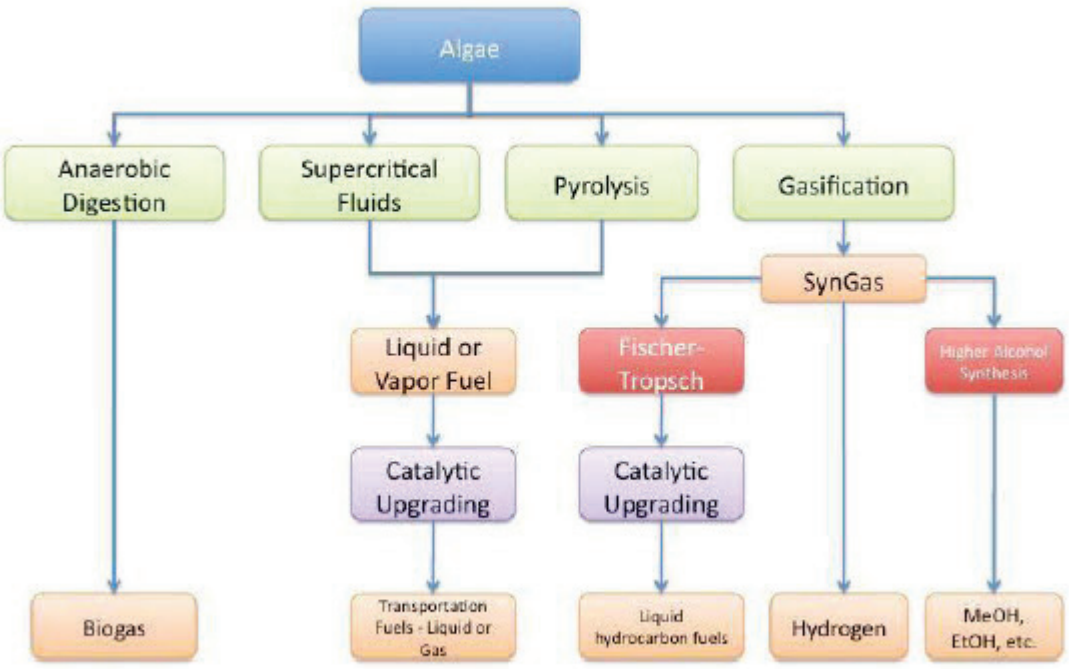
In the last couple of years and the current interest in biofuels, algae have burst onto the world stage. Indeed, some are even starting to call 2010 the "Algae Revolution." With good reason, few organisms on earth offer as much potential, or have the ability to radically change our lives as we know it. Few even speculate, that all life on earth as we know it, originated from this one celled organism. What is evident is that the next few years algae stand to revolutionize the way we do just about everything. Here are just a few of the ways in which alga is going to change the way we look at things.





Just in looking at algae from a biofuels perspective, from an open pond system, we can make…

- Biogas (Methane…to run generators, cook stoves, lighting, etc.)
- Biodiesel (To run transportation vehicles)
- BioJet fuel
- BioGasoline (To run transportation vehicles)
- Bioethanol (To run transportation vehicles)
- Hydrogen
- Methanol (To use in biodiesel process)
- Biochemicals
- Bioplastics



For Bio-fertilizers:

Bio fertilizers are defined as biologically active products or microbial inoculants of bacteria, algae and fungi (separately or in combination), which may help biological nitrogen fixation for the benefit of plants.

Bio fertilizers also include organic fertilizers (manure, etc.), which are rendered in an available form due to the interaction of micro-organisms or due to their association with plants. Biofertilizers thus include the following:

- Cyanobacteria are used and with an emphasis on the blue/green algae's namely Spiru lina and Chlorella can be used.

The need for the use of biofertilizers has arisen, primarily for two reasons.

- 1.) increase in the use of fertilizers leads to increased crop productivity,
- 2.) Increased usage of chemical fertilizer leads to damage in soil texture and raises other environmental problems.

Therefore, the use of biofertilizers is both economical and environmentally friendly. The pragmatic approach will be to develop the integrated nutrient supply system involving a combination of the use of chemical fertilizers and biofertilizers.

Algal Fertilizers -

Blue green algae (BGA) and Azolla constitute a system, which is the main source of algal biofertilizer in south and Southeast Asia, particularly for lowland paddy. BGA inoculation (without Awl/a) with composite cultures of algal genera Anabaena, Nostoc, Plectonema, Aulosira, Oscillatoria, Tolypothrix, etc. have been found to be more effective than single cultures.

Production and multiplication of BGA cultures is done at centers. Application of dried blue green algae flakes at the rate of 10 kg. /ha is recommended ten days after transplantation.

- Besides being a source of N2, BGA provides for the following other advantages:
- Algal biomass accumulates as organic matter;
  growth. promoting substances are produced, which stimulate growth
- it provides partial tolerance to pesticides and fungicides;
- It also helps in reclamation of saline and alkaline soils.

For health food supplements:

- Spirulina and chlorella are the usual algae of choice for food supplements. Both are grown commercially all over the world and sold in health food stores in pill, powder, and capsule forms. Blue green algae are one of the most nutritional foods you can have. It has been touted as a super food. It is organic, easily digested and full of antioxidants. It is extremely rich in minerals and has a higher concentration of beta-carotene than broccoli.
- Blue green algae also contain about 60 to 70% of vegetable protein, and provide all the essential amino acids. All these benefits without the risk of consuming meat, which is high in cholesterol and is difficult to digest.
- A rich source of calcium, iron, vitamin B12, enzymes and antioxidants make the blue green algae an ideal food for both adults and children. Even pets can benefit greatly from this nutrient-packed food.
- Being highly concentrated in so many nutrients, blue green algae offer numerous benefits to our well-being.

We will take a look at the top ten health benefits of blue green algae:

Top 10 Health Benefits of Blue Green Algae

- Anti-Aging: Loaded with more essential nutrients and iron than most foods that we con sume, blue green algae are perfect as an anti-aging food. Its high concentration of antioxi dants means our bodies can combat more free radicals and toxics.
- Relief from headaches aches and pain: our immune systems are strengthened.
- Energy Booster – has rejuvenating effects
- Better Digestion – it coats the stomach lining and is packed with enzymes that help to im prove digestion.
- Sleep better – it is detoxifying, resulting in better rest.
- Lose weight – Less food cravings, a more balanced appetite.
- Greater concentration and focus – increase in energy and clarity of mind
- Strengthen the hair, skin and nails – high in protein which is the main building block for healthy hair, skin and nails
- Less anxiety – it has beneficial effects on our brain development and can help us cope with stress better.
- Improves memory – as it has effects on our brain development, regular consumption of blue green algae has also shown to have an impact on our memory.

For Animal Feeds:

Many studies have been done using
- Chlorella
- Spirulina
- Scenedesmus
- Oocystis

These species being used as a replacement for land based protein supplements in animal feed. Most studies showed a significant weight gains for all animals involved.

For Cosmetics:

In cosmetics, algae are used as thickening agents, water-binding agents, and antioxidants. But some algae are also potential skin irritants. For example, the phycocyanin found in blue-green algae has been suspected of allergenicity or causing dermatitis on the basis of patch tests (Source: Current Issues in Molecular Biology, January 2002, pages 1–11).

Other forms of algae, such as Irish moss and carrageenan, contain proteins, vitamin A, sugar, starch, vitamin B1, iron, sodium, phosphorus, magnesium, copper, and calcium. For the most part, algae, in their many forms, are probably less of a risk and more of a help to skin when used as antioxidants.

Names of the algae typically found in cosmetics include
- Ulva lactuca,
- Ascophyllum,
- Laminaria longicruris,
- Laminaria saccharine,
- Laminaria digitata, A
- laria esculenta, various Porphyra species,
- Chondrus crispus, and
- Mastocarpus stellatus.

Summary

So what does this mean to you?

- It means that with an open pond, and using selected strains of algae, (Chlorella for example) you could grow algae for fuel, (Chlorella has a 44% lipid (oil) content)
- Carbohydrates could be extracted for ethanol
- Then use the left over by-product (biomass) for either health food supplements or organic fertilizer. It could also be used for animal feed as well.
- Remaining biomass could be used in an anaerobic digester to produce methane for powering your greenhouse, paddle wheels, or generators.

Imagine the impact this could have on your life if you owned a greenhouse, or were a farmer, or rancher…

Imagine simply having an open pond in your property capable of producing fuel and as a food source and/or health supplement…

It could help you…
- Lose weight
- Relieve pain
- Boost your energy
- Sleep better
- Greater concentration and focus
- Better digestion
- Improve your memory
- Strengthen your hair, skin, and nails

You could then use the left over biomass as

- Biofuel
- Biodiesel
- Animal feed
- Organic fertilizer
- Raising fish
- Cosmetics

And more

The top three uses anyone can use an open pond to grow algae and gain by are…

- Natural health foods supplement giving you better health and overall well-being.
- Organic Fertilizer in your garden thereby giving your family healthy, organic vegetables and saving money on related food costs.
- Biofuels for power generation and transportation.

Not bad, uh?

Species/group	Product	Application areas	Prod. facilities	References
Spirulina (Arthrospira platensis) / Cyanobacteria)	Phycocyanin, biomass	Health food, cosmetics	Open ponds, natural lakes	Lee (2001); Costa et al. (2003)
Chlorella vulgaris / Chlorophyta	Biomass	Health food, food supplement, feed surrogates	Open ponds, basins, glass-tube PBR	Lee (2001)
Dunaliella salina / Chlorophyta	Carotenoids, -carotene	Health food, food supplement, feed	Open ponds, lagoons	Jin and Melis (2003); Del Campo et al. (2007)
Haematococcus pluvialis / Chlorophyta	Carotenoids, astaxanthin	Health food, pharmaceutic als, feed additives	Open ponds, PBR	Del Campo et al. (2007)
Odontella aurita / Bacillariophyta	Fatty acids	Pharmaceuticals, cosmetics, baby food	Open ponds	Pulz and Groß (2004)
Porphyridium cruentum / Rhodophyta	Polysaccharides	Pharmaceuticals, cosmetics, nutrition	open ponds, tubular PBRs	Fuentes et al. (1999)
Isochrysis galbana / Chlorophyta	Fatty acids	Animal nutrition	Open ponds, PBR	Molina Grima et al. (1994); Pulz and Gross (2004)
Phaedactylum tricornutum / Bacillariohyta	Lipids, fatty acids	Nutrition, fuel production	Open ponds, basins,	Yongmanitchai and Ward (1991); Acien-Fernandez et al. (2003)

