Energy Self Sufficiency Newsletter

April 2005

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A Rebel Wolf Energy Systems Publication

From The Editor's Laptop

by Larry D. Barr, Editor

After all the conservation talk and tips I've shared here, it was a hell of a shock to get my electric bill the first of March. I'm not off-grid (wish I was), but I do my best to conserve energy here at the house. Hence the shock with the receipt of the grid bill. 951 kWh at around $0.13 per – it came out to $123.50 exactly – and I was miffed.

I would have sworn that I was living by every single energy conservation method that I've printed on these (virtual) pages. And I was. CFLs in all the fixtures. Every one of them except the tube type fluorescents. Not an incandescent bulb in the place. I was unplugging the electric water heater when I didn't need hot water. Well, most of the time. I really should put a time switch on it, but I'm cheap so I trust to memory. It's adequate, but not perfect. My memory that is. I'd be better off with a time switch. But I try to remember.

My grid bill should have been a lot lower, given my efforts. So, what went wrong? Two things, primarily. One was the kilowatt-hour guzzling resistance heater in the window unit. We've had some cold weather here, and I got complacent. Turned on the heater and sat around the house in my shirtsleeves. That cost me. Should have put on a sweatshirt.

The other was the old refrigerator I have. It runs too much. I can hear that, but right now I can't afford to replace it. I'm going to buy a Kill-A-Watt and see just how much it's costing me. If it's biting me in cold weather, what the heck is it going to do in hot weather when the temperature differential is much greater? It's gonna bite me even harder, that's what. So, what is the solution to these two expensive problems?

Let's tackle the hungry heater element first. My preferred choice would be a woodstove. But, it's a little rough to put a woodstove in a rent house. My landlord is a really nice, laid-back guy. But he'd draw the line at me installing a woodstove. My first line of defense is a sweatshirt. This house isn't super-insulated, but it's good enough that I can survive most weather by putting on a few more clothes. So, that's what I should have done. Turned off the heater and put on a sweatshirt. I already own the shirt. It would have saved me a lot of money. It's 46°F outside right now and 64.6° inside. That's a tad cool for a T-shirt, but I'm just comfy as can be in a sweatshirt.

So, what's the lesson here? Turn the thermostat down in the winter and put on a few extra clothes. You don't have to keep it hot enough so that you can cavort 'au natural' around the house. The reverse applies in the summer. Make it a bit warmer than you prefer. You don't need icicles hanging from the overhead. Summer may just be the time for the 'au natural' cavorting. Just to stay cooler, you understand.

So far, with temps headed for the low 40s for the next few nights, and the temp inside probably destined for the mid 50s, I still haven't turned on the heater. And, you know, it ain't bad. I may hate it when I wake up in the morning, but I'll bet I wake up fast once I get out from under the covers.

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Well, here it is about 24 hours later. The temp got down to 37° outside for about an hour last night, according to the NWS, but is was 56.7° inside the house this morning when I got up at 0700. A tad cool but certainly survivable. I think I'll be able to get by without running the heater for the rest of winter. Things will start heating up here in Texas fairly soon. And then, if I'm still going to be in conservation mode, I'll have to figure out a way to stay comfortable when it's 108° and 90% relative humidity. That's the rough time of year. If it wasn't for the humidity being so outrageously high, a swamp cooler would work. But not here. We'll see what happens.

Now, what about the refer that runs too much? The first thing I'm going to do is get Mario, my favorite appliance repair guy, to come over and make sure it has enough refrigerant in it. From some of the bubbling, gurgling sounds it makes, I

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Editor's Laptop . . . cont.

kinda doubt it. That would cause it to run too much. If Mario gives it a clean bill of health, then I'm stuck with the fact that it's just an inefficient unit and needs to be replaced.

But with what? Obviously, I want as efficient a unit as possible since I plan to go off-grid soon and I'd rather not have to buy yet another refer when I do. There's been a lot of discussion on the Refrigerator Alternatives group on Yahoo! recently about super-efficient refrigerators and modifications for lower energy consumption. One of my favorites is the Aussie who converted a chest freezer to function as a refrigerator Tom's idea seems a bit strange until you realize that his little creation only consumes about 0.1 kWh/day. The average fridge wastes (yes I said "wastes") ten times that amount per day. I just may make one of Tom's conversions. Sure would be nice to have a refer than only runs for 2 minutes an hour.

So, I've rambled on for a while and what, if anything, have we learned? I hope we've learned to guard against becoming complacent in our conservation efforts. It can happen to any of us. It's my job to spread the word about renewable energy sources and conservation, and I got bit by my own complacency. In this case, the most noticeable consequence was an unpleasant surprise when I got my grid bill. But, had I been living off-grid, it's likely that my lack of attention to the details would have resulted in a flat battery bank, or worse.

Let's all resolve to pay attention to the details. To practice conservation, to recycle, and to help spread the word to others. By conserving at home, we'll benefit by saving money. By encouraging and helping others to conserve, we'll all benefit by helping to save Planet Earth. ldb

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Book Review

Biodiesel: Growing a New Energy Economy
by Greg Pahl
Reviewed by:
Wolfgang Rougle and Michael "Spike" Lewis

If you're like the crowds of Americans who've been wondering exactly what biodiesel is and exactly how much of its hype is mere greenwashing and how much is deserved praise, Greg Pahl's newest book, *Biodiesel: Growing a New Energy Economy* (Chelsea Green, 2004), is a timely gift written just for you. If you haven't been wondering at all, it's even more important that you pick up a copy.

Biodiesel exists in a haze of public misconceptions. Is it vegetable oil? (Not exactly.) Don't I have to "convert" my vehicle to run on it? (No, you don't.) Isn't it prohibitively expensive? (It wouldn't be, if we gave it half the attention we give natural gas, nuclear power and petroleum. But we digress.)

When a new and poorly publicized technology appears, especially one that displaces a familiar technology while using much familiar infrastructure, the time is fertile for rumors. "I heard biodiesel takes twice as much energy to produce as it generates in burning!" "I heard biodiesel could only replace 1/367th of our global energy needs!"

A scientifically illiterate media has only made everything murkier, with evasive or outright false statements in almost every popular article. It has fallen to government and university studies to describe biodiesel's promise honestly. Unfortunately, most Americans will never read National Renewable Energy Laboratory papers, or the greasegeek handbooks written by enthusiasts for hardcore biodiesel fans.

Pahl's book appears on this smoggy scene like a welcome sea breeze in an air quality nonattainment zone. Borne aloft by research and good storytelling, the book blows away misconceptions and leaves only clarity in its wake.

To us, the measure of a good nonfiction book is its organization. The best can either be read straight through and enjoyed as good stories, or can sit on a shelf and provide quick, authoritative reference with a glance through the glossary (check), index (check), and table of contents (check). Pahl's book meets both tests.

Existing biodiesel fanatics will enjoy the intriguing tales of mechanical visionary Rudolf Diesel's life and the evolution of his engine. The chapter "A Brief History" answers several nagging questions about what happened when in the development of biodiesel. And the chapters about the biodiesel industry and economy (one focused on the U.S., one focused on the rest of the world) are invaluable references – at least this year.

Readers will be intrigued to learn how wildly different the success of biodiesel has been in countries with basically similar economies. (For instance, in Germany, B100 is such a common passenger vehicle fuel that special engine sensors have been developed to detect it and adjust engine timing automatically; in Japan, small-scale cooking oil cooperatives are blossoming across the rural landscape; while in the US, some Midwestern states have declared biodiesel mandates for their diesel fuel.)

The major pitfall of a book like this is that two-thirds of the information is destined to be obsolete in a few months. That's simply because biodiesel is such a fast-growing and dynamic industry. In fact, some of the information is already outdated. For instance, Pahl mentions the America Biofuel's plant in Bakersfield as the largest continuous-flow plant in the country. While American Biofuels did use this plant for batch fuel production, it is unclear whether any biodiesel was produced via the continuous-flow method once the plant was up and running.

Pahl's book, though, may be worth buying for that unchanging one-third: an articulate discussion of the fuel's chemistry, history, sources, and applications.

There are other questionable statements. Pahl makes the claim that engine manufactures support a B20 biodiesel blend, but the Engine Manufactures Association (EMA) only supports a B5 blend. (Both Pahl and the EMA state that individual engine manufactures should be contacted regarding their support of higher blends.) He also states that the biodiesel specification from the American Society of Testing and Materials (ASTM D 6751) covers blends up to B20. While D 6751 is for "biodiesel as a blendstock," it does not specify any specific blend at all.

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Book Review . . . cont.

Pahl also calls the creation of the ASTM biodiesel specification to one of the most important landmarks in the U.S. history of biodiesel. While standards are important, the fact that D 6751 is only for biodiesel to be used as a blendstock has caused problems with the fuel's acceptance and use – especially in California where B100 and any blends not meeting the petroleum diesel specification (ASTM D975) now have to be sold as a developmental fuel.

To his credit, Pahl does mention the importance of the Energy Policy Act of 1992 (EPAct). The growth of the amount of biodiesel used in this country after this piece of legislation was amended to permit the use of the fuel, in 1998, was phenomenal. While only 500,000 gallons were used in 1999, over 25,000,000 gallons of the so-called "fastest-growing alternative fuel" were used in 2003. Unfortunately, Pahl doesn't mention the very real possibility that this law, and the captive fleet market it created, has helped keep the price of biodiesel higher than it should be.

While Pahl does mention in passing some of the difficulties biodiesel faces in California, the book would have benefited greatly from an in-depth discussion of the state's unique biodiesel situation. It's understandable that a man charged with describing the global phenomenon of biodiesel would overlook our sunny corner, but as we all know, California tends to set trends for the rest of the US. And in no field is that axiom more reliable than in energy policy.

California, which is the second-largest consumer of petroleum diesel by state in the country next to Texas, may have the most biodiesel-savvy populace of all 50 states. More Iowans may know what it is, but more Californians use it religiously in their private vehicles. (Biodiesel is mostly a fleet fuel in the U.S.) Furthermore, because of our mild climate, terrible air quality, and a general anti-petroleum and environmental attitude, Californians are most likely to want to burn B100 – not the lower blends diluted with petrodiesel popular elsewhere. This presents a number of challenges and opportunities for California's biodiesel economy. California is a perfect laboratory in which to ask the questions: How much biodiesel use can one state sustain? How long can a region afford to import all its virgin oil ("feedstock") or processed fuel? When is it desirable to commit to growing that feedstock in local fields? Can a state's limited water resources support the development of oil crops? How will the introduction of new (oil) crops effect the rest of the state's ecosystem? Finally, what about waste or recycled oil? Could a region-wide waste oil collection project be viable, and if so, how much of a region's fuel need could it meet?

We may never know, because at present, the main obstacle to wider biodiesel use in California is not feedstock availability but regulatory hesitation. CARB – the California Air Resources Board, which has fairly comprehensive control over what gets burned in the state – is reluctant to include large-scale biodiesel use in its recommendations for cleaner air. That's because pure biodiesel, despite sparkling-clean emissions numbers overall, usually releases slightly more nitrous oxides than petrodiesel. Nitrous oxides (NOx) are a main component of smog.

Some studies show that biodiesel can release less NOx than petrodiesel if burned right or made right; some argue that NOx doesn't form smog except in the presence of other nasties biodiesel doesn't create, and some simply argue the tradeoff is worth it. It's a fascinating debate, and since at least four other states directly track California's recommendations (with Washington State possibly becoming the sixth CARB state in the near future), the way it is resolved will have far-reaching consequences for biodiesel use all across America. Unfortunately, you won't read about it in Pahl's book.

Luckily, to compensate for those omissions, the book does touch upon the essential struggles in the U.S. biodiesel industry today: agriculture-based feedstock (soy) vs. recycled oil and animal fats, large-scale producers vs. small-scale and local production, and the collective interests represented by the National Biodiesel Board (N.B.B.) vs. the concerns of the homebrewers, consumers and other grassroot interests. Pahl also makes clear throughout the book that biodiesel alone cannot completely solve our dependence on petroleum. *Biodiesel: Growing a New Energy Economy* concludes with a well-constructed example of that most essential feature of all reference books today: the list of Organizations and Online Resources.

Reader's Report

Frugal living in Flanders (Belgium)

It took a while before winter arrived in our region, but the last few weeks (Feb-March) we've been blessed (?) with serious freezing and snow. A bit late in the year, so I had to postpone a lot of gardening work. Instead I did some research to start a few new projects.

There was a small passage next to our house (between our house and our neighbours' house), about 150 cm wide and about 8 meters long. We built a roof, placed a floor and turned it into a surplus room where we have stored our food supply. (enough for at least a month, or even more). My wife even made a inventory-book so at any point we know what's in stock. I hope to make a picture of it soon and share it with you.

Living in a semi-rural village in western Flanders (used to be rural, but yuppie-developers kept on building new neighbourhoods the last few years so it's started to look a little too suburban to my taste) I have to use every inch of space. Last year I planted a few new fruit trees and some shrubs with berries next to my vegetable garden. I'm looking for some extra space to build a root cellar.

When weather is nice in summer I can use the black polyethylene camping shower I bought in a surplus shop. While working in the garden I leave the bag in the sun and in the evening I can take a free warm shower in a discrete part of the garden. We can also use the water for dishes and/or cleaning. Another small water saving tip is putting a bucket in your shower. It always take a while for the water to get hot so you can catch the water in that bucket while it's heating up. That saves about 10 litres of water each time someone takes a shower in the house.

Solar operated equipment is very expensive in Belgium so I have to improvise a lot and start by small solar projects. I found a non-battery flashlight (based on Faraday's cage, it charges while shaking it a few times) in Hong Kong and a hand-cranked emergency radio in England, both on EBay. My wife and I are pretty frugal people, so we don't use that much electricity anyway, but our main goal is to be as independent as possible from the power companies, although I choose 100% green electricity from a Flemish company called Ecopower, a small electricity company that only produces wind-energy and some small water-energy projects.

We live in a super-consumption society (something you Americans also know everything about, I suppose) so a lot of people think of my wife and me as pretty strange. We do not follow hypes and fashions, nor do we put our home full of high-tech junk and "en vogue" equipment. It's pretty hard in a society where you are judged by the size of your house, car and career. But actually, we don't really care….if people think we're strange, let them look in the mirror, if they have a spare moment in between their three jobs just to make ends meet, they're the ones to feel sorry about. I like my job as an insurance-broker (not exactly an "alternative" job, but I like it) but besides that I don't really get involved much with the hectic life around me. Besides my job I'm a volunteer with the Civil Protection Service, a national rescue service (a bit like F.E.M.A. in the USA) My wife is a housewife who takes care of our little homestead and is extremely creative when it comes to making great meals, clothes, ceramics etc….

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Reader's Report . . . cont.

I don't know if there are a lot of off-grid people living in my country, I doubt it, since it is so small and crowded, it's very difficult to hide. But we can get close to the off - grid living, the lesser strings attached to "the system" the better. Most of my contacts are from across the ocean, I don't encounter many European off-grid people, too bad, but I'm sure they're our there, maybe we will meet sooner or later.

One of my main projects for this year is building a solar cooker : I found some very detailed plans on the internet and am already starting to gather all I need. I was surprised it can be built with some cardboard and some aluminium foil. As soon as I gathered everything I need I start building and will let you know if I succeeded. For preparing the first meal, that has to wait until June, or even later, Belgian summers are not exactly the hottest on the planet.

I'll keep you informed. If you have any comments or questions, please feel free to mail me at joepri@pandora.be.

Take care !
Joeri Verschaeve
Jabbeke (Flanders)

Want to know more about Flanders ? have a look at www.flandersonline.org

Reader's Report

Off-Grid in Terlingua

In 1999 I retired after 38 years in business, been dealing with public all this time. We'd had this property in Terlingua, Texas for a while, and we knew that there was no electricity or water close. The grid is three miles from our property, the electric company wanted $47000.00 to put the lines to our property. So we made a decision to build on this property. One of our friends is a building contractor, and he helped us get the lumber together and helped build the house.

We bought all the lumber in our home town at that time. It was a whole lot cheaper that way, even with hauling it to the new place. It took two weeks to get the paint in the new house dry, so we went looking for alternative energy information. All the sites that I found I would read or print it out and read later. We found a site called a-w-h, that all they talk about is wind energy. We got a lot of info on that site, so with the information we collected from all sources, we put a system together.

Our system has four solar panels (eighty watts each), one three thousand watt inverter, one air-x windmill (four hundred watts),a 15,000 watt generator, twelve L-16 batteries. Originally, we hooked it up as a twelve volt system, Our friend has a coach with a twenty-four volt house battery system in it. We were talking about the system in his coach and the twelve volt system in our house, and he said his system would last eight to ten hours and so we made the change to a twenty-four volt system.

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Reader's Report . . . cont.

A twenty-four volt system seemed to work better, so we bought a Trace 3624 inverter and four more eighty watt solar panels, took the twelve volt solar panels and hooked them up to make twenty-four volts. The twenty-four volt system seems to charge faster and holds the charge longer. We run all the lights, a 25.5 cubic foot refrigerator/freezer, microwave, computer, fax machine, and two TV's with satellite boxes. The 15,000 watt generator runs a well pump that is 1,400 feet deep, and charges the batteries on cloudy days if necessary. We have a 1,500 gallon storage tank that supplies the house with water, with a twelve volt water pump at 65 psi.

There are myself, my wife Shirley, two great Danes and one cat. We've been on this system for over a year, and all has been working great We live just like being on the grid, but just a little more conservative, turning out the light when you leave a room. The only things we have that don't run on electricity is the hot water and a stove. My wife and myself put this system together. The only thing I don't like is you have to keep checking on your system.

by Ben Jarisch
Terlingua, Texas USA

New This Month!!

HTML Version of ESSN

For Those Who Prefer To Read On-Screen
http://www.rebelwolf.com/essn.html

Electricity 101

Batteries & The Care and Feeding of Same

by Larry D. Barr and Steve Spence

We've done a lot of theoretical learning in this column over the last couple of months. Done some practical stuff too. Learned how to calculate and measure and how to make good connections. Have you tried PowerPoles in your system yet? If not, you should. They're the neatest thing since sliced bread. Well, let's get on to this month's lesson.

We're going to learn about batteries, battery banks and the care and feeding of same. It doesn't matter how you generate the electricity, eventually you're going to need to store it in a battery bank. And, while batteries aren't the most expensive part of your system, you might as well learn how to treat them right and make them last as long as possible.

I have no intention of trying to turn you into a chemist, but we're going to have a short review of the electrochemical process that makes it possible for a battery to store the energy that's generated by your PV panels or your wind generator. To put it very, very simply (if you want the more complicated version, you can download the Battery Service Manual from Rebel Wolf Online), a battery is composed of two sets of plates which are immersed in a solution, called 'electrolyte', of water and sulfuric acid.

When current is drawn from a battery, the sulfuric acid acts on both the positive and negative plates, producing another chemical called lead sulfate. The sulfuric acid electrolyte supplies the sulfate and becomes weaker as more energy is drawn from the battery. When the acid is depleted by combining with the plates to the point where it can no longer provide a useful voltage at the terminals, the battery is said to be discharged.

To replenish, or recharge, the battery, an electric current is applied to the battery in a direction opposite to the discharge current. This reverses the chemical process, dissolving the lead sulfate from the plates and replenishing the electrolyte, which again achieves its original strength. Always remember that both hydrogen and oxygen are given off during the charging process and constitute a risk of explosion. Do not allow any spark, open flame or any other source of ignition near your battery bank.

A really neat side effect of the fact that the sulfuric acid electrolyte gets weaker as the battery is discharged and stronger as it's charged again is that we can measure the state of charge of the battery by measuring the specific gravity of the electrolyte. Specific Gravity? What's that? It's basically the weight of an amount of electrolyte compared to the same amount of water. The Specific Gravity that you're looking for in a fully charged battery is 1.260, which means that the electrolyte is 1.26 times heavier than an equal volume of pure water. As the battery is discharged the specific gravity of the electrolyte drops. You'll see the table for the corresponding state of charge in the Battery Service Manual. Don't forget to follow the table for temperature correction, too.

OK, that's enough chemistry. If you want more, download the Battery Service Manual. You were going to do that anyway, right? Let's briefly review the principles (and Ohm's Law) that relate to the construction of a battery bank for our RE system.

Each lead-acid cell produces approximately 2.1 volts, so a nominal 12 volt battery has 6 cells and produces 12.6 volts when fully charged. Remembering back to the first installment of Electricity 101, we learned that battery voltages are additive when connected in series, and that the capacities of the batteries are additive when connected in parallel. We also learned about measuring the capacity of batteries in ampere-hours, commonly called Amp-hours and abbreviated Ah. Steve Spence turned me on to one of the most well-written (and humorous) descriptions of battery capacity and Peukert's Law that I've ever seen. It was written by David Smead, the designer of the Ample Power line of products and published on http://www.amplepower.com.. Steve got permission from Ample Power for us to reprint it here.

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Electricity 101, continued . . .

Amp Hours and Beer

Editorial Note: This was first published in February 1990.

What do Amp hours and beer have in common? More than you think. Let's review the idea of Amp hours as usually explained. One Amp of current for one hour is one Amp hour, Ah. By the same logic, 100 Amps for 1/100 of an hour is also 1 Ah. This definition of Ah is not complicated. The problem in understanding Ah arises when we speak about a battery of a given Ah capacity. If we have a battery rated at 100 Ah, that battery can supply 5 Amps of current for 20 hours. That same battery can't supply 100 Amps for 1 hour, however. In fact, it can only supply 100 Amps for about 1/2 an hour. What gives?

The true capacity of a battery is dependent on the rate of discharge. The faster the rate of discharge, the less total Ah capacity can be delivered. This phenomenon was described mathematically back in 1897 by a researcher named Peukert. He formulated the equation:

$$I^n T = C$$

In Peukert's equation, the letter I is the discharge current, letter n is a value related to battery construction, letter T is the duration of discharge, and the letter C is the capacity removed as a result of that discharge. If exponent n is equal to one, then we have the familiar circumstance where 1 Amp for 100 hours is equal to 100 Ah. (I = 1, n = 1, T = 100, so C = 100 Ah.) But, exponent n is never equal to 1, even in the best of batteries. Exponent n has normal values of 1.05 to 2, with about 1.2 being a common value. Lets use n = 1.2 in Peukert's equation with I = 100 Amps. We now find that C = 251 Ah. In other words, if we want to draw 100 Amps for 1 hour, we need a battery of 251 Ah, assuming the battery has a Peukert's exponent n = 1.2. Suppose we have an exponent of 1.1. For 100 Amps, C now equals 159 Ah considerably lower than 251 Ah. As mentioned, exponent n is related to battery construction. The lower the value, the better the battery will supply high currents.

Table 1
Exponential Amp Hours Consumed

N =	1.05	1.1	1.15	1.2	1.25
Amps	EA	EA	EA	EA	EA
2	2.1	2.1	2.2	2.3	2.4
5	5.4	5.9	6.4	6.9	7.5
10	11.2	12.6	14.1	15.8	17.8
15	17.2	19.7	22.5	25.8	29.5
20	23.2	27.0	31.4	36.4	42.3
30	35.6	42.2	50.0	59.2	70.2
40	48.1	57.9	69.6	83.7	100.6
50	60.8	73.9	89.9	109.3	133.0
75	93.1	115.5	143.3	177.9	220.7
100	125.9	158.5	199.5	251.2	316.2

In Table 1, exponential Amps are tabulated for various currents with different exponents n. For instance, 15 Amps from a battery with n = 1.2 consumes Amp hours as if 25.8 Amps is being drawn. Note that for low values of current, the value of n doesn't have much impact on capacity C. As currents increase, however, the effect of n is significant. What Table 1 demonstrates is the need to measure Ah using Peukert's equation if we really want to stop guessing about battery capacity. For a battery with an exponent of 1.2, a 2 Amp draw for an hour actually removes 2.3 Amp hours, or about 13% more than a linear measurement indicates. A 20 Amp draw for an hour results in a depletion of 36.4 Ah ...a whopping 45% more than a linear measurement would show! How accurate is Peukert's equation? Recent tests indicate that errors are in the range of 0.5-1%. Only the Ample Power monitors actually compute Amp-hours remaining from Peukert's equation.

Now, what about beer? We've explained Peukert's equation in prior issues, yet many have expressed confusion about the effect of discharge rate on the Ah removed from a battery. Pouring a few bottles of beer will yield an intuitive feel for Peukert's equation. For this experiment you need a few bottles of beer and some glasses. For dramatic results the beer and glasses shouldn't be too cold.

For the first experiment, leave the glass upright and pour the beer quickly into the center of the glass. After pouring you'll find just a small amount of liquid in the bottom of the glass, with lots of foam on top. For the second experiment, tilt the glass and pour the beer slowly down the side. This time, you should have lots of liquid and only a small amount of foam.

In the beer experiment, the liquid in the bottom of the glass represents the capacity, C,available for use. The faster you pour, the less the capacity. If you pour slowly, there is more beer to drink.

The beer experiment also demonstrates another battery phenomena ...recovery. A battery that has been discharged at a high rate can be rested, and additional capacity recovered. Just as beer foam will eventually settle into liquid, battery

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Electricity 101, continued . . .

capacity recovers as electrolyte diffuses through the plates.

Ample Power products are manufactured by Ample Technology, 2442 NW Market St., #43, Seattle, WA 98107 - USA

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Thanks to David for that explanation, and we'll be back next month with a few more facts and tech tips about batteries and how to maximize their life.

How Steve Spence Spent Saturday 26 March 2005

It was a busy day Saturday, at the Green Trust facilities in Winthrop, NY. We had a class come together to learn how to construct a biodiesel processor. This unit will take lye and methanol, react it with vegetable oil, and produce a direct substitute for diesel fuel, to be used in any diesel engine, with no changes or modifications to the engine or fuel system. From tractors, to trucks, cars to generators, even your boat, if you have a diesel engine, you can make your own fuel, no fumes, no fuss.

We start with a standard electric water heater from our local Sears store, and a conversion kit from Biodiesel Warehouse. After removing the cold water inlet tube, we remove the bottom drain, and attach the valve "T" assembly. The pump then bolts on to the "T", attaching the fuel transfer manifold to the top of the pump. Connect the top pipe assembly to the cold water inlet on top of the heater, and the braided sight tube between the fuel transfer manifold and the top assembly. Rewire the electric elements so that power is delivered only to the bottom element (the top one would burn out if uncovered with oil), and optionally jumper the element from 3500 watts (220vac) to 5500 watts (220vac). An optional 2000 watt 120vac element is included with the kit. Connect hose from the safety release valve to the outdoors. An optional methanol recovery condenser can be connected to the hot water inlet at the top of the heater, with a shut off valve, otherwise plug the hot water output port. Complete details on construction and operation can be found in Girl Mark's Biodiesel Homebrew Book.

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There just wasn't enough time for Steve to get the article, with pictures, together in time to meet the deadline (that's publisher talk for "the last minute") for this issue. But he's promised me that we'll have an article on the construction of an Appleseed Biodiesel Processor in our May issue. The basic design is from Maria 'Mark' Alovert's book, "Biodiesel Homebrew Guide." It's a great book, by the way. I just bought a copy and I'm not through it yet, but it's motivated me to get busy and brew up some biodiesel. ldb

Meet The Writers

Michael "Spike" Lewis has been an advocate of alternative energy and fuels for over 15 years. He has edited and published award-winning web sites devoted to political commentary and silent film. He has also worked on four entertainment-related documentaries. Spike is currently working to help build a greater awareness of biodiesel in Los Angeles and California.

Wolfgang Rougle is a senior at UC Davis majoring in International Agricultural Development. She is the Biodiesel Coordinator at the UCD Student Experimental Farm and writes a weekly column about ecological issues for the California Aggie.

Mike Nixon was born in England at the beginning of WWII, his father being a bomber pilot in the Royal Air Force. His parents being New Zealanders, he lived in both countries in the years that followed. He finally followed in his father's footsteps and also joined the RAF, but as an engineer specialising in electronics.

His Service career took him all round the world, but after 24 years he retired from the RAF and returned to New Zealand, his "real" home. Now, after being back for 19 years in "Godzone" with his wife Karen, an Auckland girl born and bred, he is now "fully retired". In other words … he's working harder than ever, but at his main interest, the small scale distillation of ethanol.

He has now also realised his life-long ambition of setting up a real "Kiwi Bloke's Shed", complete with two

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Meet the Writers . . .cont.

metal lathes and all the bits and pieces considered essential to keep a Kiwi Bloke content, and reports that pigs just don't know where real happiness is to be found!

In partnership with the late Dr John Stone, and for the last four years with his very good friend Mike McCaw, he has co-authored two books on home distillation, both of which received widespread acclaim. Indeed, the latest book with Mike McCaw, "The Compleat Distiller", is now in its second edition and is being used by several colleges around the world as a text.

The best part of all this, of course, is that Mike's hobby is now his new career. The opportunity to branch out into the distillation of ethanol for fuel was therefore too good to miss, even though he was recently registered as an Old Age Pensioner and is therefore supposed to be past all that and put out to pasture! However, Mike reckons that if he is still considered alive enough to fulfil his duties as the Town Crier of Howick, then he's certainly not ready to be dragged away from his stills!

ESSN Needs Layout Editor

by Larry D. Barr

This is the fourth issue of ESSN and those of us who write and produce the publication are pleased and maybe a bit surprised at the response you're giving it. We had a hunch that there are a lot of folks who are dedicated to renewables and to energy self-sufficiency. I'm not sure we knew there were quite that many, or that you'd find us so quickly. It's wonderful and we thank you for being here.

However, the response has created a need for another person to help with the project. We need someone who has experience in Adobe PageMaker and an eye for layout to handle what used to be called "paste up" in the days when publications were actually assembled from a bunch of little pieces of paper. It's the now electronic process of putting all the component parts into one, hopefully, coherent publication.

Why can't I continue to do it? I can, and I will, for as long as necessary. The problem is that the time required is taking away from projects that I'd intended to work on and share with you, our readers, and from articles that I'd intended to research and write. Stated very simply, there just aren't enough hours in the day or enough days in the month to complete everything that I want (and need) to accomplish.

So, I guess the next question is, "Who is this the perfect job for?" For someone with a compelling interest and dedication to the renewable energy movement. Possibly a college student who's looking to build a resumé or a retired person who's not ready for the rocking chair yet. Could be anybody really. You just need to love what we're trying to do here and have some time to devote to the cause.

What, you ask, does it pay? Fair question. So here's an honest and direct answer. At this time, only a lot of gratitude and the feeling of a good job well done. We're all still working for free right now. I'm hoping that will change someday, but it hasn't yet. When it does, we'll re-negotiate, OK? If you're interested in being a part of ESSN, please email me at: essn@rebelwolf.com. ldb

Ethanol As A Fuel

by Mike Nixon

I must admit to suppressing a wry grin when I was first asked to write about ethanol for an energy self sufficiency newsletter, for up till then my interest in ethanol was primarily how to make it potable! It did bring back old memories though, of a dark winter night when a bunch of us were returning from a pub crawl to our airforce base in the squadron jalopy 'Jezebel', and we came to a juddering halt in the middle of nowhere with the gas needle firmly on zero. With 10 miles to go, the thought of pushing the old girl home in the pouring rain was not greeted with much enthusiasm, so my first experiment in alternative fuel technology was born. Now those were the days long before drink/drive campaigns had really started, so it was no surprise that a couple of bottles of whiskey were available to top up the tank. Not readily available of course, but only surrendered after much debate about priorities! Sad to report, the reluctant donors of those bottles were proved right. No matter how potent it might be as a beverage, whiskey is a total failure as a vehicle fuel, and we had to push Jezebel home to her garage.

Yet ethanol is now in use throughout the world, and has proved to be an excellent fuel. Indeed, it was Henry Ford's initial choice when he made his first vehicle in 1896, the Ford Quadricycle. So where did we go wrong? With sober hindsight it is now obvious … we were not trying to run Jezebel's engine on pure ethanol, but a mix of 45% ethanol and 55% water! Notwithstanding the evidence of flaming Christmas puddings, such a mix does not burn easily, and certainly does not ignite readily when sprayed into an internal combustion engine. For that to happen, we have to start thinking in terms of volatility and octane rating.

Painting by Norman Rockwell. Courtesy of Ford Motor Company

Which brings me to the main subject of this first article … what are we looking for if contemplating using ethanol as a fuel? How we go about making the stuff is another matter entirely, and best left to a later article when we know a bit more about ethanol. How pure does it have to be? Can it be used on its own, or should it be used with other fuels? Do engines need to be modified to use it? Above all, how do we go about making it?

Let's start by looking at what we have been using to run our engines on until now … petroleum. This is a volatile witches' brew of liquid hydrocarbons and additives. Its advantages are that it is easy to store and carry about, it contains a lot of energy that is quickly released when it burns, and it is a byproduct of an established industry that gets many other useful products from one source … crude oil. Some major disadvantages are that it comes from a rapidly diminishing resource, it produces copious quantities of poisonous gases when it burns, and it needs exotic additives

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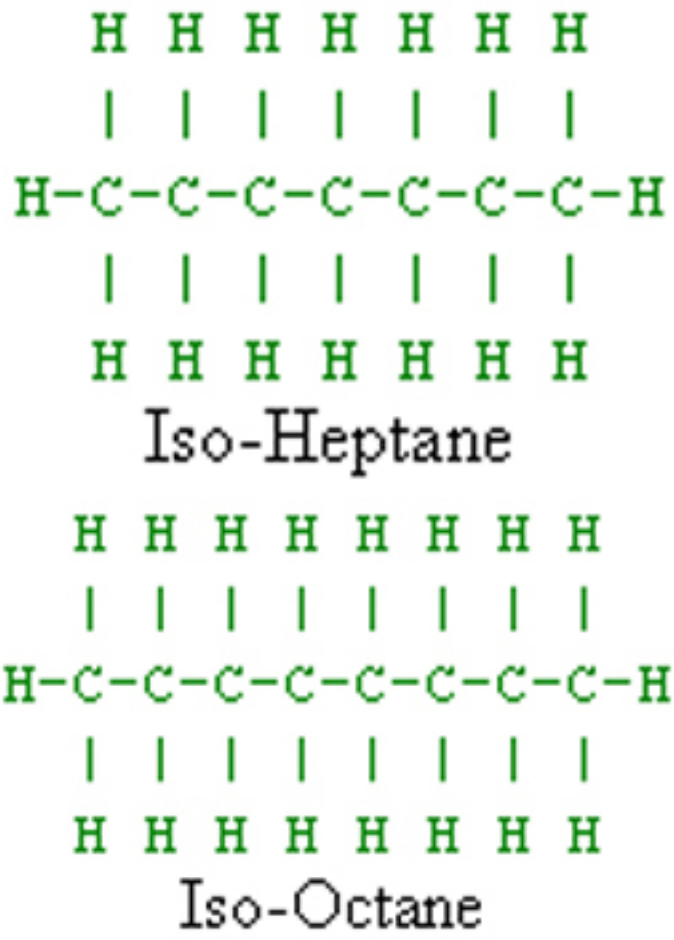
Ethanol . . . cont.

in order to be suitable for use in different types of internal combustion engine. The list goes on, but those major disadvantages are more than enough to stimulate a search for a better alternative.

I'm going to assume that you know a bit about how an internal combustion engine works. If you don't, then that is quickly remedied by looking up some of the wealth of information to be found on the internet. In any event, you do not have to be an expert motor mechanic if you plan to use ethanol as a fuel. You just need to know a few basics, and one of these is "octane number". This term crops up all over the place, not least at gas stations where the pumps are labelled with what type of fuel they deliver. There's "Regular Grade/Octane 87", "Premium Grade/Octane 93" etc. At least, those are the octane numbers in North America. The numbers are calculated differently elsewhere, and are generally about 5 points higher. So it is a familiar number that most are quite comfortable with. But what does it really mean? If we are thinking of using ethanol as a fuel, then it really is worthwhile knowing a bit more about it.



Octane Numbers

When gasoline is mixed with air and sprayed into a combustion chamber, it is then compressed on the upward stroke of the piston. This sudden compression, plus the temperature of the hot engine itself, heats the gasoline/air mixture considerably. If the compression is too great, then this can result in premature detonation of the mixture before the spark plug fires, and you get loud knocking noises from the engine. This premature detonation is wasteful of the energy in the fuel and potentially damaging to the engine. What is needed to overcome this knocking is to either adjust the timing, which sometimes does the trick, or to use a fuel with a higher octane number.

The way that this number is determined is based on the properties of two particular hydrocarbons, a form of octane (8 carbon atoms) and a form of heptane (7 carbon atoms)

A sample of gasoline is burned in an engine under controlled conditions, eg. spark timing, compression, engine speed and load, until a particular level of "knocking" is heard. The engine is then run on a fuel blended from iso-octane, which is characteristically very resistant to knocking, and iso-heptane, a form of heptane that knocks very easily. When a blend is found that duplicates the knocking intensity of the gasoline sample, the percentage of iso-octane by volume in the blended sample is taken as the octane number of the fuel. Iso-octane is used as the reference, so 100% iso-octane has been arbitrarily given an octane number of 100, 90% iso-octane therefore has an octane number of 90, and so on. Of course, this test can only go up to an octane number of 100, so for numbers higher than 100 they measure the amount of tetra-ethyl-lead that must be added to pure iso-octane to duplicate the knocking of the gasoline sample, and add that to 100.

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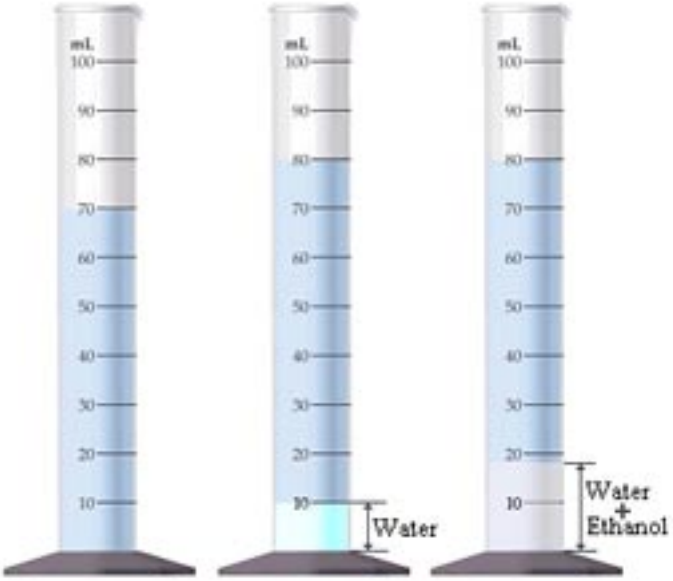
Ethanol . . . cont.

At present, three systems of octane rating are used in the USA. The first two, Research Octane Number (RON) and the Motor Octane Number (MON) are determined by burning the gasoline in an engine under different, but carefully specified, conditions. Of these two, the RON is usually higher than the MON by around 10 points. The third octane number, which is the one shown on gasoline pumps, is the average of the RON and the MON.

So what has all this got to do with ethanol? Well, the most common way of enhancing the power of an engine is to increase its compression, so high performance cars will need a higher octane number fuel than a shopping runabout. Racing cars will need even higher octane number fuels, and this is where ethanol comes in (as well as methanol, methyl tertiary butyl ether, etc etc …. but we are talking ethanol here!).

The blending octane number of ethanol is around 113, so it can raise the octane number of gasoline if mixed with it. The most common blend now available in the USA is called E10, which has 10% ethanol added. This can be used as a cleaner fuel than straight gasoline in existing engines without doing any engine modifications. Manufacturers are now producing new engines that can run on E85, which has 85% ethanol added. This is even cleaner, but be warned! Older engines cannot use E85 without extensive modification. The octane number is way too high. In Brazil, they have been using E100 for years. Mind you, that is not pure 100% ethanol, for when exposed to the air then pure ethanol sucks up water until it reaches a stable mix of 95% ethanol with 5% water. However, unlike the whiskey poured into poor old Jezebel, that burns quite nicely thank you!

So how do you know if the gasoline you are using has ethanol in it? It said so on the pump! Yeah, right! Ask a silly question!! However, enquiring minds might want to know for sure, and there is fortunately a very simple test that can be done. For this you will need a measuring cylinder. 100ml is a handy size. Pour some of the gasoline under test into it, and note the volume. Now add 10ml of water. As anyone who has had water in their fuel tank knows, water does not mix well with gasoline, so that water will collect at the bottom. Put a stopper in the neck of the cylinder and give the whole thing a good shaking for at least a minute. Leave it to settle for a further couple of minutes, and then look to see if the volume of the liquid at the bottom has increased. If it has, then that is due to the ethanol that was present in the gasoline. Gasoline doesn't mix well with water, but ethanol does, and has a great affinity for it. In the diagram, I've shown an increase of 9ml, so the original 70ml of gasoline/ethanol mix comprised 9ml ethanol with 61ml gasoline. A quick bit of arithmetic tells us that the mix contained 12.9% ethanol by volume. I got good value from that E10 pump!



Some benefits of ethanol as a fuel

What are the benefits of using ethanol as a fuel? If we are going to make it ourselves and use it, then it would be handy to know all the good things about using ethanol so we can brag about it, simply feel virtuous, or whatever turns you on!

First of all, it's clean. It burns to produce just water and carbon dioxide, with none of the exotic and often dangerous gases you get from gasoline and its additives. But hang on … carbon dioxide? Isn't that bad? Well, on its own then it can be seen as that, but we must look at the larger picture. Ethanol is produced by plants that removed carbon dioxide from the atmosphere and replaced it with oxy-

Ethanol . . . cont.

gen, so all we are doing when burning ethanol is returning to the status quo that existed before. In contrast, fossil fuels did that carbon dioxide/oxygen trick untold millions of years ago, so when you burn fossil fuels then the current balance sheet is all one way … a greater net amount of carbon dioxide in today's atmosphere.

Secondly, ethanol is produced from plant matter, and that is a renewable resource. Oh dear, oh dear! What about the poor starving millions who will have all this food snatched away from them to serve the demands of the internal combustion engine? How horrible! How selfish!! Think of them, by all means, and feed them with the nourishing edible parts of those crops. The rest goes into the fermenter to make fuel to ship all that food to those starving masses!

Thirdly, ethanol is a great engine cleaner. Indeed, it is so good that you will need to change the oil filter more frequently, for ethanol will get rid of all those deposits that gasoline detergents won't touch.

I could go on with this list of goodies, but realise that by now your only interest in ethanol will probably be to reach for that Highball and ponder the meaning of Life, the Universe, and Octane.

In the next article, we'll look at how you can make your own ethanol, and to a standard fit to pour directly into the tank of a Brazilian car. We'll also look at how you can blend your ethanol with gasoline from the pump so you can use it in your car. Then there are the benefits to be had by blending your ethanol with the biodiesel you have already learned how to make by reading this Newsletter. Until then … Cheers!

Ethanol Fuelled Vehicle??

Off-Grid Journal

by Steve Spence, Director
www.Green-Trust.org

Some months are very busy, either with new projects, or fixing issues. Then, we sometimes catch a break, what with holidays with family, no equipment breakdowns, and still too cold for outdoor projects. Well, spring has sprung, the snow is starting to recede, and is being replaced by mud. It's Maple syrup season, but unfortunately, we don't have many sugar maples on our property, so we headed down the road to help a neighbor with his. This past weekend, we did have a Biodiesel Processor construction class. More on that in it's own article in this issue, but the weather was perfect for it. The temperature wasn't too cold for a class in our screen house, lots of sunlight, and folks brought a dish to pass, so we had good conversation and community spirit flowing. We will be running other classes this year on this and other topics, and will let you know when they are coming at www.green-trust.org

It would be amiss not to mention that the price of gas is outrageous, at $2.26 for the cheap stuff this week. Although our power generator runs on waste veggie oil, It's time to convert our vehicles as well. The '97 Nissan Sentra has a bad transmission, and a tired gas engine, so it may be headed for a diesel upgrade. Our '98 Ford Windstar is begging for an EV conversion, with a towable veggie fueled Lister diesel battery charger. That's all for now, see you next month,

Steve

Do Your Part!

Conserve Energy
&
Resources

Let's All Help
Save Planet Earth

Journey to the far north

Well, I returned late last night from my journey to the far north... northern New York State that is. I managed to make it to the bio-diesel processor workshop hosted by Steve Spence of the BackHome NY Chapter.

A small group gathered in the mud and the snow (that's springtime in NY!) to learn about processing waste vegetable oil into biodiesel fuel. A lot of people have experimented with and done a lot of work with biodiesel fuels, and some of it has been compiled into a manual, which was the guide for the workshop. http://www.localb100.com/book.html.

The equipment used is an electric hot water heater; with assorted pipes, tubes, valves; and an electric pump to do the mixing. This workshop was the processor equipment introduction... a 2 day workshop would be required to get into the actual processing.... something which I would like to attend! Watching the parts go together was amazing... seeing ordinary everyday objects turned into something new.. a pump.. a water heater.. the pipes and valves came pre-assembled... and the workings of it were explained all along, with quite a discussion afterwards. The guys whose project this was got to take an assembled biodiesel processor home with them... to help fuel their diesel trucks and tractors... and with diesel selling at $2.50 a gallon this was a financial business decision for them... in other words, it really makes sense!

I'd like to thank Steve and his family for hosting this workshop and for the hospitality everyone enjoyed at their home. It was well worth the journey to learn more about this and to meet others interested in it also. later!
DaveH

Biodiesel -- Making a Test Batch

by Maria 'Mark' Alovert

This photo shows most of the items you'll need to produce your test batches of biodiesel. You don't have to memeorize everything in the shot, but you'll probably be wanting to refer back here as you read the artivcle.

This is the first in an ESSN series on making homebrew biodiesel fuel. Future articles will include: washing fuel, troubleshooting and quality control, and equipment discussions.The best way to learn how to make your own backyard biodiesel is to make a few 1-liter batches. It requires almost no equipment to get started- we use old juice bottles as a 'reactor'- and getting some experience with 1-liter batches will help you decide whether biodiesel homebrewing works for you. The learning curve, and subsequent experiments, are easier on a small scale.

Overview:

Biodiesel is made by reacting methanol, a poisonous 'wood alcohol', with vegetable oil in the presence of 'lye' or another alkaline catalyst. This process splits off a glycerol (or "glycerine") molecule off from each molecule of vegetable oil, and reacts the oil's fatty acids with the methanol (an unavoidable side reaction which forms some soap also takes place with this method) The glycerol falls to the bottom of the container and can be drained off. The oily 'fatty acid methyl esters' or biodiesel remains, and is then 'washed' by mixing with water to remove soap and other water-soluble contaminants, and to stop the reaction. After this process is complete and the water is gone, biodiesel has none of the toxicity and flammability of handling either diesel or methanol and is quite safe to store.

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Biodiesel Test Batch . . . cont.

The first step is the actual 'reaction' of the oil with methanol/lye.
The quantities of chemicals used are:
5 parts waste vegetable oil
1 part methanol
about 5-10 grams of lye for every liter of oil, depending on how 'used' the cooking oil is. The amount of lye to use is determined by testing the oil with a simple titration.

Lye is a common name for sodium hydroxide (NaOH), which is found on the hardware store shelf as 'Red Devil Lye' drain cleaner. A better catalyst is potassium hydroxide (KOH) - easier to use than NaOH, but not as easy to find in small quantities. Both are used by craft soapmakers, and can be mail ordered in small amounts (try www.braintan.com for mailorder of less than 20 pounds of KOH)

Methanol or methyl alcohol- for small quantities for 1-liter experiments, yellow bottle 'Heet' brand gas line antifreeze is 99% methanol, sold at wal-mart or auto parts stores (not to be confused with the red bottle version, isopropyl alcohol, which you'll buy for the titration).For info about buying larger quantities of methanol see the article website links.

Vegetable oil from a restaurant fryer is usually actually two or more chemicals: vegetable oil (triglycerides) and free fatty acids (FFA) which are formed when vegetable oil breaks down from prolonged heat and frying. There's also sometimes some water present, which comes from the food that was fried in the fryer. The free fatty acids and the water are contaminants and interfere with our biodiesel reaction, and one of our tasks is to find out how much FFA and water are present. If you start with new oil from the store, there won't be any FFA or water to worry about.

The biodiesel recipe:

for every 1 liter vegetable oil, warmed to 55C (130F, NO HIGHER)
use:
220 ml of methanol and first dissolve into the methanol:
5 grams of lye, plus more lye as determined by titration (explained below), or 7 grams of KOH, and more as determined by titration (see links for complete titration instructions)

Safety —

While biodiesel is safe to handle and store, the process of homebrewing it involves flammable/poisonous alcohol and caustic catalyst, both of which can be hazardous if handled incorrectly. Methanol is poisonous if you drink it, it is flammable, and the vapors are harmful to breathe. Luckily, you can avoid all of the above with just a little common sense. Label the container well, and keep out of reach of children. Store methanol in well-labeled gas cans or metal drums, and keep the containers completely sealed- it's very similar in flammability and toxicity to gasoline- treat it the same way- keep it off your skin, don't

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Biodiesel Test Batch . . . cont.

let the fumes escape, don't sniff it, and be aware that it'll be more volatile on a hot day or when mixed into hot vegetable oil than in cold weather- be aware of sparks and exposure to fumes when working around hot liquids and methanol.

An very important note is that there are no cartridge respirators that can protect you from methanol fumes for more than a few minutes- the internet is full of photos of people making biodiesel with a respirator, which is due to our past ignorance of this issue. Today we use sealed processors for working with methanol, and for small batches like the liter experiment, hold your breath while pouring. Work with good ventilation or outside.

Please wear safety glasses and long sleeved clothing when handling methanol, and use gloves- nitrile, or even better, PVC gloves.

Lye safety- lye is a strong alkali (base), and will burn your skin- wear glasses, gloves, and long sleeves. Please get into a habit of washing off your gloves after handling lye, and do not adjust your safety glasses or touch your head while handling lye. People tend to be more cavalier about lye than methanol, because they've seen it under the kitchen sink- be careful!

For both chemicals, have a water hose nearby in case of skin contact. The methanol evaporates when it's spilled, but if you spill it on yourself, flush it off your skin with water because it can be absorbed through the skin. Lye should be flushed off of skin with water or vinegar. Precautions for KOH are identical to those for NaOH.

Shopping list:

you'll want to buy a few items for this process, but they're not expensive: (Here's where you refer back to that picture at the beginning of the article)

-metric gram scale, sensitive to at least .5 grams. Try pawn shops and flea markets for a triple beam scale, or use a diet scale if it has sensitive enough resolution. See article website for homemade scale instructions.
-a way to measure 1 liter (can be a Tupperware type of small pitcher) and a way to measure 200-ish ml (kitchen measure or tupperware, or a mason jar with a 200 ml marking on it)
-Three syringes calibrated in mililiters: these are oral syringes found at the drugstore for giving medicine to babies. You'll probably want ones that go up to 10 ml, and that are sensitive enough to give you .2 ml increments.

-Candy thermometer- very important- available at the supermarket housewares section
-distilled water
-Red Devil lye (easier to come by) or KOH (much easier to work with)
-methanol- a few bottles of yellow bottle HEET brand gas line antifreeze (it's 99% methanol) from the auto parts stores. You may even want to label this as methanol with a marker to keep from confusing it with red-bottle isoHeet.
-one bottle of red bottle HEET- this one is 99% isopropyl alcohol for titration testing your waste oil
-samples of oil from several restaurants-restaurant oil varies greatly in quality- dont' take only one sample home and get stuck trying to use it when it turns out to be rotten. Get samples (a half gallon or so each) from several restaurants grease barrels. Small mom-and-pop places might be more amenable to your experiments than chain burger places, and the oil might be nicer too.
-Two glass pint mason jars with tight lids
-another small mason or babyfood-sized jar to use as a 'beaker'
-another couple of small jars for oil samples
-masking tape and a marker for labeling everything
-a few PET plastic or glass 2-literish bottles- I prefer wider mouth juice bottles.
-a funnel
-a small pot
-some clean rags
optional: small hot plate

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Biodiesel Test Batch . . . cont.

What you'll be doing with all these goodies:
-test oil- see article web pages for details, or skip tests and use new oil from the store measure and mix together methanol and lye warm a liter of oil to 130F then mix this 'methoxide' into the warmed oil in a 2-liter bottle Shake the bottle for 10 minutes to mix and react, and let settle.

-testing: first, you'll test your oil to find out what it really is, and how contaminated with water and free fatty acids it is.
there are two testing steps- heating to test for water content, and titration to test for free fatty acids. They sound complex, but are quite a bit simpler in 'real life' than on paper. If you use new oil rather than waste oil you don't need to do either step. The complete instructions for both tests are in the article website.. See the supplemental web pages for full instructions.

-Figuring out the formula to use: After testing oil, we adjust the 'formula' based on the titration, to decide how much lye to use to compensate for the acids that might be in waste oil. Again, new oil= no titration needed.
The amount of methanol always stays the same= about 220 ml per liter of oil- but the amount of lye changes depending on how used the waste oil is. Basically, a more heavily used waste fryer oil will be acidic so you'll have to use more (alkaline) lye. The titration that's outlined in the web pages will give you a result that tells you how many extra grams of lye will neutralize all the acids in the waste oil you're working with.

The catalyst needed for making biodiesel with new oil is 5 grams of NaOH, and for the more acidic waste oil it is that same 5 grams of NaOH plus an additional amount determined by titration. If using KOH, the process is the same but you'll need 7 grams KOH plus amount determined by titration. You can use a little less (down to 3.5 grams lye or 4.9 grams KOH, plus the titration for both) so as to minimise excess soap production, which is what many homebrew recipes do. Don't skimp on the methanol though.

ProcessingOverview: -Mix lye into methanol in the small mason jar and let the lye dissolve completely. You will form something called 'sodium methoxide' in methanol, or 'potassium methoxide in methanol if you're working with KOH catalyst.

-Heat the oil on a kitchen stove or hot plate to 130F, no higher. Let it cool back down if you've overshot the temperature.
-Measure 1 liter of the oil and pour it into the juice bottle.

-Mix the 'sodium methoxide' into the warmed oil. Cap off the juice bottle and shake like mad for a few minutes.
-Set aside and admire- glycerol is darker fluid which should start to settle to the bottom in half an hour or so.
-Let it keep settling at least overnight. If you're sure your bottle isn't leaking, you may want to let it settle upside-down so the glycerol can be drained easily by cracking the bottlecap. But that's next month's article...

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Biodiesel Test Batch . . . cont.

The liter batch:

The recipe is as follows:
1 liter used oil
220 ml methanol (yellow bottle Heet brand gasoline line antifreeze).
catalyst measured as follows:
NaOH: 5 grams per liter, plus whatever the titration told you to use (ie if you needed 1.5 ml on the titration, use 1.5 grams here, and add it to the 5 grams for a total of 6.5 grams for a liter of this oil). New oil just uses 5 grams per liter
OR
KOH: use 7 grams of 99% pure KOH, plus whatever the titration determined (ie if you used an extra 2 ml on the titration use an extra 2 grams of KOH here and add it to the 7 grams to make a total of 9 grams for a liter of this oil). New oil just uses 7 grams/liter.

It is important to mix ingredients in the correct order: dissolve the lye into the methanol, and only THEN dissolve the 'methoxide' into the warmed oil. It will not work if the lye does not dissolve fully. It is also important to use the correct containers: pure lye will put holes into clear plastic soda or juice bottles! Use glass for this step of the process.

Instructions:
Wearing goggles and gloves, measure out about 220ml of methanol and put it into a lidded jar.

I like to use a mason jar with mililiter markings on the side so I can pour directly into the jar, or to mark a jar with masking tape at the 220 ml mark. Wash the jar lid when you're done with your batch, or its seal will dissolve.

(Wearing goggles and gloves!) Weigh out lye or KOH: if you don't have a scale, you can improvise one with the Dixie Cup method (see article web pages):

Keep the lye or KOH container closed as much as possible- it is destroyed by contact with carbon dioxide in the air, and absorbs moisture.

Immediately add the lye to the jar of methanol, and cover tightly. Tip the jar to make sure that the lid won't leak, then swirl or shake gently to dissolve all the lye so there are no particles in the bottom of the jar. It will take a few minutes and will get slightly warm. Wash your hands/gloves after handling lye.

You can warm your oil to 130F/55C in a small pot on a hot plate or your kitchen stove, then measure a liter of it with the kitchen measuring cup. Use your thermometer and let it cool if the temperature gets too high.

When the oil is warmed but not over 130F, use a funnel to pour oil into a PET plastic (soda bottle plastic) or HDPE (milk jug plastic) 2-liter or larger bottle.
http://www.localb100.com/literbatchphotos/slides/VV1C0603.html
Then, wearing glasses and gloves, use the funnel to add the methanol/catalyst mixture to the same bottle of oil. Cover tightly, and tip it to make sure the lid wont' leak.
http://www.localb100.com/literbatchphotos/slides/VV1C0611.html
Shake the bottle violently for about 5 minutes. The contents might change color a couple of times. http://www.localb100.com/literbatchphotos/slides/VV1C0614.html

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Biodiesel Test Batch . . . cont.

Then set the bottle down and clean up. In about half an hour, you might see the beginning of glycerol/soap forming at the bottom of the bottle. It'll be a single dark layer (if there is more than one layer something's wrong- like excessive soap or monoglyceride formation). The larger layer of lighter colored material is biodiesel.

Both the glycerol and the biodiesel have some extra leftover methanol in them, so dont' sniff the stuff- label it well.Depending on the oil and the catalyst you used, the glycerol might be liquid or solid, although the biodiesel should be completely liquid. The biodiesel will clear up in a couple of weeks even if you don't wash it- this is due to more of the extra glycerol/soap slowly settling out over time. You will have to wait at least overnight after making your batch, before you can do the next step- washing and testing- as glycerol and soap will continue to settle at a slower rate than in the initial half hour.

Next month we will show you how to wash the sample batch and test it for quality. See you then!

Biodiesel Web Resources

Article Supplemental Web Pages:
This is an webpage-enchanced article, so here are a few more pages that make the article more functional:

Where to buy methanol in bulk:
http://www.localb100.com/testbatch/buyingmethanol

Improvising a 'Dixie-cup balance scale':
http://www.localb100.com/testbatch/dixiecup

testing oil for water content:
http://www.localb100.com/testbatch/watercontent

titration of oil- testing for free fatty acids:
http://www.localb100.com/testbatch/titration

photos of the entire process:
http://www.localb100.com/testbatch

ask questions about this article in this thread here:
http://biodiesel.infopop.cc/eve/ubb.x/a/tpc/f/719605551/m/493100328
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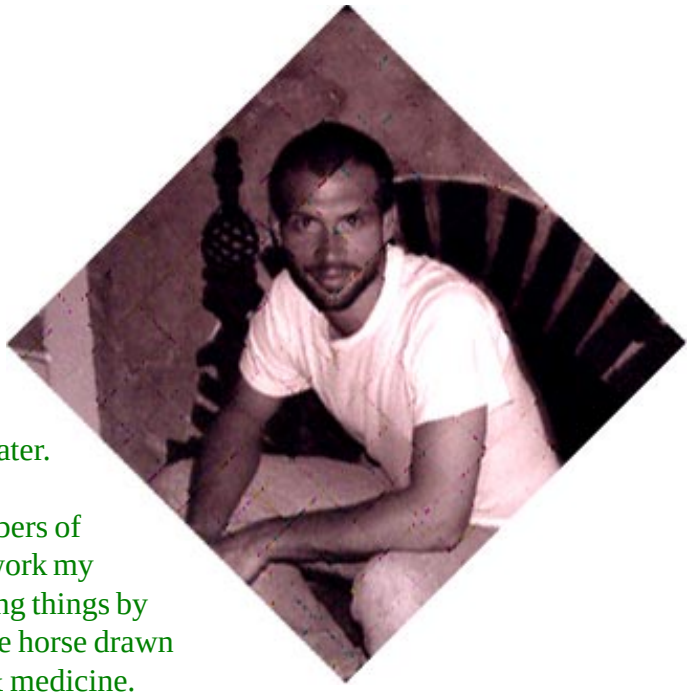
general biodiesel resources:

Biodiesel Homebrew Guide- everything you need to know to make quality alternative diesel fuel from waste restaurant fryer oil , by Maria 'Mark' Alovert, 107 pages, $15 by mail through http://www.localb100.com/book.html

http://biodiesel.infopop.cc homebrewing forum
http://www.veggieavenger.com/media
http://www.localb100.com more links and details about biodiesel
http://www.biodieselnow.com an even better forum on biodiesel policy and activism.
http://www.groups.yahoo.com/group/biodieselbasics this is an email-based biodiesel homebrewing discussion

Charris Ford's Bio



Back to the Land

My passion for all things Eco started when I was 18 in the hills of Tennessee, where I spent ten years running the family's Organic farm, living with solar power, harvesting rainwater, chopping wood and hauling spring water.

I was a student of Permaculture and apprenticed with members of a nearby Amish community. The Amish taught me how to work my team of Belgian horses and they reinforced my love for doing things by hand. My fondest memories of Tennessee are of driving the horse drawn wagon, mowing with a scythe and foraging for wild food & medicine.

I have been dedicated to protecting the environment and have lived "off grid" for over18 years. Though living close to the land and striving to live in greater harmony with nature has always been my favorite kind of activism, I realized that dwindling resources, exploding populations and global warming would not resolve themselves, nor would they be remedied by a handful of dedicated "back to the land-ers". Significant cultural evolution requires extensive mainstream education and I have since made awareness raising the focus of my environmental work.

Biofuel

Driven by a passion for the possibility of biofuel, I founded the first and for many years the largest biodiesel making facility in the state of Colorado (using recycled french fry oil collected from local eateries). I also spear-headed the launching of the nations first 100%biodiesel powered city bus and played a significant role in getting the needed Department Of Energy grant.

In addition to running two biodiesel-powered vehicles of my own, (a Jetta Wagon and a Scout Truck which hasn't had a drop of dinosaur diesel in 5yrs), I met actress Daryl Hannah in 1998 and introduced her to the budding Biodiesel movement. Since then I helped her get a biodiesel El Camino and we've done a great deal of work together, raising awareness about the need to develop clean and renewable fuel sources for this nation and around the world.

Speaking

I am an experienced educator who gives regular presentations at conferences, universities, renewable energy events and environmental festivals such as: International Mechanical Engineering Conference (Cuba), Solar Energy International, University of Queens (Canada), University of Colorado and many others.

Last year, I had the pleasure of befriending and sharing the stage with Julia Butterfly Hill and Woody Harrelson in addressing thousands of participants during the *We The Planet* Tour.
Daryl Hannah and I have also given numerous presentations together at events such as: Keynote address at the National Biodiesel Board Expo (the largest Biodiesel convention in America), Wild & Scenic Film Festival, "SolFest" (RealGoods alternative energy event), and others

Continued on Next Page

Charris Ford's Bio . . . cont.

Eco Rap

While back on the farm I started writing Eco Raps on a variety of environmental topics and have continued to perform and perfect them as part of my educational approach. These raps blend humor, science and vocal percussion known as "Beat Boxing".

Being a rapper in the environmental movement has given me a unique tool for educating and entertaining audiences across the country. Besides performing at music festivals and concerts, I often "kick" a rhyme or two when giving talks at events and universities.

One rap starts out like this:

> We could get driven to extinction just for spinnin' our wheels
> up an offin' ourselves with our own automobiles
> an like them dinosaurs that died out, that technology's old.
> and while they profit from pollution we been getting sold

* To hear Rap samples: visit Grassolean.com > click Fun Side of Biodiesel > click Ayatollah of Canola > click Eco-Rap

French Fries to Go

The origin of the Grassolean Project was documented in an award winning short film called "French Fries to Go". The film is a humorous and heartfelt romp that proves environmental responsibility can be fun. The excellent soundtrack (composed by Woodstock musicians) offers up an eclectic mix of "Eco-Rap", electric sitar, stand up bass and bluegrass. In addition, the film has Cameo Appearances by Daryl Hannah, Dennis Weaver and internationally renowned Doctor, Andrew Weil.

"French Fries to Go" was selected as Best Environmental Film at Telluride MountainFilm Festival 2002 and chosen for the recent Banff Film Festival World Tour. The film has played in over 250 cities worldwide and continues to be shown internationally at universities, environmental events, high schools and respected film festivals.

Media

My work has been prominently featured in many national media outlets such as:

- **Television**; O'Reilly Factor, Car Tech of the Future (History Channel) & The Big Idea (CNBC)

- **Magazines**; National Geographic, Outside Magazine, and Organic Style Magazine.

- **Newspapers**; New York Times, Los Angeles Times and San Francisco Chronicle

- **Nationally Syndicated Radio;** NPR, Motor Trend Radio and Planet Check Radio

Grassolean.com

I also built the biodiesel information site, Grassolean.com, which (since it was launched in 2001) has educated millions of visitors and been one of the top1000 websites in America.

* Complete press packets are available I can be reached by email at charris@grassolean.com

ESSN Classified Ads

FOR SALE -- Wincharger 1222 12V 200W Wind Generator. In excellent condition, but currently disassembled. Includes spare bearings and brushes. Prop is in good condition. $1000. info@rebelwolf.com

SOLD

FOR SALE -- 12.5 KW Biodiesel generators. Conbines the 2-71 Detroit Diesel engine with an extremely heavy duty Delco or Emerson brushless alternator. This is the generator Steve Spence chose for his own BIODIESEL system. Rebuilt units starting at $4395. Non-rebuilt units starting at $1995. www.affordablepower.com 1-888-454-1193 X3

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$150/month
$600/6 months
$1000/year

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$400/6 months
$700/year

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$75/month
$300/6 months
$500/year

Classifieds
$0.25/word/month
20 word minimum

Submit ad copy or advertising inquiries to:
ads@rebelwolf.com

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Circulation Info

This is our fourth month of publication and our circulation just keeps on going up. Our handy little stats utility on the website, Webalizer, only tallys the hits once a day -- about 0300. Well, if somebody's going to be counting things at that hour, it's a good thing we have the software, because I'm sleeping then. Anyway, the news is -- as of 0301 (CST) this morning, 31 March, 10057 of you have downloaded the March issue of ESSN. We've broken the 10 grand plateau. Thanks to all of you. ldb