Energy Self Sufficiency Newsletter

May 2005

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A Rebel Wolf Energy Systems Publication

From The Editor's Laptop

by Larry D. Barr, Editor

Conservation or Just Plain Stingy?

The results aren't entirely in yet on my conservation mode experiment here at the house. I got my bill this month and I'd knocked it down from 951 KWh to 499 KWh. That made a bit of a dent in my bill, but not enough to make me really happy. Then I counted days and noted that there were 11 days of the old, complacent habits in the billing cycle that I was still paying the price for. And, Mario's coming over tomorrow night to look at the fridge. I'll have more info on this for you next month.

Let's talk for a bit about conserving things other than energy. Like money. We all have computers and to many of us, they are a very important device in our way of life. I know they are to me. I'm a member of twenty-some-odd email groups, most renewable energy related in one way or another. A few are planetarium and astronomy groups since that's what I do at the 'real' job. And, of course, without computers, we couldn't have this little conversation each month.

So, what do computers have to do with conserving money? I'll get to that in a minute. Let's go back to conserving energy for a short while first. Since it's necessary for me to have access to several email accounts both at home and at work; and since I'm always transporting work in both directions, I've taken to carrying a laptop back and forth. Very convenient and saves the trouble of copying to floppy, ZIP disks, CDs, DVDs or even USB drives. And, it can save energy.

I had time last weekend to hook the Dell 1150 up to 12 VDC power using the Dell supplied Lind 'auto adapter.' The 1150 is a fairly hot little unit with a 2.8 GHz P4, 1 GB of RAM, a 60 GB HDD and a DVD burner. First thing I had to do was modify the adapter with a couple sets of Anderson PowerPoles in the 12 VDC input line so I could use it on my system here at home. I don't believe in lighter plugs, but with the PowerPoles inline, I can still use it on a lighter plug if I have to. Once it was suitably modified, I connected the Medusa Research Digital Power Analyzer and checked it out.

It draws about 1.75 amps from a 12.6 VDC source (a fully charged deep cycle battery) when idling and right up at 2.9-3.0 amps when playing a DVD. That's just shy of 38 watts and makes it a very viable computer for off-grid use. I have a couple others here I'd like to check out as well, but I'm having a bit of trouble finding the auto adapters for them. The Dell XPS just doesn't seem to have one made for it, and the old Inspiron 8200 seems to have just faded away as far as accessories go. I'll keep looking.

Speaking of the 8200, I'm using it as an experiment in conserving computer related funds. It originally had Windows 2000 on it, but I reformatted the hard drive and loaded MandrakeLinux 10.1 on it. I'm experimenting with Linux, since the prices of "mainstream" software keep going up. The most common operating system, MS Win XP Pro, is currently running right at $300 from major online outlets. Software suites containing word processing, spreadsheet and presentation programs are priced about the same – and more. I've heard that the next version of Windows, currently in development and code-named "Longhorn", will cost $400 per copy. At prices like that, it doesn't take long to run out of software money.

I'm not badmouthing Windows here. Windows has made it possible for a lot of folks to enjoy computers. Folks who never would have braved the old DOS command line interface. I'm just pointing out options for those who'd like to save some money. The distribution of Linux that's on the laptop was a free download. All it cost me was the price of three CD blanks to burn the image files to. Included in the distro is a complete suite of office applications, photo editing software, email clients, desktop publishing apps, web browsers, FTP clients and just about everything else one could need. I haven't had a chance to try it all out yet, but I'll get to it. If it will do the things I need a computer to do, I'll make the change completely.

Why is Linux free? It's called Open Source Software, and it's written by volunteer programmers just because they have a dream and believe that software should be free to everyone. If you want a printed manual, you can buy the CDs and a manual, but if you can get by without a book, you can get it for free. It's probably not for everybody, and I'm not sure at this point if I can do everything I need to do with it, but it's sure worth a try. All the money I save can be used for more renewable energy equipment. And that's the end of this month's editorial, written in OpenOffice Writer and the Linux operating system. At no cost to me. See you next month. ldb

Electricity 101
An Interim Observation
by Larry D. Barr and Steve Spence

I'm flying solo this month since Steve is taking a short break from his usual writing duties. He's moving this month -- we'll have more on that elsewhere in this issue -- so I'm going to deviate from our usual Electricity 101 format. We'll talk a bit about one of the worst enemies of energy self sufficiency.

Phantom Loads!

What exactly is a phantom, or ghost, load? A phantom load is a device that's consuming power, but giving you nothing in return. For example, an "instant on" television consumes power to keep all the electronic widgets inside warm and full of electrons so that it 'turns on instantly' when you push the ON button. It's not really instant on -- it's already on. All you did was wake it up. And you've been paying to keep it ready for you.

Some other phantom loads you may not be aware of or have forgotten about are: VCRs, satellite TV boxes, electric clocks in anything, computers in sleep or suspend mode, monitors in standby mode, and generally anything that still has a light of any kind glowing after you turn it OFF. Think about it.

So how do you combat these nasty little power-sucking gremlins? Well, let me tell you what I did and you can take it from there. Remember that I'm currently on the grid, so I have a few appliances operating on electricity that I wouldn't have if I was off-grid. Like an electric water heater. Which I unplug when I'm not home or won't be using hot water. Yeah, I could get a timer -- but that's a phantom load.

I also traded off my digital microwave overn and got one with a mechanical timer. When it's off, it's off. I put almost all of the cord connected devices in the house on power strips and I turn them off when they aren't being used. When I leave for work, only the refrigerator, range, alarm clock and answering machine actually have power running to them. Everything else is physically disconnected or switched off at a power strip. It's made a difference in my electric bill and the same habits will serve me well when I go off-grid. Conservation is the first step to energy self sufficiency. ldb

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Laptops on 12 VDC

by Larry D. Barr

There have been changes in my home computer network since I wrote my "From The Editor's Laptop" column a couple of weeks ago. In that column I mentioned that I was having trouble finding DC adapters for the old Dell Inspiron 8200 and for the XPS. Not any more. A Google search led me to Lind Electronics (http://www.lindelectronics.com/) who seem to have what they call Auto/Air Adapters for every laptop ever made.

That may be a bit of an exaggeration, but I found DC supplies for both the 8200 and the XPS there. Nothing, of course, ever happens quickly – and in my case, available funding tends to limit progress at times. So, I have the 8200 covered, but haven't gotten the DC adapter for the XPS yet. Nor have I checked out Lind's stock of DC supplies for other laptop manufacturers, but there are sure a lot of choices for you on Lind's menu page.

And, always a plus, I felt like I got really good value for the money spent, too. Here's what you get with the package: the adapter itself, a lighter plug input cable, an airline plug input cable and (a really nice touch) a nylon zipper bag to keep everything together in your road warrior kit. I ordered an additional item – an input cable with bare wire ends that I put the Anderson PowerPoles on to mesh with my 12 VDC system. That saves me cutting into the lighter plug cord and installing two PowerPole sets as I did on the 1150 power supply. I ordered that one through Dell and didn't know the optional cable was available. In the photo below, the 1150 input cable with the inline Anderson PowerPoles is on the nylon bag.

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Laptops on 12 VDC . . . cont.

I reported on the DC power consumption of the Inspiron 1150 in my other column, so I won't reiterate that here. Let's take a look at the DC eating habits of the Inspiron 8200.

With the unit running from a fully charged deep cycle battery, the Medusa Research Digital Power Analyzer was showing a source voltage of 12.6 VDC and a current draw which varied (rather widely, I thought) between 3.3 A and about 4.5 amps. That was a larger variation than I expected with the computer performing in an essentially stable mode with an email client and a web browser open and the CD player app playing "Sin Wagon" by the Dixie Chicks. It was also a higher draw than the 1150 playing a DVD, which really surprised me, since the 8200 is an older computer with less processing power. So, it may very well be that the new proc technology is more energy efficient than I gave it credit for.

Does that mean you need to rush out an buy a new lappie just to go off-grid? Not to me, it doesn't. Given a tight budget, I'd favor buying an older, used unit and spending the money I saved on more PV (or wind) and batteries. The price differential will pay for a lot more generating and storage capability than the old laptop will consume.

The image at the top of the article shows the 8200, running MandrakeLinux 10.1, on the left, the WinXP Pro powered 1150 on the right and the Orion 9" TV/DVD on the shelf. All the units are capable of 12 VDC operation, although only the 8200 was 12 VDC powered when the shot was taken. One of my soon-to-come projects is installing 12 VDC wiring on the desk so that everything just plugs in. Just as easy as standard AC stuff.

To me, the figures show that laptops with a DC adapter are truly viable choices for off-grid computing. They are quite light on the power consumption and there is both an efficiency and cost advantage over an inverter. It will be interesting to see how a laptop compares with a native 12VDC computer built using the Mini-ITX form factor motherboard. That's a project we hope to report on fairly soon.

If you're considering a laptop and don't feel like spending a couple extra PV panels on a new one, you can generally find a good deal on a used one from E-topco. They get used computers off corporate leases and put them out at very reasonable prices. http://www.e-topco.com/

We'll keep reporting on off-grid computing solutions, and to do a really good job with that we could use your help. Let us know about your efforts, your successes and, yes, even your failures with off-grid computing. Send your silicon sagas to essn@rebelwolf.com and we'll share them with the world.

SO YOU THINK ETHANOL IS SOMETHING NEW?

If you think that using ethanol to push your car or your lawnmower around is something new, and should only be considered by those who dream of blue skies and unpolluted air, forget it! Millions of cars powered by ethanol-blended fuels are already being driven around the world by drivers blissfully unaware that the fuel they are using has ethanol in it, and the number is growing rapidly.

Ethanol's original use was as a gas extender when oil prices skyrocketed. The phasing out of leaded fuel also boosted ethanol's popularity as a high quality octane booster, and it is a rare pump now that doesn't deliver fuel that contains ethanol, whether the sign on the pump says so or not. Most refineries now add it as a matter of course, then brag about how much cleaner their fuel leaves your engine with their "secret ingredient". I remember the Good Old Days when I was a student, and swept floors at a depot for one of the leading fuel companies. In those days, their "secret ingredient" was a commercial brand of liquid detergent, TCP. Of course it had been known since the dawn of the automobile that ethanol could be used as a fuel, but for some reason knowledge of the cleansing powers of the stuff seemed to be the preserve of cosmetic manufacturers.

Ethanol-blended fuel sales now represent over 11% of all automotive fuels sold in the United States alone, and this figure is exceeded by other countries such as Brazil and India. There are more than 4.2 million ethanol-powered vehicles in Brazil (about 40% are passenger vehicles), which consume nearly 4 billion gallons of ethanol annually! The USA now produces approximately 1.6 billion gallons of ethanol each year from more than 50 ethanol producing facilities operating in 20 different States, and Canada, with full support from its government, is rapidly catching up.

State governments in the US are now actively recognizing the economic, energy, and environmental benefits of ethanol. Many Midwestern States and the federal government now operate a large number of E-85 variable fuel vehicles in their fleets. Of these, Iowa is a leader in the introduction and operation of one of the nation's largest variable fuel fleets. These vehicles are capable of operating on E-85, a blend of 85% ethanol and 15% unleaded gasoline. The ethanol is made from Iowa corn. The small percentage of gasoline is only retained as it enhances starting in extremely cold weather.

Larry asked me to find him pictures of ethanol powered vehicles. My answer was that he could take his pick, for every present day car is capable of running happily on E-10, and often does. E-85 requires work to the engine, but all the leading manufacturers are now falling over themselves to design and manufacture E-85 capable automobiles. So instead of favoring one manufacturer over another by putting a pic of their pride and joy here in this Newsletter, just keep your eyes open when next you cross the road. That car that almost ran you down would probably fail a breathalyser test!

Now I know that this possibly comes as a horrible shock to many who read this Newsletter, for many who do so yearn for an alternative lifestyle that features self-sufficiency as a major driving force. Please don't worry! Ethanol can still be your driving force, as can biodiesel recycled from your local fish and chip shop. It's not so much the fact that you can go out and buy a commercial product, as the satisfaction of knowing you did it yourself and are therefore independent. Here in the wilds of New Zealand, an enlightened government permits us to distil our own booze. Why on earth should we bother though, if the nearest off-licence is only a few staggering steps away? The answer is satisfaction. Satisfaction that you can produce something that knocks the socks off any commercial brand, and satisfaction that you have not joined the couch potato brigade sitting dreamily soaking up the latest soap on their telly.

So roll up your sleeves and get to it! Join the man who broke the bank in Monte Carlo and walk down the street "With an independent air"

Mike Nixon

Software Review
Electrist for Palm OS
by Larry D. Barr

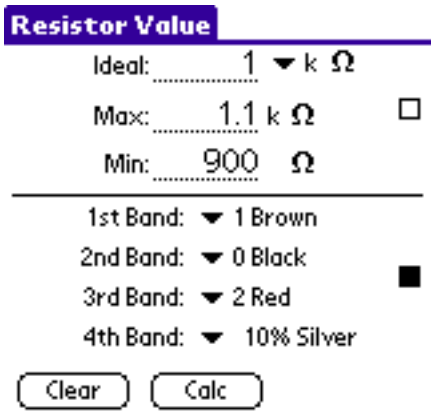
One day last month I got a rather cryptic email from Steve Spence. The subject line was "Check This Out" and the body of the message said only http://www.redbinary.com/electrist_index.php

Well, that caught my attention, so I pointed Mozilla Firefox (my browser) that direction. What I found was a description of an app for PDAs using Palm OS from V3 to V6. Billing itself as "*The Top Electrical and Electronic Engineering Tool for Palm OS* " the app is called Electrist and lives up to its billing.

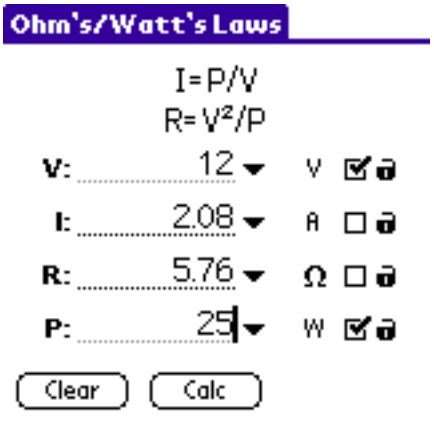
After reading the overview, looking at the screenshots and perusing the online documentation, it was beginning to look like my Palm Tungsten T5 needed to make the acquaintance of this app, so I bought, downloaded and installed it immediately.. The list of functions the program offers is truly impressive.

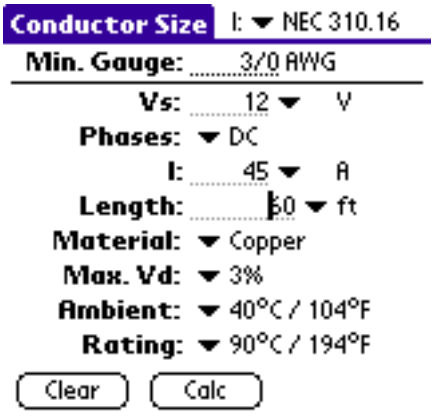
- Integrated Ohm's Law/Watt's Law
- Resistor Color Code
- Series/Parallel Resistance/Inductance/Capacitance
- Unknown Value of Parallel Resistance/ Parallel Inductance/Series Capacitance
- Voltage/Current Dividers
- Capacitive/Inductive Reactance
- Series/Parallel Resistive/Inductive/Capacitive Impedance
- Peak/Peak-to-Peak/RMS/Average Sine Wave Conversion
- Delta/Wye Conversion
- RC/RL Time Constant
- dB Power/Voltage Gain/Attentuation, dBu,dBm,dBW,dBuV,dBV Decibels
- VSWR
- Resonant Frequency
- Conductor Voltage Drop
- Conductor Size Selection

Although you won't, or at least I don't, use all the functions every day, when you need one of them, there's nothing like having it handy. Now, I'll also admint that there's at least one of them I'll never use. I've been doing things electronic for so long that I have no need for the "Resistor Color Code" app. But, I'm glad it's there for folks who don't have the benefit of all those years looking at those little tiny stripes. Those of us who have PDAs generally have them with us, but a resistor color wheel is probably back on the bench.



A few of my favorites are the Ohm's and Watt's Law function; the Unknown Parallel Resistor Value (great for working out of the junkbox), the Decibel functions simplify audio work immensely, and the Conductor Size Selection function is absolutely magnificent. It complies with NEC 310.16 or lets you calc the conductor size based on Voltage Drop alone.





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Electrist Review . . .cont.

For US$20, it's a heck of a buy. If you have a Palm OS PDA and work in electrical, electronics or audio, you need this software. If you don't have a PDA, you work in any of the above fields, and you're thinking about getting a PDA, you probably should consider one that uses the Palm OS.

Does it sound like I'm excited about Electrist? Well, I am. Several years ago (actually back in the DOS days), I set out to write a similar program for the PC using MS Quick Basic. It turned out to be quite a project and I never did get it exactly the way I wanted it. Patrick Griffin of Red Binary has done a great job with Electrist and it's a must-have Palm OS app. Oh, yeah, I forgot to mention. You only have to buy it once. The purchase price includes free support and upgrades for life. You can't beat that.

Just before we "went to press" Patrick let me know that Version 1.17 is available for download. And he says it has some nifty new additions. I haven't had time to check it out yet, but you can bet I will. ldb

Do Your Part!

Conserve Energy
&
Resources

Let's All Help
Save Planet Earth

Overhangs and Oversights

by Laren Corie

This month I will be discussing overhangs. The simplest thing in the world, is to just put the correct overhang over your south windows. It is totally automatic, and needs no attention, winter or summer. The tilt of the Earth's axis gives a reliable seasonal change of sun angles, so your south facing windows will be fully illuminated in the winter, and get no direct sun during the summer.

If you bought that, you are a victim of over simplified passive Solar literature. It could not be further from the truth.

First, there is no such thing as the Winter position, or the Summer position, of the sun. The sun moves through half its total noonday altitude range (23.5,° half of 47°), during each of the winter and summer seasons. Every day, it rises to its noon altitude, from the horizon. So, how high is it on any day? In the US, somewhere from the horizon to straight up. Take 90,° minus your latitude, then add 23.5° to it. That is the highest point of Solar altitudes that you will have to deal with, for every house, whether you call it Solar, or think that by not using the word,that the sun will go away.

The sun is at its lowest noonday point on "Winter Solstice," at 90,° minus your latitude, minus 23.5.° Winter Solstice is the first day of winter, not the middle day of Winter. The sun is at its highest point on "Summer Solstice," which is the first day of Summer, not the middle day of summer. These are also the shortest and longest daylight days of the year, even though they are not the coldest and the warmest days. The Winter and Summer solstices are on approximately December 21st, and June 21st, respectively.

At Winter Solstice, winter begins, and the days begin to get longer, as the sun rises and sets further toward the closer pole (north in the northern hemisphere, etc) and traces a path higher across the sky. Every day it will be slightly more than a quarter degree higher in the sky at noon., so in a mere two weeks, it will have risen nearly 4°, so you can see that Solar collector tilts might not need to be all that critical, but that is another myth to debunk, at another time. Anyway, as the sun runs its ever longer, and higher course across the winter skies, it eventually reaches the last day of Winter, which is also the first day of Spring, the equinox.

The solstices, and these other points, called "equinoxes" are highly unlikely to ever fall on exactly midnight, so the last day of one season, and the first of the next season are the same day. These times, when the sun's path is halfway between its lowest and its highest, are called the "Vernal Equinox" which some just call the "Spring Equinox" and the "Autumnal Equinox" which we can also call the "Fall Equinox" Not only is this the middle point of the sun's height at noon, it is also the middle point for the length of day. Interesting? No? Well, let's think about that a lttle. I did not just say that it was the middle point for the people in the north. It is also the middle point for the people in the south. That is because the equinoxes are the points when the Earth's axis is exactly perpendicular to the light from the sun. Everybody (except right at the poles), gets exactly 12 hours of daylight, and the sun rises due east, and sets due west, everywhere. On the poles, the equinoxes are the points when the six months of day and night change places.

This all gets a little more interesting at the equator, and other location in the tropics, between the Tropic of Cancer (north) and the Tropic of Capricorn (south) which set at 23.5° from the equator, which coincides to the 23.5° tilt of the Earth's axis, which creates the 47° range of the seasonal sun angles, that was mentioned above. In this region, however, the sun can actually go past the 90° point, and be in the northern sky, in the north, and in the southern sky, in the south. This changes that simple high/low sun altitude situation, but the equinoxes are still the mid-points between solstices. At the Equator the length of day does not vary hardly at all, and is always basically twelve hours.

At the poles, there is six months of 24 hour daylight, and six months of 24 hour darkness. Though areas like the far north, and far south have winters with very short daylight, they also have much longer summer daylight, than in more tropical climates, often with over sixteen hours of sunshine. All of this factors into controlling Solar gain through south facing windows. Here is the essence of why simple fixed overhangs are not a very effective way to shade south facing windows, used for Solar heating,

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Oversights . . . cont.

It is cool near the end of March, at Vernal Equinox, the last day of Winter, yet it is warm near the end of September, at Autumnal Equinox, the last day of Summer. This happens even though the sun follows the identical path across the sky, during both times. Any fixed shading will block the same amount of sunlight, and let the same amount through, during both times. A fixed overhang makes no differentiation between these times, though the average daily temperature, may require considerable heating in March, and considerable cooling in September

This situation does not affect just these two days of the year. It affects every day. The sun's angles are the same on October 14th as on February 26th, the same on November 21st as on January 20th, and the same on April 24th (when I just got a few inches of snow) , as on August 18th. None of these sets of days have even close to the same weather conditions, and heating or cooling needs...yet the Solar gain, and the shading, will be identical with fixed overhangs. Similar inequities occur for every day of the year, and their matching days. There are ways to overcome these imbalances, but it must be first recognized that fixed overhangs are far from the ideal solution, that many have claimed they are.

Since, winter is not centered around the sun's lowest path, nor its shortest days, and Summer is not centered around the sun's highest path, nor its longest days, fixed overhangs which are designed to totally shade the windows on Summer Solstice, and allow full sunlight on Winter Solstice, will also shade much of the windows during the coldest part of winter, and allow direct sunlight to enter during the hottest days of Summer. A fixed overhang, therefore can cause underheating in Winter, and overheating in Summer. The seasons lag considerably (about forty five days) behind the sun's movement.

This situation, of partial shading, is further exacerbated by the tall windows that are often used for both large areas of Solar gain, and for allowing sunlight to strike the floor mass, as presented to be so simple in most presentations of direct gain Solar. The same overhangs which undesirably shade the glass, even more radically shade the floor. With tall windows, even a fairly poor functioning overhang would need to be high enough, and far enough extended to begin to dominate the whole design of the house. It will be high and large enough to usually look odd. On top of that is the fact that the sun is not at the same height, above the ground, all day. An overhang that might be perfect shade at Solar noon, will allow the sun through in the morning and afternoon. Without some very strange "wings" floating out in front, and to the sides of the building, windows will not be shaded in the morning or afternoon, when the sun is lower in the sky. Overhangs are wonderful for getting water away from the walls of the house, but as shading for Solar windows....they fall desperately short of the mark.

To further demonstrate the basic problem with all fixed overhangs, the following is NREL weather data for Sioux City Iowa:

Average sunlight, per day, per sq ft, on a south facing vertical window.

March..... 1150BTUs/day
September.. 1160BTUs/day

Virtually identical amounts of Solar gain.

Average temperatures:

March ..... 35.8°F
September ...63.4°F

28° colder in March...

Compared to the standard heating base temperature (65°F)

March 29.2° of heating needed
September 3.3° of heating needed
also
September 1.8° of cooling needed
Therefore —
September average 1.5° of heating needed

To put this into perspective.....

To keep a house at about 72° you only need a temperature above 65°, because of the heat of the people, lights, appliances etc. The heat from normal life could over-heat the house in September, if you do not open some windows part time. However in March, when the temp outside averages almost 30° colder, and is below freezing about a third of the

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Oversights . . . cont.

time, you need your windows closed, and you definitely do not want them completely shaded, like you would want in September. The heating need in March is eighteen times greater, than in September. You may need 100 times more south glass, un-shaded in March.

Fixed overhangs do not allow for that. They give you the same identical amount of glass exposed, on both equinoxes. They can only give you a very small amount of desirable Solar control, and that will be just at the extremes of the solstices. In the between times, they will shade part of your windows, most of the time when you need the heat, in late Winter and in early Spring. And, they will also let the sun shine in most of the time, when you do not want heat, in late Summer and early Fall. Fixed overhangs are a poor shading device. All they give you is a big area of exposed glass most of the summer, letting in heat you do not want, and a big area of shaded glass most of the winter, letting out the heat that you want to keep inside.

Even the specialty Low-E glass, which reflects a high degree of Summer sun, will reject as much March warmth, as September over-heating.

What are the alternatives?

There are several categories of Solar gain control strategies. Perhaps the most basic division is between interior and exterior. The most effective strategies are usually a combination of approaches.

It is possible to use movable shading devices, which get positioned differently for the heating and cooling seasons. Thought must go into these systems, to be sure they are durable and convenient enough that they will remain operational for the life of the building, with little repair or maintenance beyond what is needed by other building components. Many systems of this type, especially movable louvers, have fallen victim to ice and snow. Movable shading devices might be as straight forward as boards, screens, or shades that simply hang from the fixed overhangs, on eye hooks, and are removed to a protected storage area,during the heating season. They could be boards that lay on horizontal beams, projecting from the wall, and might even serve as a balcony floor in summer, then get stacked back against the wall in the winter. In some cases, greenhouse shade screen may work well. For others, roll-down security shutters will be the ideal solution. There are many workable systems, which will do the job that a fixed overhang can never do, as well.

My favorite external shading device is self installing, self adjusting to the degree of need, is long lived, and self replenishing. It also actually cools the area through evaporation. It even floats, high out in front of and to the sides of the windows, but never looks odd. It is vegetation, either in the form of trees, bushes, vines, or any combination. They know just when to bloom and grow leaves, and then when to drop them in the fall, just in time to let the sun shine in, as the cold winds begin to blow. Vegetation is about as perfect an "overhang" as we could ever wish for. There are as many varieties, and ways of using it, as there are styles of houses. Some plants hang down, other grow up, other hang far above, and even others climb over the south face. Personally, I have a south wall shaded by an ancient oak tree, plus ivy that covers the whole wall in the summer, then drops every leaf in the fall, to let the sun shine in all winter. Vegetation can also shade the roof, and non-window areas of the walls, as well as the ground around the house, all adding to the effectiveness of its cooling.

The other basic category of shading devices, work inside the house, after the glass. Most of these are the standard window coverings that we are all accustomed to. Some reflect the light back out the windows. Some absorb it, and let the resulting heat rise, perhaps back out an opening in the window. Some are the insulating shades, shutters, or curtains that keep heat from escaping in the winter time. They can just a well insulate the house from unwanted heat gain, as from unwanted heat loss.

There are literally hundreds of variations, including approaches where the heat of the sun is used, like a Solar chimney, to draw a breeze through the house, and out the south windows. The combination of exterior, and interior shading can do a very effective job of controlling Solar gain through south facing windows, so that it will always be working for you, not against you.

There is one circumstance where fixed overhangs can work excellently. That is when they are inside of a Solar sunspace*. Inside of a sunspace the overhangs can stop the light, but the heat can still be collected from the air of the sunspace. This gives the option of moving the heat into the house, or into a

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Oversights . . . cont.

heat storage, or to heat your water, or venting it to outdoors, or even letting it rise out, to draw an easy breeze through the house. These interior overhangs need only be shelves above the windows that let light pass through the sunspace, and on into the inner house. They may even function as "light shelves" to reflect the light up into the house, to light the ceilings of the rooms. Balconies do a fine job of doing this interior sunspace shading.

*For those not familiar with the term, a "sunspace" is a shallow glass room, like a big walk-in Solar collector on the south wall of the house. Sunspaces can be extremely beautiful living spaces, with high ceilings, their big wall of glass, and sometimes a glass roof. They are very similar to "Solar greenhouses" but are designed to give up their heat to the house, and not for growing plants. In cold climates, they are far more efficient as Solar heaters, when they contain very little "thermal mass" so they can go cold when the sun is not shining, and not spend all their heat back out through the glass, in the middle of the night.

One last area to mention, is the east and west facing windows. Overhangs work even worse for these, than for the south facing ones. However, vegetation works even better for shading them, because by the time the sun is around far enough to shine in these windows, it is very low in the sky. This means that low trees, or bushes, set out in front of the windows can shade them. Obviously this must be done in a way that does not shroud your favorite view, but it is usually very workable.

There is very good information available on where to plant trees (or leave them standing) around the house, so that you get heat when you want it, and shade when you want that. Plants will also shelter you from winter winds, and bring in cooling summer breezes. The moisture will cool the summer air, and keep it warmer in the winter.

In summary: It is not possible to design fixed overhangs so that South facing windows are fully illuminated in the winter, yet get no direct sun during the summer. The sun follows virtually the same path across the sky at the end of winter, as it does at the end of summer. Therefore, other provisions must be made to control Solar gain, in a way that will allow as much gain as is needed to heat the house, yet also limit the Solar gain, when cooling is needed.

Off-Grid Wind and Solar Powers Straw Bale House

by Peter Asmus

While New York State Energy Research and Development Authority's (NYSERDA) rebate program is limited to those customers whose small wind or solar photovoltaic systems are hooked up to the grid, some consumers may still want to install renewable energy systems if they are not connected to the electricity grid.

Such is the case of Amy Yahna and Brian Musician, who in November 2003 purchased 270 acres in the small town of Lebanon near Syracuse in eastern New York, a region quickly emerging as the central hub of New York's wind farming. Two utility-scale wind farms, featuring wind turbines each generating more than 1 megawatt (MW) of electricity on towers more than 200 ft tall, are located within a 10 and 20 minute drive of their property. Seeing these unfamiliar yet graceful machines spinning is raising interest in wind power among locals.

The property Yahna and Musician purchased features an incredible array of micro-climates: soft and hard wood forests; two spring-fed ponds of three acres and five acres a piece; wetlands; fields; and pasture and foraging areas. "We have a long-term plan of transforming our property into a living example of sustainable living and green buildings that include green energy," commented Yahna. "We really wanted to get off of our dependence upon fossil fuels," she added.

The couple started with a straw bale house, a structure that makes use of natural materials and is highly energy efficient. They started building the structure in the fall of 2003. "It was a two-part deal," remarked Musician. "We put up the roof first and then the solar panels. By then, there was so much snow, we had to stop." The rest of the house, and the wind turbine, were then completed in July 2004. The solar PV system consists of twelve panels producing a total of just over 2.2 kW of electricity. The wind turbine is a Whisper H-40 manufactured by Southwest Windpower of Flagstaff, Arizona, and produces 900 watts of electricity when operating at full throttle. In a wind regime with average wind speeds of 12 mph, this small wind turbine mounted on an 80-foot tower is expected to produce roughly 100 kilowatt hours of electricity per month.

Located at an elevation of 1,700 feet and on the top of a ridge, the wind turbine is subjected to incredible gusts of wind. "The wind comes blasting across, bone-chilling Arctic winds that can freeze you right on the spot," observed Musician, who was raised in the area. While the wind comes from the northwest in the winter, winds also arise from the southwest and southeast in the summer. "These summer winds can plaster you right against the wall with torrential rains," he pointed out. "There is a saying around here," he continued. "It's a breeze in the summer, but it's the damn wind when it gets cold in the winter."

Generally speaking, New York's wind resource is best during the winter months, but Musician and Yahna have noticed that during the last year, the months of November and December were a bit erratic in terms of wind fuel. To fill in the gaps, they relied upon a gasoline powered generator, which they first installed during the construction of their straw bale house. "Hard to find carpenters willing to use a hand saw," he complained. They hope to switch to a propane-powered back-up generator in the near future.

Continued on Next Page

Straw Bale House . . . cont

Yahna noted that they had very little trouble with local permitting officials on the solar or wind power systems. They had far more trouble getting their straw bale house approved. Local officials rejected both their proposed composting toilet and grey water management systems. "They didn't seem to be ready to take on the wind or solar systems after we talked circles around them on the straw bale house," she said. In fact, when the final inspection took place, the local code officer and electrician were astonished about how quiet the Whisper H-40 was. "If I would have known that the latest generation of wind technology was so quiet, I would have gotten one a long time ago," said Kevin Stausser, the local electrician.

Ironically enough, Yahna and Musician wanted to hook both solar and wind systems to the grid, but they discovered it would have cost $10,000 for them to connect to the local utility grid due to the long distance between the existing grid infrastructure and their installation site. That seemed too high, so instead they installed a battery back-up. Their Southwest Windpower dealer Dr. Gay Canough of ETM Solar Works of Endicott, New York, presumed that the permitting process went smoothly in part because the system was not grid-connected.

They went with an integrated solar and wind system because the sun tends to shine in the summer and the wind tends to blow in the winter. They are both contemplating becoming even more deeply involved with renewable energy. "We are thinking about getting into alternative energy farming," acknowledged Musician. "We have quite a bit of land here. We just might start harvesting some more wind here," he added, envisioning some large utility-scale machines on their property generating power for their neighbors in the area.

For more information on wind incentives in New York, access www.PowerNaturally.org, or access the nationwide Database of State Incentives for Renewable Energy (DSIRE) at www.dsireusa.org.

Peter Asmus, author of Reaping the Wind, has covered energy issues for 15 years. As a member of the AWEA (American Wind Energy Association) Small Wind Advocate Team he compiles and writes about the people and communities that are benefiting from successful small wind turbine installations. Visit www.awea.org/smallwind.html for more information. Contact him at pthfind@earthlink.net.

Whisper H-40

Off-Grid Journal

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

Interim Report
by Larry D. Barr

Steve Spence usually writes this column from his base at Green-Trust. However, as many of you already know, a changing of the guard is underway at GT. Steve and his family are moving back to "civilization" so that Steve won't have an 8-hour commute to his new job.

The caretaker's duties at Green-Trust will be assumed by Greg and Chandra, who will also take over the writing duties for this column. Steve has promised to introduce Greg and Chandra to us in the June issue of ESSN. Steve has some new projects in the works already and he'll be writing about them, and his progress on them, right here in the e-pages of ESSN.

So, be sure to join us next month when we'll meet the new caretakers at Green-Trust and we'll hear a bit about Steve's new projects. ldb

Do Your Part!

Conserve Energy
&
Resources

Let's All Help
Save Planet Earth

About Our Cover

Our cover image this month was designed to showcase a couple of articles that I intended to run in this issue. As it turned out, our cover image this month is actually acting as an advertisement for articles which will run next month.

The desk lamp is a $7 (or so) piece I bought at my local Wal-Mart and converted to an LED desk lamp for 12 VDC operation. It turned out magnificently and I'd planned to tell you all about it this month. But a whole lot of things got in the way and it just didn't happen. We're shooting for next month. It's a neat project and works great. I think you'll like it.

The pic of Steve with the Appleseed Biodiesel Processor is almost embarrassing, since we used it last month too. Too many things happened too quickly in Steve's World for him have the time to finish the article for last month -- or for this month. You can see a bit more about what Steve's up to in the column immediately to your left. We will have the article on the Appleseed Biodiesel Processor and it WILL be worth waiting for. Guaranteed.

It's not always easy for a small group of folks, all of whom have 'real' jobs and other obligations, to remain exactly on schedule and operating according to plan. This month is a classic example of that fact. Things didn't turn out exactly the way they were planned and we were (well, I was) a day late getting the issue posted. How does that old saying go: "The mind was willing, but the body had the flu"? Thanks for waiting for me to get better. ldb

Introduction To Biodiesel Chemistry and Washing A Test Batch

by Maria "Mark" Alovert

In Part 1 of this series we explored making a test batch of biodiesel. Hopefully you have had 'separation' whereby the batch turned into biodiesel and glycerin at the end of the experiment (if it failed, try again with better quality restaurant oil for now, or use new oil, or check your scales and measurements).

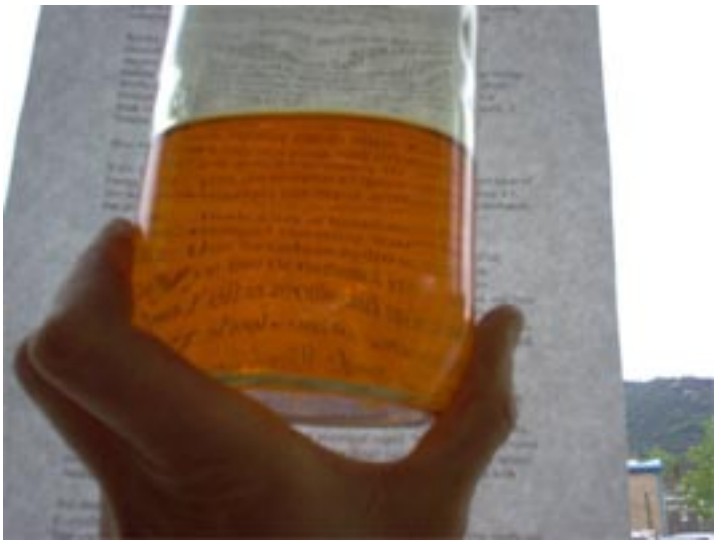
In this month's article, I'd like to introduce you to some chemistry and the next step in preparing a batch of biodiesel- washing out the water-soluble contaminants that you have made along with the biodiesel. Next month we'll discuss quality tests and fixing 'emulsions' or other washing problems in more detail.

Science Anxiety Pep Talk:

At this point some of you may groan at the thought of chemistry and claim you don't remember any. Fortunately, you don't need to learn very much chemistry to make and troubleshoot biodiesel. To get the most out of it, you should take a moment to learn what reacts with whom and what conditions govern the whole business.

Biodiesel follows a fairly simple set of rules- with the unfortunate problem that there is usually more than one chemical present and more than one reaction present so you have to do some thinking and experimenting to deduce what rules are being followed (for instance waste vegetable oil is actually two or three chemicals- oil, free fatty acids, and water. Likewise, the biodiesel process makes biodiesel, bound and free glycerol, and soap).

Once you get over the learning curve, making biodiesel is very much like cooking. There's chemistry involved in baking a cake correctly but your great-grandma probably didn't call it 'chemistry'- if a new cake recipe didn't rise right, she just knew that the rules said she had to add more leavening next time.



You can read thourgh properly washed biodiesel. We'va slso uploaded a couple of web pages which introduce additional information on how to wash a test batch using mistwashing or bubblewashing: http://www.localb100.com/testwash/

Here we go:

If this is your first issue of ESSN, go back to the internet and download the April issue of Energy Self-Sufficiency Newsletter (www.rebelwolf.com) for an article on making a 1-liter test batch of biodiesel, and read the web pages (www.localb100.com/testbatch) that go along with it.

Shake It Up:
Last month you measured and warmed up some oil, measured methanol and lye and mixed them together, and then mixed that 'methoxide' into the warm oil. This took place in a bottle 'reactor' and you just shook the sealed bottle for 10 minutes to mix the oil and methoxide together. After 12 hours or more of glycerin settling, you can start with the washing or testing process.

In The Last Episode, Our Hero Lost its Glycerin...
Biodiesel is made by removing glycerin from oil and reacting the remainder of that oil with methanol. This has to be done in the presence of lye or KOH. The 'caustic'- the lye or KOH - acts as a catalyst and doesn't actually become part of the biodiesel. The oil splits up into two liquids- the biodiesel, or fatty acid methyl

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Biodiesel . . . cont.

esters, and much heavier glycerol (or glycerin) the unwanted thick portion of vegoil. Tthis makes the oil more runny because the glycerin is part of what makes oil 'thick' or viscous. The resulting biodiesel resembles diesel fuel in viscosity, and sprays out of a fuel injector better than thick vegetable oil could.

But there was a subplot...

Everything in biodiesel chemistry seems to involve mixtures of liquids, and you rarely see 'just one' pure chemical or 'just one' reaction.

I already mentioned that waste restaurant oil isn't just oil- it's usually oil, free fatty acids, and some water. Likewise, when you mix methanol and NaOH/KOH to make methoxide, you form some water. Lye, vegoil, and water are all ingredients in soapmaking.

So, while the vegoil was reacting with the methanol, there was also a soap side reaction happening- lye or KOH react with free fatty acids to form soap and water. The FFA are present in waste oil, or could be formed from new oil in small amounts during the biodiesel process. This soap reaction ALWAYS happens to some extent, even if you didn't see it make solid 'glop' like in the photo.

Complicating matters, we used more methanol than what was needed, so our resulting biodiesel mixture has some excess methanol left. And even after settling of most of the glycerol, there's still a little bit of glycerol that doesn't want to settle, which can cause some problems in your vehicle. That glycerol is in the biodiesel because of the extra methanol, which acts as a co-solvent for both biodiesel and glycerol. The methanol makes the biodiesel less safe to handle and the glycerol and soap could eventually settle in someone's fuel tank.

So the next step in biodiesel processing is to remove these contaminants. We can do this by adding water to the biodiesel temporarily, to wash out the methanol, glycerol, soap, and any leftover NaOH/KOH.

Let's look for a minute at the variations of reactions and ingredients we deal with:

Oil is called a triglyceride, and an oil molecule had two kinds of parts that we are concerned with: a section made of glycerin, and a section that looks like three separate fatty acid molecules, all bonded together chemically. It's like a capital 'E' shape, with the upright part of the E being a "glycerin backbone" and the arms being fatty acids. Our task is to remove the glycerin and to bond methanol molecules to the fatty acids. One oil molecule can make a maximum of three biodiesel molecules out of it's three fatty acids, but it can also make some biodiesel and some 'bound glycerol' instead. More on bound glycerol later.

Fatty acids give an oil its properties – olive oil has different fatty acids than lard, for example. We make the biodiesel out of the fatty acids, not the glycerin, and that means that the properties of the different oils we use (like its color, and its tendency to freeze at different temperatures), will carry over to biodiesel.

Bound glycerin:

However this happens slowly- the oil can be broken down piece by piece- one fatty acid can fall off the 'oil' molecule to make one biodiesel, but that still leaves us two fatty acids bonded to one glycerol (a capital F instead of a capital E?). The 'F' shaped thing is a diglyceride- a molecule halfway between biodiesel and oil. It can be further broken down to form another biodiesel molecule and another 'not-quite-oil' molecule, called a monoglyceride (the "F" has lost another horizontal bar at this point, but still has one fatty acid and one glycerol backbone). Then if the reaction continues, the last fatty acid will fall off, leaving you a 'free glycerin' (the dark layer that fell out of your liter batch last month hopefully) and three biodiesel molecules (the amber stuff that floated on top). Our job is

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Biodiesel . . . cont.

to maximize how much of the oil becomes biodiesel and free glycerin, rather than stopping at a mix of biodiesel, monoglyceride or diglyceride.

Now let's discuss properties and visual appearance for a moment.
-Oils aren't water-soluble.
-Monoglycerides and diglycerides are oily, so you can't usually separate them from biodiesel or from the original oil- but if you have enough of them, they can do interesting things with water- they're emulsifiers and can help mix up oil and water into a sort of mayonnaise. Soap and oil and water can do the same thing.
-"Free glycerol" is water-soluble and therefore won't mix with oil- it'll fall to the bottom of a container of oil. Monoglycerides and diglycerides mostly stay in the oil portion. -Biodiesel is an oil and doesn't mix with water or glycerin very well either, although methanol can bind the two together ("co-solvent" in both glycerol and biodiesel).
-If your reaction went only partially to completion, you may have a layer of free glycerin on the bottom, and then a layer of biodiesel, monoglycerides, and diglycerides, with maybe some oil mixed in for good measure. This is usually what's in a homebrew biodiesel mix.
-Once in a very great while, you can get what's called 'crystallization of monoglycerides', which is when certain types of monoglyceride (from saturated fats mostly) falls out into a third layer, grayish, and like an extra-large layer of glycerin, in several unexciting colors. Monoglycerides and diglycerides don't' usually get removed in 'the wash', so sometimes this crystallization problem can happen after the biodiesel is washed. This is one major reason for making a more 'complete' biodiesel – if the crystallization happens in a car fuel tank, it can cause someone an unexpected fuel filter clogging, hard starts, and possibly clogged injectors. It's an uncommon problem though.
-Over time, soap can form a 'disc' or layer between the glycerin and unwashed biodiesel too, but soap can also exist as a completely invisible substance in both layers.
-If you made biodiesel last month and it sat for a few weeks, you may have noticed that the bottle was slightly cloudy for a few days and then one day became very 'clear' and see-through (if you didn't keep shaking the glycerin back into it that is). That is caused by the last of the glycerin droplets slowly falling out of the biodiesel layer. This is a lot easier to wash or to use than freshly made, cloudy biodiesel. Washing is a sort of shortcut to this prolonged settling, and washing also removes methanol to make the biodiesel safer to store.
-generally, a 'clean' separation between glycerin and biodiesel– doesn't' mean anything. Whether soap is visible or not, is dependent entirely on what kind of oil you used and what kind of catalyst you used (NaOH versus KOH). Crystallized mono/diglyceride is uncommon, and usually mono/diglyceride is invisible.

We'll return to the topic of quality control and monoglycerides/diglycerides in a future issue (I don't' want to overload anyone with Science Anxiety yet), in the meantime, just be aware that you don't usually see any of the oily contaminants 'visually' and there's no easy test for them at the low levels they're found at in 'better' biodiesel.

Cleaning up the fuel:
You generally want to get rid of:
-glycerin droplets because they clog filters or settle in a fuel tank,
-soap out of a concern about it not burning completely and forming ash that can damage injectors or other parts,
-methanol out of a concern about safety in storage
-catalyst out of a concern for solid abrasive particles especially in high-pressure fuel systems
You can't really get rid of monoglycerides and diglycerides but the unpredictable 'crystallization' problem is a reason to try and fine-tune your process to avoid making them in the first place. Invisible mono/diglycerides can cause injector clogging under some circumstances.
-Crystallized mono/diglycerides and free glycerin both behave worse in cold weather than just the biodiesel alone does, causing hard starts.

The water-soluble contaminants can be removed by a water wash, or, with the exception of methanol, the same contaminants can be removed by gravity using a very long settling period before the fuel is used (3 weeks or more).

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Biodiesel . . . cont.

How washing works:

Washing the biodiesel: your objective is to bring water and biodiesel into contact, without mixing it too vigorously. The biodiesel contains soap which you're trying to wash out. If you overdo the agitation during the wash, the soap and oily biodiesel and water can make an 'emulsion' – a stable 'mayonnaise' which won't separate water very easily and can't be used as fuel until the water's removed. Washing usually entails some way to make the two liquids come in contact as much as possible (without overagitation) - either making droplets of water go through the biodiesel, or something similar. Once the danger of emulsification is gone in the first steps of washing, the rest of the wash process can be more vigorous to maximize the cleaning process.

Emulsion:

It's quite common to form a middle layer of cream-colored emulsion between the water and the biodiesel layers- emulsion is mostly biodiesel, so don't throw that layer away- just drain the soapy water from beneath it. The emulsion layer will eventually separate if you keep adding water and continue to 'wash'. Be aware that a major cause of emulsion happens if the glycerin layer gets into your wash tank as the glycerin layer contains more soap than the biodiesel layer does, so contaminating the wash tank with a little glycerin introduces a LOT of extra soap.

Appearance:

Biodiesel will change colors a few times during the wash, becoming opaque or murky, and it's not ready to go into a vehicle until it's perfectly see-through again. The murkiness, creaminess, or opacity are all

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Biodiesel . . . cont.

caused by water droplets in the biodiesel (although chilling your biodiesel will also make it look murky right before it gels completely, and this is a different phenomenon called cloud point)

Instructions:
There are a couple of ways to wash your liter batch. The easiest is to do a bottle wash. Don't be shocked- the bottle wash will take a lot more water than you will actually use in the techniques you use for a full-size batch:

1> drain off all glycerin- I just pour the biodiesel off slowly, through a funnel, into another bottle, and I don't' worry about leaving a little bit of biodiesel behind on top of the glycerin. A little glycerin in the biodiesel can cause a problem.

2> Gently add some warm water to the biodiesel.

3> Rotate the bottle end for end, and do this until the water starts to take on a little bit of white/soapiness (this may take a few minutes). Resist the urge to shake it- you definitely want to avoid vigorous agitation at this stage.

4> Turn the bottle upside down and crack the lid open to start draining the soapy water. Squeeze the bottle gently or else it'll 'glug' some air and mix up the two layers again. If you're using a soft drink bottle with a narrow neck, you can plug the opening with your thumb instead of using a lid. (Picture on next page)

5> Add more warm water and repeat the same process. You may be able to do 'mildly' more vigorous sloshing of the bottle this time (don't' shake it!). It's also possible that if your fuel is very soapy (such as: when you've used higher FFA oil and/or oil with water in it, the Dixie Cup Scale let you down and your measurements are off, or you got glycerin into your wash, or the opposite problem) or has extreme underreaction with high levels of monoglycerides and diglycerides (causes: too little lye, too little methanol, water in the oil, cold oil, or a combination of the above), or both soap AND extreme underreaction that you will have some emulsion formed from the first wash. Don't throw it away- it's mostly biodiesel.

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Biodiesel . . . cont.

After the second or third wash water change, you can shake it a little more vigorously, and it'll separate into a couple of layers more easily.

In the end, you should have clear water no matter how hard you shake it (the fuel will still be a little murky). This might take 5 or 6 or 7 or more wash water changes. In the full-size batches you make later, you'll use different washing techniques which won't require this much water relative to the biodiesel.

Your last wash water change should be shaken hard for several minutes to cause as much contact between the water and the remaining soap as possible.

Drying the washed biodiesel batch:
When washing is finished, you can dry the test batch by one of several ways: letting it settle with the top open, or heating it up.

Left: washed, not yet dry (cloudy)Right: fully dry fuel (clear)

Heat:
Heat it up on the kitchen stove (ask your family first! It may get smoky!). The cloudy fuel will go clear when warmed. Pull a little sample out and leave it to cool- you'll notice that the sample may cloud up again at a certain temperature. This is the temp where water comes out of solution (harmless when in solution) and becomes free water droplets (visible, and probably not good for an engine when in the free water state). If you keep heating the rest of the liter you'll see some bubbles- that's water boiling off (stir it). Please note that you shouldn't heat biodiesel UNLESS it's been washed first- unwashed bio contains methanol which will form hazardous fumes when heated! Unwashed biodiesel no longer contains methanol. Keep warming it- it'll eventually boil off the water and should stay clear when cooled.

Settling/evaporating:
More common than heating is to just let the biodiesel sit, open to the air. I'd suggest putting it into an open container (a flat pan or another cut-open drinking water dispensor works well) for a day or two (keep pets out of it, it smells yummy to dogs) and let it evaporate the water. It will eventually be clear (sometimes

Continued on Next Page

Biodiesel . . . cont.

in a few hours, sometimes in a few days, depending on how well-washed it is). That's when the water is all gone.

You should be able to see through a quart jar sample well enough to read a newspaper

You're done!

You can put it into a jar to pass around to your admiring friends, or use in an engine to make B-002 or some similarly miniscule biodiesel blend. Generally we filter fuel before adding it to the vehicle to remove micro-abrasives- but a liter or two probably wont' do you any damage. You can filter your liter through several coffee filters if that makes you more satisfied.

It is unlikely that any quality problems with your fuel would cause any damage just from adding a liter or two to your fuel tank of diesel fuel. We'll cover the topic of quality effects on a diesel in a future issue, but for now, don't worry about whether 'it's OK' to add your washed/dried biodiesel to your fuel tank. However, make sure you understand how to look for 'dry' fuel and don't put in anything murky.

For information on other test batch washing methods- mistwashing andbubblewashing- please see www.localb100.com/testwash

Maria 'Mark' Alovert is the author of Biodiesel Homebrew Guide,available through www.localb100.com/book.html

Biodiesel Tutorial: www.localb100.com/cbt

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