



Biological Systems Engineering

BSE Announcements—Winter 2006

BSE Named a University Exemplary Department!

In this issue...

- Injury Cost Sheets.....2
- Biodiesel Publication.....2
- Welcome John Ignosh.....2
- BioEnergy Program.....3
- Crazy idea of the year.....4
- VCE Energy Website6
- eXtension's HorseQuest.....6
- Winterizing Equipment7
- Baler - Winter Tune-Up...8-9
- Drivers for Winter.....9
- Fire safety10
- Checklist: Welding11
- Safe raking12
- HydroPower Potential13
- Agricultural Injuries.....14
- Soil Compaction15

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in Seitz Hall*

Engineering Update



**Biological Systems Engineering
December 2006**

To: Extension Unit Directors, Extension District Directors, Extension Program Directors, and ANR Agents

Dear Co-Workers: Engineering Update is a joint effort of Biological Systems Engineering and other interested agents. Subject matter areas include timely information on water quality, natural resource management, TMDL, air emissions, animal waste management, machinery management, precision farming, application technology, farm safety, energy, engineering education, and technology. Please use this information in your on-going Extension programs and circulate to all Extension staff. Engineering Update is electronically accessible via the VCE Intranet World Wide Web site



Virginia Cooperative Extension

A partnership of Virginia Tech and Virginia State University www.ext.vt.edu



VIRGINIA STATE UNIVERSITY

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NIOSH Fatal Occupational Injury Cost Fact Sheets

A new series of fact sheets on the NIOSH Traumatic Occupational Injury Web page estimates the cost to society of a workplace fatality using the cost-of-illness approach. This approach combines the direct and indirect costs to produce

an overall cost of an occupational fatal injury. Fact sheets are available for ten industry groupings, including agriculture, forestry and fishing; mining; construction; services; manufacturing; transportation, communications, electric, gas

and sanitary services; wholesale trade; retail trade; finance, insurance, and real estate; and public administration.

<http://www.cdc.gov/niosh/injury/traumapubs02-04.html>

New extension publication on Biodiesel

An extension publication (442-880) on biodiesel fuel has been published by Zhiyou Wen, Bobby Grisso, Jactone Arogo, and David Vaughan in October, 2006. The publication is in response to the recent increasing interest across the nation in using domestic, renewable bioenergy. In Virginia, farmers and transportation fleets use considerable amounts of diesel fuel in their operations. Biodiesel is an excellent alternative fuel for diesel engines.

The purpose of this publication is to introduce the basics of biodiesel fuel, address some myths, and answer some questions from biodiesel fuel before farmers and fleet owners.

It covers (1) the ASTM standard for biodiesel, (2) the performance when using biodiesel, (3) engineer warranty of using biodiesel, (4) storage and material compatibility issues, (5) cold temperature concerns, (6) incen-

tive and tax credits, and (7) current production and usage of biodiesel in the U.S. and Virginia.

Another publication (442-881) on how to make biodiesel for a small/farm scale is being developed by the authors and will be in press by January 2007.

<http://www.ext.vt.edu/pubs/ageng/442-880/442-880.html>

(from Zhiyou Wen)

New extension specialist-agent (John Ignosh)

Mr. John Ignosh joined the Northwest District Office of Virginia Cooperative Extension as an area specialist on November 10, 2006. John's work at VCE focuses on the efficient utilization of agricultural byproducts. He holds an undergraduate degree in environmental science from Ohio State University and a master's degree in forest resource management from the University of Minnesota. Prior to his work with Virginia Cooperative Extension, he performed air

quality research with the University of California and federal environmental agencies. He also served as a resource extension agent with the U.S. Peace Corps in Guatemala from 2002 to 2004. At VCE, John will closely work with faculty at BSE to inventory the agricultural byproducts in Virginia, and develop processes to convert those byproducts into value-added products. He will also participate in various outreach activities, and facilitate the establishment of strategic

collaborative partnerships.



Bioenergy Engineering Education Program (BEEP)

BSE Extension Specialists have received many inquires about bioenergy and other energy related issues from extension agents, farmers, and the general public. The questions and issues range from what bioenergy is to how to produce and utilize bioenergy. We have responded to these inquiries by developing a Bioenergy Engineering Education Program (BEEP) (see figure below).

The objective of the BEEP is to

provide participants with basic knowledge about bioenergy, bioenergy production, and bioenergy utilization in Virginia. BEEP covers the following topic areas: bioethanol, biodiesel, bio-oil, gasification, combustion, and biogasification. The program takes about two hours to deliver.

We have a training scheduled for January 18, 2007 from 8:00 am to 9:30 am as part of 2007 VCE Annual Staff Development Conference, in Charlottesville.

We are willing to bring the training session to your area, so please let us know if you would like us to do this program for you and your clientele.

Contact:

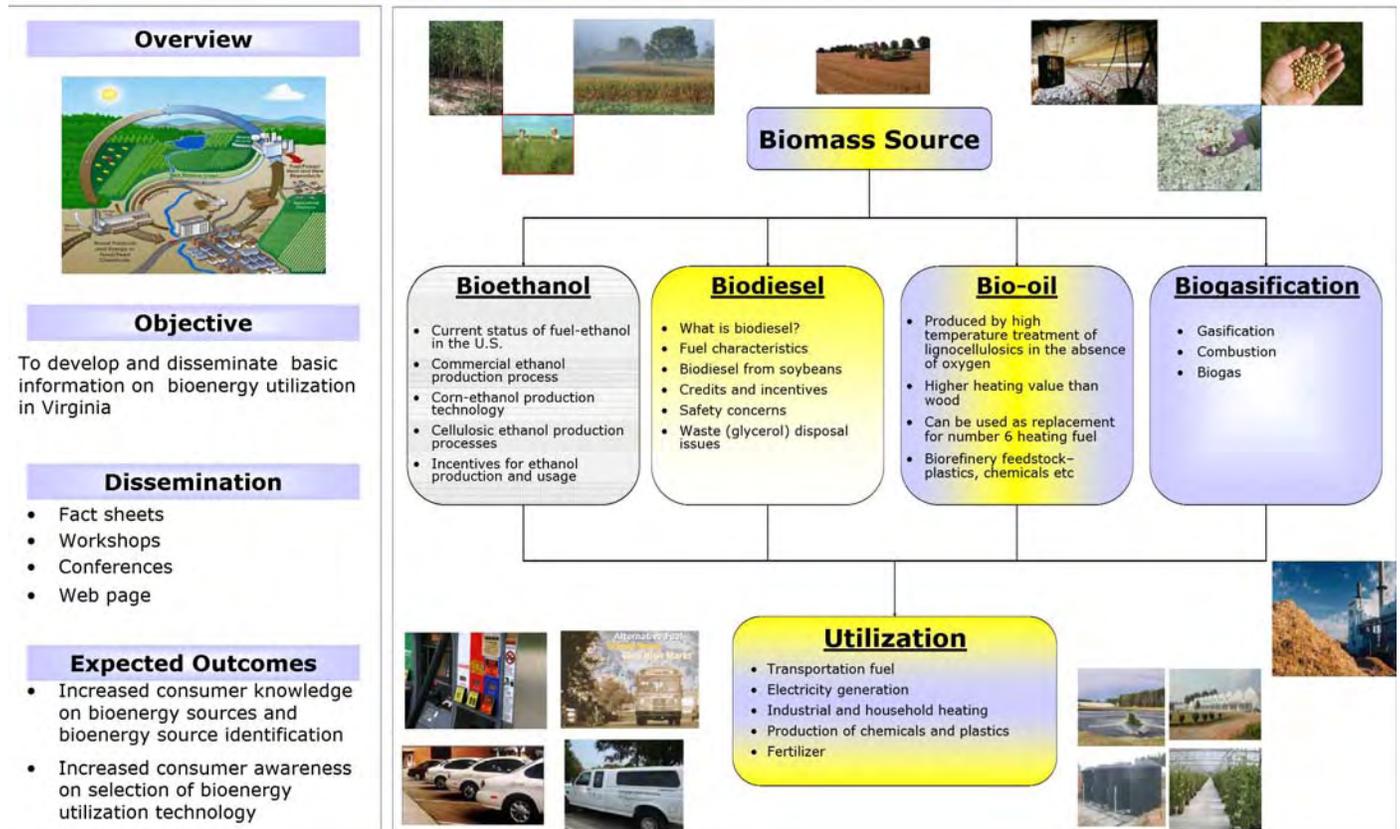
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Bioenergy Engineering Extension Education Program



Jactone Arogo Ogejo and Zhiyou Wen



Bioenergy Engineering Education Program (BEEP)

Crazy idea of the year

(adapted Esquire, December 2006, Volume 146, Issue 6, by Christine Ajudua)

Per-cival Zhang, a modest professor, drives a safe, fuel-efficient black Hyundai Elantra. It gets him to and from his biochemical-engineering lab at Virginia Tech, where he is quietly working on some rather unspectacular solvents and enzymes that could change the world.

In a field defined by explosive chemical reactions and exorbitant costs, Zhang has formulated a chemical process that can a) turn agricultural waste into cheap cellulosic ethanol and b) possibly solve the "hydrogen puzzle"—the holy grail of alternative fuel.

Zhang, speaks softly and with a thick Chinese accent as he explains with considerable restraint that "pollution is a serious problem" in his home country; he moved here in 1996 to pursue a career in alternative energy and has spent the last decade developing a better way to produce ethanol from renewable raw materials.

Most ethanol today is derived from corn kernels, which Zhang sees as a waste of good food; there's plenty of energy-rich sugar in the cellulose of corn's inedible stalks, leaves, and cobs, among other types of biomass. But the cellulose is locked tight within the plant cell walls. Stan-



dard scientific thought has been to break those cells down by basically blowing them up—under high pressures and temperatures (up to 390 degrees) in special reactors based in billion-dollar biorefineries. Then the cellulose has to be loaded up with expensive enzymes to convert it into fermentable sugar. All of that translates into really high costs and relatively low yields.

Zhang has a different idea. "No one thought to use a solvent," he explains. Zhang copatented a recyclable biochemical pretreatment that generates amorphous cellulose and a few biodegradable coproducts. Operating under normal atmospheric pressure at about 120 degrees, his milder reaction requires no special facilities, and the cellulose recovered is more easily converted to sugar. All of this

means that his process costs much less and yields more.

Zhang's patent has already been licensed to a bioethanol start-up. He foresees networks of small, local biorefineries to avoid large transportation costs. But this is just the beginning of a bigger vision: He believes that "the future energy carriers are hydrogen."

Why hydrogen? It's high in energy and clean—a hydrogen-powered fuel cell would be several times more efficient than a gasoline-fueled engine and would emit only pure water. But hydrogen's an extremely bulky gas, requiring storage tanks that are way too large for mobile application. Distribution would call for huge investments in infrastructure, not to mention new vehicles. And then there's the production problem: While hydrogen is abundant, it's rare in pure form, and the energy needed to extract it by conventional methods—to reform natural gases, gasify coal, electrolyze water, or burn hydrocarbons—can be less efficient and more polluting than petroleum.

Zhang, however, has a simpler solution, he's making hydrogen from sugar.

His recipe starts with his ethanol-pretreatment process to re-

Crazy idea of the year (cont)

lease sugar from cornstalks, switchgrass, or other feedstock. Next he adds water, using the energy stored in those sugars in combination with a novel enzymatic system to divide the molecules into hydrogen and oxygen. So far, he's had high yields without inputting extra energy or emitting extra carbon dioxide. Moreover, "reaction conditions are modest, so you can put the reactors anywhere" - cell phones,

laptops, cars, airplanes, and submarines.

"We do not store and distribute gaseous hydrogen any more," says Zhang. "We can do it through solid sugars." He envisions a future in which "sugar cars" would fuel up at "sugar stations," using much of our current infrastructure: Drivers would pump solid sugar into the tank, a converter would extract hydrogen on de-

mand, and a fuel cell would convert the hydrogen into electricity.

Zhang's formula for "sweet engines" is being taken quite seriously. Virginia Tech and Oak Ridge National Laboratory have applied for a joint patent. He's running tests at Oak Ridge through the spring, and not about to tell too much. But he will "dare to say" one thing: "This new technology could change the whole world's energy future."

PLANS

In response to numerous requests, building and facility plans are now available for download from the Virginia Cooperative Extension (VCE) Intranet. Plans are categorized under five main categories: Forage Storage and Feeding, Grain Handling and Feeding, Beef, Horse, and Sheep. You will need Adobe Acrobat to download these files. For the building and facility plans, as well as additional resources, please visit:

<http://www.ext.vt.edu/vce/anr/bse/index.html>

Household Drinking Water Program

BSE Specialist Brian Benham will present a two hour workshop entitled *Understanding and Conducting a Household Drinking Water Program* at the upcoming VCE 2007 Annual Staff Development Conference in Charlottesville, VA.

The objective of the BSE Household Water Quality Program is to protect the health of rural Virginians by improving the quality of individual water supply systems. The program achieves this objective by educating Virgini-

ans who use private wells and springs as sources of water about: 1) the quality of their water, 2) strategies to address water quality issues if they exist, and 3) ways to prevent future water quality degradation.

Those attending this session will learn about:

- the current status of the BSE Household Water Quality Program,
- existing extension publications that document results from previous county-based programs,
- existing extension publications that address ways to address water quality problems and plans for

future publications,

- plans for a train-the-trainer in-service where agents will learn how to conduct household water quality programs more autonomously with the support of BSE staff and specialists,
- plans for analyzing historic program data to examine water quality trends and refine program direction,
- the formation of linkages with faculty at Virginia State University who are interested in developing a similar household water quality program for 'under-served' clientele, and
- plans to develop a Master Well Owner network in Virginia.

AEM Pictorial Database On-line

The Association of Equipment Manufacturers (AEM) has completed phase one of a database of "industry recognized" pictorial illustrations for voluntary use in the design of equipment safety signs, manuals and

other training materials. AEM developed this database to promote greater consistency and clarity among pictorial images so they are more recognizable by industry workers, thus enhancing safety. The pic-

torials are offered free of charge to anyone, saving manufacturers and others the time and cost of developing their own graphics.

<http://www.aem.org/News/AEMNews/Details.asp?P=468>

(adapted by Bobby Grisso)

Energy Resource Guide for Virginia

Virginia Cooperative Extension searched for the best available web-based resources on energy and compiled a recommended listing representing various universities, state and federal agencies, and energy related organizations. The Energy Resource Guide for Virginia provides Virginia's households, farms, small business/industry employees, and middle school teachers and students with an electronic tool that allows individuals to review an array of energy information quickly.

The Energy Resource Guide for Virginia is reviewed and updated at regular intervals. FIRSTGOV for Consumers is an excellent location to find federal information resources on food, health, product safety, your money, and transportation.

For example, as agricultural produc-

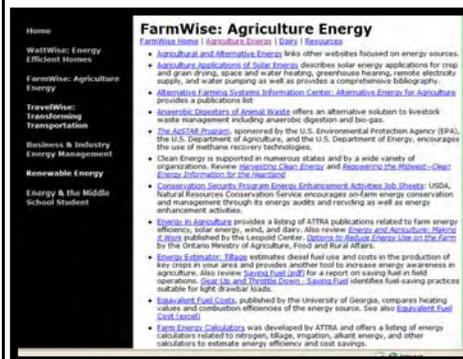
ers consider alternative energy for their farms, a useful resource is FarmWise. FarmWise: Agriculture Energy provides you with references to the AgSTAR Program sponsored by the U.S. Environmental Protection Agency and the U.S. Department of Agriculture. The ATTRA, National Sustainable Agriculture Information Service's website, offers a discussion on anaerobic digestion of animal wastes.

Also discover options for recovering beneficial products from dairy manure in the Dairy Waste Anaerobic Digestion Handbook. Websites for energy estimators will calculate estimates of diesel fuel use and costs in the production of key crops for your farm.

Not only will you find information on alternative energy but also informa-

tion on livestock production facilities, greenhouse operations, and wineries. These resources can be found at: <http://www.ext.vt.edu/energyguide/farmwise/energy.php>

Developed by Martha A. Walker (walker53@vt.edu), Ph.D., Extension Community Viability Specialist, Central District. Should you have recommendations for additional material, please e-mail walker53@vt.edu.



Horse Information Abounds at eXtension's HorseQuest Web Site

Those looking for the latest news and information about horses need look no further than HorseQuest, a new interactive Web site from the national eXtension project. The Web site at www.extension.org/horses contains information ranging from finding the best horse for a child to riding techniques, horse diseases, nutrition and care.

It's the best of the best university research-based education on horses. HorseQuest provides frequently asked questions; ask the expert features, online chats, news, events, and in-depth learning lessons on equine-related topics.

The frequently asked question feature includes the most commonly asked

questions and peer-reviewed answers on horse ownership and care. The "ask an expert section" offers equine expert answers within 48 hours of submission. Online chat sessions are scheduled routinely with experts in each subject area matter. News and upcoming events offer something nearly everyday that is happening in the world of horses, while the learning lessons offer interactive lessons on the costs of horse ownership, selecting the right horse and more.

HorseQuest is only the beginning for eXtension. Twenty more sites will come online in the next few months – each of them organized around a community of interest designed to mine extension experts' knowledge from across the nation and represent it in a

dynamic, accessible Web-based format.

The new U.S. land-grant university project – eXtension, pronounced e-extension – will continue to bring resources from the nation's largest non-formal education system, the Cooperative Extension Service, to broader audiences via the Internet.

Other eXtension Web sites coming online soon include financial security, imported fire ants, disaster response, parenting, rural entrepreneurship, horticulture and wildfire damage management. For more information about eXtension, visit the Web at www.extension.org

(adapted by Bobby Grisso)

Winterizing Farm Equipment

Take steps now to save time and money later!

After harvest is an excellent time to give your tractors and other equipment the once-over in preparation for winter use or storage. These measures will not only ensure that equipment is protected from the cold weather during the nonactive months but that the equipment will be ready to go when needed. This will help avoid costly delays and possible downtime next spring.

Tractors

Consider the follow list of maintenance items when preparing tractors that will see limited use during the winter months:

- Clean and inspect the machine
- Check all fluids, especially antifreeze
- Check belt tensions
- Grease necessary grease points
- Check and clean or replace all air filters
- Check tire condition and air pressure

If the tractor will be used in the winter, do all of the above and do the following:

- Use only No. 1 diesel fuel to prevent gelling. Most fuel suppliers offer a winter mix of fuel. A fuel additive will prevent gelling and promotes easier starting.
- Make sure cold-starting aids are properly functioning. Ether injection, glow plugs, intake warming grid and block or antifreeze heater are helpful.
- Test cab heater for correct function and control.

Combines

- Clean the combine with all openings ajar, using compressed air then run the machine for 5 minutes
- Lubricate all grease points and run for another 15 minutes
- Change oil and filters
- Check and replace any worn or damaged parts
- Put blocks under the axles and lift the combine to relieve pressure from the tires
- Remove batteries and recharge
- Remove most of the fuel
- Remove chains, wash in solvent and soak in oil
- Retract all hydraulic cylinders and cover exposed areas with grease

Planters

- Remove all seed, including any metering units
- Relieve brush tension by loosening seed disc knobs
- Check and replace brushes in the seed meter
- Lubricate all grease points
- Clean all chemical hoppers, tanks, tubes, spreaders, discs and other areas.
- Clean planter population sensors
- Clean inside of air ducts
- Check hydraulic hoses for leaks and abrasion. Replace if necessary.
- Follow storage instructions in the operator's manual for removing seed plates and other components to relieve pressure on seals, brushes, and seed plates

Tillage implements

- Remove soil and apply appropriate rust preventive
- Store with soil engaging components raised or on blocks to prevent rust

- Hydraulic cylinders should not be stored fully extended

Lawn Equipment

A well-maintained lawn mower should give you years and years of trouble-free service -- especially if it is well taken care of.

- Empty the fuel tank. Gas that is left in the fuel tank over the winter will eventually go "stale" and could harm the engine. To burn any remaining fuel, start the engine several times until it won't start anymore
- Remove the old spark plug. Place a few drops of engine oil into the empty socket, and pull the starter cord a few times to distribute the oil into the engine. Install a new plug -- but leave it disconnected until spring
- Drain and replace the engine oil.
- Sharpen the mower blade
- Clean the mower. Turn it over, and scrape away any matted grass clippings with a putty knife
- Clean grass and dirt from between the engine cooling fins
- To protect against rust, spray all metal parts with WD-40
- Replace the air and gasoline filters. Replacement filters should be available where you purchased the lawn mower
- Tighten all exposed screws and bolts
- Store the lawn mower in a dry place

Where possible store equipment -- particularly tractors, combines, planters, drills, and balers - to improve equipment performance and resale value.

(adapted by Bobby Grisso)

Round Baler – Winter Tune-Up

Time spent inspecting and adjusting your round baler this winter can save costly downtime during the season.

It goes without saying that a properly maintained round baler is going to perform better in the field. But there are other reasons to make sure your round baler is in top operating condition. A well-maintained baler demands a better price on the used market or at trade-in time. Timely maintenance also extends the life of a baler, which helps reduce your cost of production.

If nothing else is done before you park your baler at the end of the season, you should at least clean the baler and relieve the tension on the forming belts. On most models, this is as simple as activating the hydraulic dump valve. However, it's easy to do on models with spring tension, too.

In most cases, it's as simple as opening the tailgate, inserting a pin in the belt tension arm as explained in the operator's manual and closing the tailgate. The pin will contact the frame as the tailgate closes, taking the spring pressure off the belts.

Blow any remaining crop residue off the machine and out of hidden crevices, where it can collect moisture and lead to rust or corrosion. If an air compressor isn't handy, you might want to use a leaf blower instead.

If the bailer monitor isn't left inside a tractor cab, move it from the

machine and store it in the shop or some other dry location.

Also check the connection and wiring harness to make sure they are clean and the wiring is free of nicks or cuts. Don't wrap the connections with plastic, because that can lead to moisture condensation and corrosion. It's better to just leave them exposed.

All of those steps, however, are only meant to prepare the baler for storage. There are several other procedures that should be completed prior to first use in the spring.

- Start by checking the condition of belts, chains, and sprockets
- Start with a thorough cleaning, using a pressure washer or air compressor
- Inspect the bale monitor and wiring
- Check gearbox fluid levels and, if applicable, hydraulic reservoir fluids
- The belt tension adjuster knob enables you to release belt tension
- Adjust for proper tension while greasing and checking chains and sprockets
- Jiggle teeth in every row to check for worn teeth and pickup bearings
- Make sure forming belt lengths vary no more than 2 inches from belt to belt
- Check flaps that are attached to the starter rolls; replace if needed
- Check PTO for shaft damage or damaged shield
- Check fluid levels in gearboxes and in the hydraulic reservoir on an automatic baler with a hy-

draulic system. Follow the operator's manual and change the breather filter and the oil filter once a year on any baler with a self-contained hydraulic system

Check the length and condition of the forming belts. If the belts are not all within 2 inches in length of each other, the errant belts should be adjusted accordingly.

Replace the forming belt lacing pins at least once a year. They don't have to replace the lacing that often, but they should at least replace the lacing pin.

Of the dozens of round balers he has sold in recent years, nearly 70% come back to his shop each year for annual maintenance and tune-up. Based on those experiences, the dealership has developed a set of steps to follow during a baler check up.

Replace the flaps that are attached to the starter roll on many round balers. Replacement after every 1,000-1,500 bales will make it much easier to start a new bale.

Replace damaged shield on the PTO shaft. Some think of this primarily as a safety issue; but it's also a reliability issue. If the plastic shield that covers the shaft gets damaged, it allows dirt and debris to collect, or the tubes that slide in and out on turns. That leads to problems with the universal joints.

Check sprockets, chains, and drive belts for wear. Run the baler for a few minutes and then shut it down, using a heat-sensor gun to

(Continued on page 9)

Round Baler – Winter Tune-Up (cont)

(Continued from page 8)

check for any bearings that might be overheating.

Assure the cam follower bearings and tooth shaft bearings are in good shape, since round-baler productivity starts at the pick-up. Replace missing, bent, or broken teeth.

Check the condition of drive chains. It's a lot less expensive to replace a chain than to wait and have to replace the sprocket, too.

Of course, that goes for a number of things. Your investment in money and time this winter can save a lot more of both commodities during the season. It's hard to put a price on the cost of downtime.

Use a Checklist

It's always good to have a checklist when performing an inspection of any kind.

Transport Equipment

- √ Ensure all lights, reflectors and SMV symbols are in place and operating
- √ Check wheels, tire condition and inflation
- √ Inspect hitch, draw pin and safety chain

Controls

- √ Check all indicator lights, gauges and alarms for proper operation
- √ Clean and check connections
- √ Check and replace fuses as required

Bale Chamber

- √ Check all rollers, belts, chains, bearings, tension and pressure mechanisms

Hydraulics

- √ Examine all hoses, connectors, and cylinders for leaks
- √ Check and top off fluid levels
- √ Check and replace filters

Driveline

- √ Check belts, chains, sprockets, and other moving parts for wear, alignment and proper operation
- √ Ensure all lubrication devices are in working order or replace
- √ Check for proper alignment and operation of the equal angle hitch

Twine-Tying/Cutting

- √ Check for proper operation
- √ Check and adjust twine tension

Pickup

- √ Replace worn or broken teeth
- √ Check for wind guards, gauge wheels, gathering wheels and lift/lock mechanism for proper operation

Safety

- √ Ensure all safety devices such as shields, extinguishers and first-aid kits are in place
 - √ Check adjustment on slip clutches
- (adapted by Bobby Grisso)*

Safety Tips, Kits Prepare Drivers for Winter

Safety needs to be a driver's main priority when traveling this winter.

Pay attention to weather forecasts before leaving home and if dangerous weather is imminent, consider delaying or canceling travel plans. Travelers should share their plans with family members or friends who can notify authorities if they don't arrive on time. Also, let contacts know if plans change.

Even prepared drivers can have mishaps. Travelers that do become stranded should follow these safety tips:

- Don't run the engine or use the

heater if the vehicle is resting at a steep angle, facing downward or has snow and ice around the exhaust outlet. Use extreme caution if the vehicle rests under an overpass or in a low area.

- Bundle up and stay with the vehicle. Blowing snow can be disorienting and cold temperatures, through hypothermia, can sap a person's strength.
- Use the vehicle engine and heater sparingly to conserve fuel. Run the engine often enough so it starts easily to prevent running down the battery.
- Avoid using the vehicle's electrical accessories if possible. Use parking lights instead of head-

lights to warn approaching drivers.

- If more than one person is stranded in the vehicle, only one should sleep at a time.
- Don't forget to pack a survival kit before traveling with blankets and thermal protection for head, hand and feet. Include enough high energy, non-perishable food, such as candy bars, for each passenger.
- Keep water inside the car to prevent it from freezing and a flashlight with extra batteries. Cell phones are helpful, but should not substitute for survival kits.

(adapted by Bobby Grisso)

Checklist: Fire safety for the home

The best defense against fire in the home is early detection. The following checklist offers guidelines that, if followed, will help ensure the safety of your family and home before a fire emergency gets out of control.

Early warning: Smoke detectors

To best ensure the safety of your home from fire, you should be able to respond "yes" to the following safety statements.

- At least one smoke detector is located on every floor of my home.
- Smoke detectors are placed near bedrooms, either on the ceiling or 6 to 12 inches below the ceiling on the wall.
- Smoke detectors are tested on a regular basis according to manufacturer's instructions and are kept in working condition at all times.
- Batteries are replaced annually according to manufacturer's instructions and never disconnected.
- The detector has a distinct warning signal that can be heard whether asleep or awake.

Fire safety recommendations

- Purchase a smoke detector if

you do not have one; they are required by law in many localities. Check local codes and regulations before buying your smoke detector because some codes require specific types of detectors.

- For advice on the best places to install a smoke detector, read the instructions that come with the detector. Also, follow the manufacturer's instructions for proper maintenance. Proper installation and maintenance will increase the detector's effectiveness.
- Never disconnect a detector. Consider relocating the detector rather than disconnecting it if it is subject to nuisance alarms.
- Replace the battery annually, or when a "chirping" sound is heard.
- Follow the manufacturer's instructions about cleaning your detector. Excessive dust, grease or other material in the detector may cause it to operate abnormally. Vacuum the grill work of your detector. If you have a disabled person in your home, contact your local fire department for assistance in identifying and installing special early warning devices.

Creating an escape plan

Planning ahead, rehearsing, thinking and acting are crucial keys to surviving a fire. To ensure that your family has a proper plan in place to escape a fire emergency, you should be able to respond "yes" to the following safety statements.

- The family has an escape plan and an alternate escape plan.
- If your family has a disabled member, the escape plan assigns someone in the home to assist that person in evacuating.
- Escape routes and plans are rehearsed periodically.
- The escape plan includes choosing a place safely outside the house where the family can meet to be sure everyone got out safely.
- At least two exits from each part of the house are established.
- The fire department number is posted on every telephone.

Fire safety recommendations

- Establish advanced family planning for escape.
- Include small children as a part of the discussion and rehearsal. It is especially important to make sure children understand that they must escape; they can't hide from fire under a bed or in a closet.

(adapted by Bobby Grisso)

Checklist: Welding, Cutting and Brazing

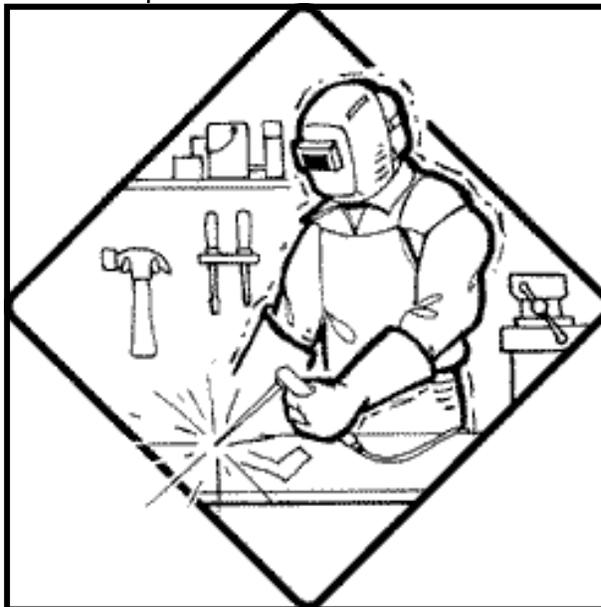
According to OSHA, welding, cutting and brazing pose a unique combination of both health and safety hazards to more than 500,000 workers in a wide variety of industries. The risk from fatal injuries alone is more than four deaths per thousand workers over a working lifetime.

The following checklist may help evaluate safety procedures for welding, cutting and brazing tasks. Please note that this checklist does not ensure compliance with all applicable laws and regulations, nor should it substitute for a comprehensive health and safety program.

- Are only authorized and trained personnel permitted to use welding, cutting or brazing equipment?
- Are compressed gas cylinders regularly examined for signs of defect, deep rusting or leakage?
- Are cylinders kept away from sources of heat?
- Are employees prohibited from using cylinders as rollers or supports?
- Are empty cylinders appropriately marked, their valves closed and valve-protection caps placed on them?
- Are signs reading: "**DANGER -- NO SMOKING, MATCHES OR OPEN LIGHTS,**" or the equivalent, posted?
- Are cylinders, cylinder valves, couplings, regulators, hoses and apparatus kept free of oily or greasy substances?
- Unless secured on special trucks, are regulators removed and valve-

protection caps put in place before moving cylinders?

- Do cylinders without fixed hand wheels have keys, handles or non-adjustable wrenches on stem valves when in service?
- Are liquefied gases stored and shipped with the valve end up and with valve covers in place?
- Before a regulator is removed, is the valve closed, and then gas released from the regulator?
- Is open circuit (no load) voltage of arc welding and cutting machines as low as possible, and not in excess of the recommended limit?
- Are electrodes removed from the holders when not in use?
- Are employees required to shut off the electric power to the welder when no one is in attendance?



- Is suitable fire-extinguishing equipment available for immediate use?
- Are welders forbidden to coil or loop welding electrode cable around their bodies?
- Are work and electrode lead cable frequently inspected for wear and damage and replaced?

- Do means for connecting cable lengths have adequate insulation?
- When the object to be welded cannot be moved and fire hazards cannot be removed, are shields used to confine heat, sparks and slag?
- Are fire watchers assigned when welding or cutting is performed in locations where a serious fire might develop?
- When welding is done on metal walls, are precautions taken to protect combustibles on the other side?
- Before hot work begins, are drums, barrels, tanks and other containers thoroughly cleaned and tested? Containers that stored fuel or volatile chemicals should never be heated.
- Does all protective equipment (welding helmets, hand shields and goggles) meet appropriate standards?
- Are employees exposed to the hazards created by welding, cutting or brazing operations protected with personal protective equipment and clothing?
- Is a check made for adequate ventilation where welding or cutting is performed?
- Are UV curtains used to protect others from arc rays?
- When employees work in confined spaces, is the atmosphere monitored and are means provided for quick removal of welders in case of an emergency?
- Never cut or weld galvanized metals.
- Never cut or weld directly on a concrete floor.

(adapted by Chris Mariger & Bobby Grisso)

Tips: Safe raking and snow shoveling

Cleaning up piles of leaves and heaps of snow can cause more pain than just a headache. While these seasonal activities may seem mundane, they can be dangerous. Snow shoveling and leaf raking can pose threats to the back, shoulders and wrists, if proper precautions are not taken.

According to the U.S. Consumer Product Safety Commission, there were more than 73,000 snow shoveling-related and 22,000 raking-related injuries treated at hospital emergency rooms, doctors' offices and clinics. The potential for an orthopaedic injury is high, whether one shovels and rakes routinely, or only once or twice a year.

The improper use of yard tools, combined with overextension and overexertion of muscles, increases your susceptibility to musculoskeletal injuries. When shoveling or raking, don't twist your body, but instead, use your legs to shift your weight, switching sides frequently.

The American Academy of Orthopaedic Surgeons offers the following tips for safe raking and snow shoveling:

- Check with your doctor. Because these activities place high stress on your heart, you should always talk with your physician before raking or shoveling. If you have a medical condition or do not exercise regularly, you might want to hire someone to remove the leaves or snow.
- Pace yourself. Raking and shoveling are aerobic activities, comparable to weightlifting.
- Take frequent breaks and replenish fluids to prevent dehydration, which affects muscles.
- If you experience chest pain, shortness of breath or other signs of a heart attack, seek emergency care, by calling 911.
- Rake or shovel early and often. Begin when a light covering of leaves or snow is on the ground. Before you begin these physical activities, warm-up your muscles for 10 minutes with light exercise.
- See what you are raking or shoveling. Do not let a hat or scarf block your vision.
- Watch out for large rocks, branches, tree stumps, ice patches and uneven surfaces.
- Avoid falls by wearing shoes/boots that have slip-resistant soles.
- Use a rake or shovel that feels comfortable for your height and strength. Avoid using a rake or shovel that is too heavy or too long. Space your hands on the tool grip to increase your leverage.
- Push the snow instead of lifting it, but if you must lift, do it properly. Squat with your legs apart, knees bent and back straight. Lift with your legs, without bending at the waist.
- Scoop small amounts of snow into the shovel and walk to where you want to dump it.
- Holding a shovelful of snow with your arms outstretched puts too much weight on your spine. Never remove deep snow all at once; do it piece-meal.
- Do not throw the leaves or snow over your shoulder or to the side. This requires a twisting motion that stresses your back.

(adapted by Bobby Grisso)



HydroPower Potential for Renewable Energy

Flowing and falling water have potential energy. Hydropower comes from converting energy in flowing water by means of a water wheel or through a turbine into useful mechanical power. Most people in North America understand hydropower as involving big dams and large-scale generating facilities. Small-scale hydropower systems, however, are receiving a great deal of public interest as a promising, renewable source of electrical power for homes, parks and remote communities.

Hydropower technology has been with us for more than a century. Many early mills, mines and towns in North America built some form of power generation from small hydropower systems in the late 19th and early 20th centuries.

Micro-hydropower systems are relatively small power sources that are appropriate in most cases for individual users or groups of users who are independent of the electricity supply grid. Hydropower systems are classified as large, medium, small, mini and micro according to their installed power generation capacity. Electrical power is measured in watts (W), kilowatts (kW) or megawatts (MW).

A micro-hydropower system is generally classified as having a generating capacity of less than 100 kW. Systems that have an installation capacity of between 100 kW and 1000 kW (1.0 MW) are referred to as mini-hydro. Small hydro is defined as having a capacity of more than 1.0 MW and up to 10 MW, although small-hydro can be defined by provincial and regional utilities as having

a capacity of less than 30 MW or 50 MW.

Micro-hydro systems have the following components:

1. water turbine that converts the energy of flowing or falling water into mechanical energy that drives a generator, which generates electrical power - this is the heart of a micro-hydropower system
2. control mechanism to provide stable electrical power electrical transmission lines to deliver the power to its destination

Depending on the site, the following may be needed to develop a micro-hydropower system:

1. intake or weir to divert stream flow from the water course
2. canal/pipeline to carry the water flow to the forebay from the intake
3. forebay tank and trash rack to filter debris and prevent it from being drawn into the turbine at the penstock pipe intake
4. penstock pipe to convey the water to the powerhouse
5. powerhouse, in which the turbine and generator convert the power of the water into electricity tail-race through which the water is released back to the river or stream

Many micro-hydropower systems operate "run of river," which means that neither a large dam or water storage reservoir is built nor is land flooded. Only a fraction of the available stream flow at a given time is used to generate power, and this has little environmental impact. The

amount of energy that can be captured depends on the amount of water flowing per second (the flow rate) and the height from which the water falls (the head).

Is Micro-Hydropower for You?

You may have wondered whether the stream flowing through or near your property can be used to generate electrical power using a hydropower system to power your home. Is a micro-hydropower system feasible for you? Many factors will determine the viability of such a system:

1. local, provincial/regional and federal legal restrictions on the development of the hydroelectric site and the use of the water
2. the amount of power available from the stream and its ability to meet energy and power requirements
3. availability of turbines and generators of the type or capacity required cost of developing the site and operating the system

Free Software on Micro-Hydropower Systems

RETScreen® International is a standardized, renewable energy project analysis software program that will help you determine whether a micro-hydropower system is a good investment for you. The software uses spreadsheets and comes with a comprehensive user's manual and supporting databases to help your evaluation. You can download the software and user manual free from the Web site at www.retscreen.net

(adapted by Bobby Grisso)

Agricultural Injuries in Virginia 2006

The risks of production agriculture are well known to VCE agents and specialists. However, it is vital to maintain a surveillance program to identify trends or shifts in the causes of agricultural injuries. On a practical level, up to date information on the causes of injuries is a valuable tool agents and specialists need to update or develop a comprehensive agricultural program for their clients.

The BSE department at Virginia Tech recently conducted a survey of Virginia farmers with 1,500 farms larger than 75 acres. A representative sample of over 300 farmers from 76 counties responded to the survey.

The respondents to the survey reported 45 injuries (in the 12 month period preceding the survey) serious enough to require medical attention or prevented the

victim from doing their normal activities for more than half a day. Livestock was found to be the leading cause of serious injuries among Virginia farmers in 2006, with over 24% of all injuries attributed to livestock other than horses. Falls and farm tractors tied for the second leading cause of injuries, at 16% of all injuries each. The survey also asked respondents to report

their exposure to 21 agricultural hazards. Farmers reported spending most of their time working with livestock, an average of 977 hours a year and operating farm tractors, an average of 776 hours a year. In contrast farmers reported spending the least amount of time, an average of 27 hours a year working above the ground such as on a ladder, which is the hazard most associ-



ated with falls. As risky as working with livestock is, farmers were 44 times more likely to be injured in a fall while working in an elevated location than they were to be injured while working with livestock.

With the holidays approaching many of your clients, not just farmers, will be climbing ladders to put up and take down holiday

decorations. According to the Occupational Safety and Health Administration (OSHA) safety when using ladders can be improved by making sure the ladder is up to the job and used properly. Whether you are using a folding step ladder or a leaning extension type, choose a sturdy ladder in good condition. A ladder should be able to support four times its rated maximum load.

When using a leaning/non-self-supporting ladder such as an extension ladder, the ladder should be positioned so that the foot of the ladder is a fourth of its length away from the wall or other structure supporting it. Ladder rungs, cleats or steps should be parallel, level, skid resistant and evenly spaced between 10 and 14 inches apart. Ladders should always be kept free of oil, grease, wet paint, ice and other slipping hazards. The area around the top and bottom

of a ladder should be kept free of clutter to prevent tripping. One should never stand on or work from the top rung of a ladder this will make the ladder unstable. Finally never use a ladder for any purpose for which it was not specifically designed. Happy holidays and a safe new year.

(Provided by S. Christian Mariger Ph.D.)

Safety Videos, Slide Sets, and Films

BSE has a loan library of safety presentation materials available on a short-term loan basis for educational programs. Users are required to pay return postage fees.

Following is a categorical listing of safety presentations currently available:

- ATV Safety
- Automobile Safety
- Bicycle Safety
- Chain Saw Safety
- Chemical & Pesticide Safety
- Electrical Safety
- Falls

- Fire Safety
- General Farm Safety
- Gun Safety
- Home Safety
- Garden, & Landscaping
- Spraying Systems
- Tool & Shop Safety
- Tractors & Machinery
- Water & Recreation
- Wood Stoves
- Miscellaneous

Descriptions are found at:
<http://www.ext.vt.edu/vce/anr/bse/farmsafety/videos.html>

To request: Phone (540) 231-6809,
Fax (540) 231-3199 or
E-mail: tlcox@vt.edu

BSE In-service Training

Bioenergy Engineering Education Program—January 18, 2007 from 8:00 am to 9:30 am as part of 2007 VCE Annual Staff Development Conference in Charlottesville. (Contact Jactone Arago Ogejo or Zhiyou Wen—see previous page for details)

Understanding and Conducting a Household Drinking Water Program at the upcoming VCE 2007 Annual Staff Development Conference in Charlottesville will be presented by BSE Specialist Brian Benham will presenting.

Thoughts on Soil Compaction

During wet falls, soil compaction may be worse, and last longer, than most farmers have experienced.

Ruts are the first sign of compaction, and often the tires sink to tillage depth. But there can be deep soil compaction even where big tires only sink a couple of inches. Fields in continuous no-till (including strip-till) typically came through harvest in much better condition than others.

There are differences among soils. Compacted soils are more likely to produce lower yields after severe compaction. Often there are variations in the same

field. For example, on low areas and on slopes with exposed subsoil the combine left deep ruts, but on most of the field there is little obvious damage.

Subsoiling is the quickest way to deal with deep compaction. But it is not an automatic solution, and may lead to reduced yields later on. Be aware that if a field is ripped 16 inches deep this winter, running the same heavy loads that caused the compaction in the first place may result in even worse soil structure later.

Getting ruts leveled out is the first priority to eliminate any standing water or poor drainage.

Then subsoiling where needed and when the conditions are right is a reasonable strategy.

Now is a good time to consider controlled traffic. Even if you can't get all equipment to match on width and tire spacing, moving a step or two closer to a controlled traffic system is a good start.

For more information review:
Deep Tillage Prior to No-Till Corn: Research and Recommendations

<http://www.ext.vt.edu/pubs/grains/424-053/424-053.html>

(adapted by Bobby Grisso)

Visit our website:
<http://www.bse.vt.edu>

