Biological Systems Engineering

Engineering Update Summer 2012

Engineering Update: ASABE Blue Ribbon Winner!

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Engineering Update

Biological Systems Engineering
June 2012

VirginiaTech Invent the Future

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

Dear Co-Workers: Engineering Update is a joint effort of Biological Systems Engineering and other cooperators at Virginia Tech. Subject areas covered in these newsletters include water quality, natural resource management, TMDL, air quality, animal waste management, machinery management, precision farming, agrochemical application technology, farm safety, energy, engineering education, and technology. Please use the information in newsletter to support your ongoing extension programs. You may circulate this to other extension staff and others who are interested. Electronic version of Engineering Update is available at: *http://intra.ext.vt.edu/anr/bse/index.html*

Sprayer Nozzle Guide

Many pesticide labels now list recommended spray particle size (or droplet sizes) for application. Following guidelines on the label may increase pesticide efficacy and help minimize spray drift.

While it is not currently required, the expectation is that the EPA may soon be requiring the use of validated drift reduction technologies (DRT) to further reduce spray drift. This may involve selecting the appropriate nozzle, adjuvant for the intended application, taking into consideration the wind speed, application height, droplet size, and buffer zone.

The following charts list nozzle tips, pressure and speeds (lower speeds are preferred for application) recommended for various spray droplet sizes. To simplify the charts, only Spraying Systems nozzles are included. Most nozzle manufacturers will have nozzle tips similar to the ones listed.

Always consult the direction on the pesticide label for application recommendations.

(adapted by B. Grisso from Bob Klein, UNL)

Table 2. Droplet-size classification chart.

Droplet Category[1]	Symbol	Color Code	Approximate VMD Range[2] (microns)
Very Fine	VF	Red	< 145
Fine	F	Orange	145–225
Medium	M	Yellow	226–325
Coarse	C	Blue	326–400
Very Coarse	VC	Green	401–500
Extremely Coarse	XC	White	> 500

Table 1. Recommended sprayer nozzle tips, pressures, and speeds to achieve various droplet sizes.

For Coarse Spray Quality 10 GPA

Speed mph	Rate gpm	20-inch	Rate gpm	30-inch
6	0.2	TT110025 @ 26 psi	0.303	AIXR110025 @ 59 psi
7	0.24	TT11003 @ 25 psi*	0.354	AIXR11003 @ 56 psi* or TT11004 @ 31 psi*
8	0.27	TT11003 @ 32 psi	0.404	TT11004 @ 41 psi
10	0.34	AIXR11003 @ 50 psi* or TT11004 @ 28 psi*	0.505	TT11005 @ 41 psi*
12	0.4	AIXR11003 @ 72 psi or TT11004 @ 41 psi	0.606	XRC11008VK @ 23 psi or TT11005 @ 59 psi
14	0.47	TT11004 @ 55 psi	0.707	XRC11008VK @ 31 psi or TT11006 @ 55 psi

For Coarse Spray Quality 20 GPA

Speed mph	Rate gpm	20-inch	Rate gpm	15-inch
6	0.404	AIXR11003 @ 72 psi or TT11004 @ 41 psi	0.303	AIXR110025 @ 59 psi
7	0.471	TT11004 @ 55 psi	0.354	AIXR11003 X 56 psi* or TT11004 @ 31 psi*
8	0.538	TT11005 @ 46 psi*	0.404	TT11004 @ 41 psi
10	0.674	TT11006 @ 50 psi* or XRC11008VK @ 28 psi	0.505	TT11005 @ 41 psi*
12	0.808	XRC11008VK @ 41 psi* or TT11006 @ 72 psi	0.606	XRC11008VK @ 23 psi or TT11005 @ 59 psi
14	0.942	XRC11010VK @ 35 psi	0.707	XRC11008VK @ 31 psi or TT11006 @ 55 psi

*Just into coarse droplet size range

For Medium Spray Quality 10 GPA

Speed mph	Rate gpm	20-inch	Rate gpm	30-inch
6	0.2	TT11002 @ 41 psi	0.303	TT110025 @ 59 psi
7	0.24	TT110025 @ 36 psi* or TT11002 @ 56 psi	0.354	TT11003 @ 56 psi* or XRC11004VK @ 31 psi
8	0.27	TT110025 @ 46 psi	0.404	TT11003 @ 73 psi or XRC11005VK @ 26 psi
10	0.34	TT11003 @ 50 psi* or XRC11004VK @ 28 psi	0.505	XRC11005VK @ 41 psi or XRC11006VK @ 28 psi*
12	0.4	XRC11005VK @ 26 psi	0.606	XRC11006VK @ 41 psi
14	0.47	XRC11005VK @ 35 psi	0.707	XRC11006VK @ 55 psi

*Just into coarse droplet size range

For Medium Spray Quality 20 GPA

Speed mph	Rate gpm	20-inch	Rate gpm	15-inch
6	0.404	XRC11005VK @ 26 psi	0.303	TT110025 @ 59 psi or TT11003 @ 56 psi*
7	0.471	XRC11005VK @ 35 psi	0.354	TT11003 @ 56 psi or XRC11004VK @ 31 psi
8	0.538	@ 72 psi or XRC11006VK	0.404	TT11003 @ 73 psi or XRC11005VK @ 26 psi
10	0.674	XRC11006VK @ 50 psi	0.505	XRC11005VK @ 41 psi or XRC11006VK @ 28 psi*
12	0.808	XRC11008VK @ 41 psi	0.606	XRC11006VK @ 41 psi
14	0.942	XRC11008VK @ 55 psi	0.707	XRC11006VK @ 51 psi

*Just into coarse droplet size range

Virginia Biomass Energy Webinar
webinar recording now available:

The Virginia Biomass Energy Educational Webinar was held on February 21, 2012. This webinar highlighted examples of a wide range of biomass energy projects and introduced the participants to a variety of resources they can utilize. This webinar considered biomass energy use and biomass boiler retrofits for facilities such as schools, industry, and hospitals. While biomass energy may not be a good fit for all applications, it may potentially reduce annual energy costs in certain applications while increasing the demand for local renewable products.

Ninety-two people registered for this event and they included interested citizens, environmentalists, state agencies, universities, businesses, project developers, and many other sectors. Approximately, 70 percent of registered participated in the live session and many more made use of the archived version that is available at Virginia Cooperative Extension's Agricultural Byproduct Utilization website (below). One hundred percent of respondents indicated that they had learned more about biomass energy potential and related issues as a result of their participation in the webinar. Participant feedback were very positive and they had the following comments:

"Excellent, thank you!"
"Very nicely done"
"Excellent webinar"
"Good job, good speakers"
"Interesting"
"An excellent overview of biomass"

This webinar was made possible by the collaboration of the Virginia Department of Mines, Minerals and Energy (VADMME), Department of Biological Systems Engineering and the Department of Forest Resources & Environmental Conservation at Virginia Tech. For additional information on the webinars, you may contact John Ignosh.

(by J. Ignosh—jignosh@vt.edu*)*

With Presentations from:

FOREST SERVICE U S DEPARTMENT OF AGRICULTURE

BTEC Biomass Thermal Energy Council

TRANE

ENGLISH BOILER AND TUBE, INC.

Be. Biomass Energy

U.S. DOE CLEAN ENERGY APPLICATION CENTERS

http://ww2.bse.vt.edu/green/Web%20Meeting/022112/Virginia%20Biomass%20Educational%20Webinar.htm

NEW PROJECT: Farm Manure to Energy Initiative

Farm Manure to Energy Initiative

Using Excess Manure to Generate Farm Income in the Chesapeake's Phosphorus Hotspots

Giving farmers choices – choices for managing excess dairy and poultry manure, choices for reducing energy costs, and choices for new revenue streams, all while lowering pollution to local waters and the Chesapeake Bay – is the goal of the Farm Manure to Energy Initiative.

To achieve this goal, project partners will work to identify, demonstrate and evaluate innovative technologies capable of converting excess manure and poultry litter to energy, while providing alternatives to land application and additional revenue streams for farms. Technologies are to be demonstrated on farms located in manure "hotspots" in the Chesapeake Bay region including: the Delmarva Peninsula, the Shenandoah Valley (VA), the Western Potomac River (WVA), and Lancaster County (PA). Partners will also work to increase technical assistance, information, and financing options available to farmers.

Specific project objectives are to:

- Demonstrate manure-to-energy technologies on farms in nutrient hotspots in the watershed. Monitor projects to document technical, environmental and economic performance.
- Create a network of manure to energy experts as well as a web-based clearinghouse of data and resources that can help farmers and technical service providers compare differing technologies.
- Stimulate the development of markets for byproducts from energy production that generate additional revenue for farmers.
- Improve access to both public and private funding by developing state-specific financing templates that identify existing funding options as well as innovative approaches for private financing.

The overarching goals of the ***Farm Manure to Energy Initiative*** are five-fold: 1) reduce the land application of manure in the Chesapeake Bay's nutrient hotspots, 2) displace imported fertilizer products with products derived from locally produced manure, 3) reduce phosphorus and nitrogen runoff to the Chesapeake Bay and its tributaries, 4) strengthen the viability of animal agriculture in the region by supporting the development of new revenue streams for excess manure and poultry litter, and 5) expand financing options for manure-to-energy technology deployment in the region.

Anticipated outcomes include: an annual reduction of 3,280 tons of land-applied manure, an annual reduction of 100,800 pounds of phosphorus runoff, and an annual reduction of 200,000 pounds of nitrogen runoff. The project is in the start-up phase. To start with, the partnership is focusing on identifying technologies that can convert poultry and other livestock manure to energy (and other valuable products), and reduce fertilizer loss to surface waters, that are suitable for demonstration on farms in the region.

In addition, project partners are in the process of identifying appropriate demonstration farm sites where these technologies may fit best. Two technologies have already been selected for demonstration on two poultry farms – one on the Eastern

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NEW PROJECT: Farm Manure to Energy Initiative

(Continued from page 4)

Shore and the other in the Shenandoah Valley of Virginia (see figures below). We are currently in the process of finalizing plans for additional technology demonstrations on three other host farms in the Chesapeake Bay region. Manure to energy technologies that will be demonstrated by this project are ready for farm scale operation, but they need to be demonstrated on working farms in the Chesapeake Bay watershed before widespread adoption is likely to occur.

Field days where farmers can see the technologies operational in familiar settings, as well as objective, third-party economic analysis, environmental monitoring and performance evaluation. This information will provide farmers, conservation professionals, and funders necessary steps to identify technologies that are appropriate for widespread deployment. In addition evaluation of new technology, the on-farm demonstration will generate new information that can be passed on to farmers by experts when they meet with them or through a web-based information clearinghouse. This approach will enable farmers to quickly adopt and select appropriate technologies for their operations. Efforts to identify and expand options for financing resources will increase the likelihood that farmers interested in adopting these technologies will have the financial resources necessary to proceed with implementation.

Virginia Project Locations
LEFT: Davel Lovell farm in Melfa, VA. Eleven poultry houses producing 1.8 million birds and 2,200 tons of litter annually. *RIGHT*: Oren Heatwole farm in Dayton, VA. Two broiler houses producing 422,000 broilers and 814 tons of litter annually.

Project Partners: National Fish and Wildlife Foundation, Chesapeake Bay Funders Network, Farm Pilot Project, Inc., University of Maryland, Center for Environmental Science, University of Maryland Finance Center, Lancaster County Conservation District, Sustainable Chesapeake, Virginia Tech-Biological Systems Engineering & Virginia Cooperative Extension. Funded Through: USDA Conservation Innovation Grant, National Fish and Wildlife Foundation, EPA, Chesapeake Bay Funders Network, participating farmers and vendors.

For more information please contact: John Ignosh, Agricultural Byproduct Utilization (*Jignosh@vt.edu)* or Kristen Hughes Evans, Sustainable Chesapeake *Kristen@sustainablechesapeake.org* or visit *www.sustainablechesapeake.org*

(by J. Ignosh)

www.sustainablechesapeake.org

NEW: Transitioning Small Dairies to Phosphorus Balance

The "Transitioning Small Dairies to Phosphorus Balance Project" proposes a comprehensive approach to implementing phosphorus-based nutrient management plans on small dairy farms in priority high-phosphorus yielding watersheds in the Shenandoah Valley using a strategy that benefits individual farmers and the industry as a whole.

One part of the part of the project will demonstrate and evaluate a mobile manure nutrient removal system (pictured below). The system will be deployed as a mobile unit to be moved from farm to farm to recover nutrients from stored dairy manure just before land application. The system can remove up to 95 percent of the phosphorus, and 50 percent of the nitrogen from manure. The technology targets small dairy farms that typically may not be able to afford to install on-farm manure treatment technologies. Technical and economic feasibility of using the technology as a shared resource and producer interest in utilizing the technology in the long term will be evaluated. If the demonstration is successful and dairy farmers are interested in adopting the technology, project partners will work with dairymen to facilitate implementation. Project partners will also host educational seminars to identify strategies for transitioning dairies towards on-farm phosphorus balance for dairy farmers, certified nutrient management planners, local and state government staff and industry stakeholders.

The project team includes Virginia Tech's Departments of BSE, Crop & Soil Environmental Sciences, Dairy Science, Virginia Cooperative Extension, Virginia Waste Solutions Forum, Virginia State Dairymen's Association, Farm Pilot Project Coordination, Inc and Water Stewardship Inc. The project is sponsored by a Chesapeake Bay Stewardship Fund's Innovative Nutrient and Sediment Reduction Grant.

(Project summary adapted by Arogo, Welsh and Ignosh)

What is RETScreen?

RETScreen Clean Energy Project Analysis Software

Developed by CanmetENERGY the RETScreen Clean Energy Project Analysis Software is the world's leading clean energy decision-making software. It is provided completely free-of-charge by the Government of Canada. RETScreen significantly reduces the costs (both financial and time) associated with identifying and assessing potential energy projects. These costs, which arise at the pre-feasibility, feasibility, development, and engineering stages, can be substantial barriers to the deployment of Renewable-energy and Energy-efficient Technologies (RETs). By helping to break down these barriers, RETScreen reduces the cost of getting projects on the ground and doing business in clean energy. RETScreen allows decision-makers and professionals to determine whether or not a proposed renewable energy, energy efficiency, or co-generation project makes financial sense. If a project is viable—or if it is not—RETScreen will help the decision-maker understand this: quickly, unequivocally, in a user-friendly format, and at relatively minimal cost." (*Full Excerpt and More Details Available at:* http://www.retscreen.net/ang/what_is_retscreen.php

An educational webinar titled ***Introduction to the RETScreen® Clean Energy Project Analysis Software*** was held on March 7, 2012. This webinar served as an overview of the RETScreen project screening tool while introducing participants to the many features of *RETScreen 4* and *RETScreen PLUS* software.

Twenty-one people registered for this event with participation from interested citizens, environmental groups, state agencies, universities, businesses, project developers, and many other sectors. Approximately, 67 percent of registered participants participated in the live session and we anticipate many more accessing the archived version (posted as a video) available at Virginia Cooperative Exten-

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RETScreen Clean Energy Project Analysis Software

(Continued from page 7)

sion's Agricultural Byproduct Utilization website: http://ww2.bse.vt.edu/green/Web%20Meeting/Recent%20Web%20Meeting%20Information.htm

One hundred percent of respondents indicated that they had learned more about RETScreen and Econoler Training programs as a direct result of their participation in this webinar session. Participant feedback has been very positive with attendees commenting:

"Great webinar!"

"Looks useful in evaluating biomass projects for clients"

"It has been a few years since I used RETScreen. I can't wait to use it again!"

This webinar was made possible by the collaboration of Econoler and the Virginia Department of Mines, Minerals and Energy (VADMME). Additional in person training sessions are being planned for various locations in Virginia later 2012. Please contact John Ignosh (jignosh@vt.edu) for more information.

Keep Safety in Mind during Summer Field Work

Farmers are off to an early start this year. Summer is generally the busy period of the year for most farmers. While rushing to take full advantage of ideal conditions available, one may neglect simple steps for staying healthy and for keeping the work place safe. According to the U.S. Bureau of Labor Statistics, on an average, approximately 700 deaths occur each year due to injuries sustained from farm work. The same statistics also show that an additional 120,000 agricultural workers with disabling injuries from work-related accidents.

Mechanical, chemical and environmental hazards pose risks to farmers on a daily basis. While most farm workers are extremely cautious while attending to their responsibilities, some accidents are unavoidable. However, safety steps taken may reduce the number of deaths and accidents.

Safety education is vital for reducing the number of fatalities and injuries on the farm. Such programs may provide some safety tips the farmers can adopt to avoid serious accidents and associated injuries. Two specific examples of such tips are: (1.) To reduce the risk of traffic accidents, keep the headlights and taillights on farm machinery clean when they are brought to highways for transportation, and (2) Take the extra time needed to properly secure the cargo to avoid accidents on highways during transportation.

Most farmers put in long hours on a daily basis for several weeks during the season because they depend heavily on unpredictable weather. These long work days may result in exhaustion and fatigue that can adversely affect their decision making ability while operating equipment or handling livestock.

Farmers should take scheduled periodic breaks during the day to rest and to take their minds off the operation of complex machinery. Also, they should seek help when fatigued, It is better to be safe than experiencing an accident.

It may be tempting to rush and finish the work faster, but a few extra minutes might be all it takes to prevent dangerous accidents and ensure the safety of yourself and others.

(adapted by B. Grisso and J. Perumpral)

Q/A for Employing Youth Workers

Q/A for Employing Youth Workers: What about meal and rest breaks?

Workers are entitled to a meal break of at least 30 minutes if they work more than 5 hours in a day. They also are entitled to at least a 10-minute paid rest break for each 4 hours of work.
(adapted by B. Grisso & J. Perumpral)

What hours are minors permitted to work?

Hours and schedules minors are permitted to work in agricultural jobs

	Hours per day	Hours per week	Days per week	Begin	Quit
12-13 year-olds					
Non-School weeks	8 hours	40 hours	6 days	5 a.m.	9 p.m.
Note: 12- and 13-year olds are allowed to work only during non-school weeks hand-harvesting berries, bulbs, cucumbers and spinach.					
14-15 year-olds					
School weeks	3 hours	21 hours	6 days*	7 a.m. (6 a.m. in animal agriculture and irrigation)	8 p.m.
Non-school weeks	8 hours	40 hours	6 days*	5 a.m.	9 p.m.
**Exception: 14- and 15-year olds are allowed to work 7 days a week in dairy, livestock, hay harvest and irrigation during school and non-school weeks.*					
16-17 year-olds					
School weeks	4 hours	28 hours	6 days*	5 a.m.	10 p.m. (No later than 9 p.m. on more than 2 consecutive nights before a school day.)
Non-school weeks	10 hours	50 hours (60 hours per week in mechanical harvest of peas, wheat and hay)	6 days*	5 a.m.	10 p.m.

**Exception: 16- and 17-year olds are allowed to work 7 days a week in dairy, livestock, hay harvest and irrigation during school and non-school weeks.*

"SPOT Skin Cancer"

A little detective work can go a long way in spotting or detecting the most common type of cancer. When detected early, this form of cancer is treatable. A new dermatology campaign called "SPOT Skin Cancer" focuses on the steps individuals can take to prevent skin cancer.

Results of a recent survey by the American Academy of Dermatology (AAD) found that most individuals are incapable of spotting skin cancer and they are also unaware of the consequences of skin cancer. In response to their survey, AAD hopes to increase the public's understands of skin cancer and motivate them to change behaviors. The campaign's tagline says it all: "Prevent, Detect, Live."

Unlike other types of cancer, skin cancer can be easily detected by simple examinations. The goal of "SPOT Skin Cancer" is to help save lives by increasing the public's awareness on how to protect themselves from the sun and how the skin can be examined for skin cancer.

AAD Skin Cancer Survey Statistics
The results of a nationwide survey conducted by AAD included the following:

- Nearly 75 percent that participated in the survey did not know that skin cancer is the most common form of cancer in the US.
- Only half (53 percent) in the same groupknew how to examine their skin for signs of skin cancer.
- Thirty percent of those surveyed were either unsure or did not know that skin cancer can be easily treated when detected early.

These conclusions clearly demonstrate the need for a comprehensive programs to improve the awareness among the general public about skin cancer and detection examines.

Dermatologists believe that the number of deaths related to skin cancer could be reduced if people knew how to spot skin cancer and see a doctor if they see suspicious moles or marks.

When it comes to skin cancer, the AAD survey demonstrate that knowledge is power. For example, respondents familiar with skin examination were more than twice as likely to have shown suspicious moles or spots to a medical professional than those who were not familiar. Early detection may mean life and death difference.

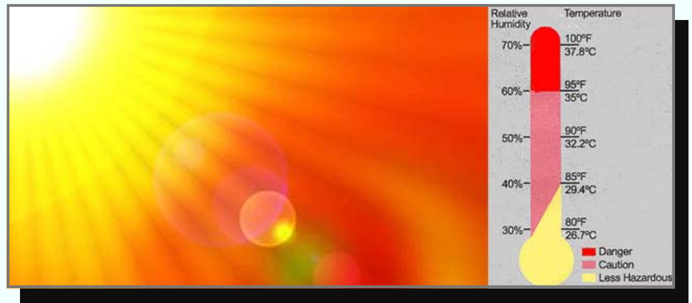
Skin Cancer Facts
More than 3.5 million skin cancer cases affecting 2 million people are diagnosed annually. Current estimates shown that one in five Americans will be diagnosed with skin cancer in their lifetime. The 5-year survival rate for people with melanoma (the deadliest form of skin cancer) is 98 percent, if it is detected and treated before spreading to the lymph nodes.

The "SPOT Skin Cancer" Web site describes the procedure for performing a skin self-examination and for tracking changes in your skin. The site provides opportunity for skin cancer patients to share their experiences with others.

(adapted by B. Grisso and J. Perumpral)

See: http://www.aad.org/spot-skin-cancer/

The Heat Is On: Protecting Workers from Heat Stress



Keep your workers cool, healthy and productive even in the hottest work environment. Heat does not affect everyone equally – not all workers share the same level of susceptibility to heat stress. Workers who are overweight, over 65, on medication or of poor health may face a higher risk of heat exhaustion or heat stroke. Employers must make their workers aware of the steps they can take to avoid heat stress.

Most often we relate heat stress and heat exhaustion to workers in the construction industry. However, it is not uncommon that workers in variety of other industries also experience the same. For example, a worker working in a warehouse that has no air-conditioning or a police officer directing traffic on a hot day are equally susceptible to heat stress, particularly when it is not his/ her regular job. Heavy uniforms or PPEs worn by workers may also cause human body to overheat.

The presence of sweat always does not rule out the occurrence of heat stroke. When workers experience heat stroke, they generally stop sweating. This may not necessarily be true in all cases. Often, when workers are so used to doing certain types of work, they experience heat stroke due to exhaustion. In such situation, the body will continue to sweat even when the individual is experiencing heat stroke.

Taking periodic breaks from work and cooling down in an air- conditioned room may be helpful in preventing heat exhaustion and heat stroke. Among some employers there is a feeling that cooling down in an air-conditioned during breaks may affect the performance of workers adversely. This is not true and it is only a myth. It is perfectly fine for a worker working in the hot sun to take periodic breaks and cool down in an air-conditioned room.

Heat waves are a threat even for acclimatized workers – All workers are at risk of experiencing heat stress when exposed to heat waves. Anytime when a heat wave is anticipated, workers should take precautionary measures to protect themselves.

The type of drinks consumed by workers play an important role in the heat-stress they experience. While coffee consumption was not traditionally recommended while working in hot son, recent studies suggest moderate amounts of coffee consumption is acceptable. Ideally it is best to avoid coffee or tea while working in hot sun. Consumption of any kind of hot foods has the potential to increase the body temperature. The best drink is water and employers should provide adequate supply of cold water to drink when the workers go out in the heat. Unfortunately, in this day and age, many depend on energy drinks even though they are not recommended.

Take a pass on the salt tablets – The current view is that the typical American diet contain adequate amount of salt and no supplement is needed. . Those who are on a special non-salt diet may require supplements to maintain proper electrolyte balance. Frequent lunch and snacks breaks throughout the day will also be helpful for the maintenance of electrolyte balance.

Heat stress is not the only safety concern – When working in the heat, workers have other safety issues to deal with in addition to heat stress. For example, if the worker develops sweaty palms while working in the hot sun, it can create problems during hauling of equipment or swinging tools. Hot equipment may also cause burns if the workers are not protected. Dizziness while working in hot sun may cause falls and injuries from falls. Slippery surfaces from sweat and impaired vision due to fogged up safety glasses are other safety issues the workers have to deal with when work in the heat.

When working in the heat, workers should always be able to contact their safety officers or their supervisors easily. If someone in the team is experiencing heat exhaustion, he/ she should stop working and supervisors should be notified. If the symptoms continue, and if the indi-

http://www.cdc.gov/niosh/docs/2011-174/

The Heat Is On: Protecting Workers from Heat Stress

(Continued from page 11)
vidual is not recovering, he/she should receive medical attention immediately.

Heat Stress 101

Heat stroke, the most critical form of heat stress, can be fatal. Symptoms may include confusion, seizures, loss of consciousness and either hot/dry skin or profuse sweating. If a worker is experiencing heat stroke, 9-1-1 must be contacted immediately. While waiting for assistance, the victim should be moved to a cooler location and his/her body should be sponged with water or ice to bring the body temperature down. Someone should stay with the individual until medical assistance arrives.

Heat exhaustion may also have serious consequences. Symptoms include headaches, dizziness, nausea, thirst, heavy sweating, weakness and elevated body temperature. Get the worker medical treatment as soon as possible. Have the worker drink cold water, and let the person cool down with cold compresses to the head, neck and face.

Heat cramps and heat rash are other common heat related illnesses. Workers experiencing heat cramps should take a break and have cold water and/or snacks. Avoid salt tablets and obtain medical assistance if cramps persist after one hour. If a worker develops heat rash (small red blisters or pimples), he/ she should keep the area cool and dry and avoid using ointments or creams.

To protect workers from heat stress, employers should:

- Allow workers to acclimate gradually by assigning fewer hours in the hot sun.
- When workers go out, make sure that they have plenty of cold water to drink. Encourage workers to drink water before and during their shifts to stay hydrated (but not to exceed 12 quarts in a 24-hour period).
- Provide areas the workers can use to cool down during breaks.
- Keep a close watch on weather (heat) conditions and manage the work load taking into consideration the weather conditions, particularly when a heat wave is anticipated.
- Schedule heavy work for either earlier in the morning or later in the afternoon instead of midday.
- Give workers more frequent breaks and/or assign additional workers when they are working in the hot sun.
- Encourage workers to have snack or meal breaks periodically to maintain proper electrolyte. balance
- Train workers to recognize heat stress symptoms, and get medical assistance when needed.

(adapted by B. Grisso & J. Perumpral)

Heat Index Chart

Air Temperature (°F)

Relative Humidity (%)	140	135	130	125	120	115	110	105	100	95	90	85	80	75	70
0	125	120	117	111	107	103	99	95	91	87	83	78	73	69	64
5		128	122	116	111	107	102	97	93	88	84	79	74	69	64
10			131	123	116	111	105	100	95	90	85	80	75	70	65
15				131	123	115	108	102	97	91	86	81	76	71	65
20				141	130	120	112	105	99	93	87	82	77	72	66
25					139	127	117	109	101	94	88	83	77	72	66
30					148	135	123	113	104	96	90	84	78	73	67
35						143	130	118	107	98	91	85	79	73	67
40						151	137	123	110	101	93	86	79	74	68
45							143	129	115	104	95	87	80	74	68
50							150	135	120	107	96	88	81	75	69
55								142	126	110	98	89	81	75	69
60								149	132	114	100	90	82	76	70
65									138	119	102	91	83	76	70
70									144	124	106	93	85	77	70
75										130	109	95	86	77	70
80										136	113	97	86	78	71
85											117	99	87	78	71
90											122	102	88	79	71
95												105	89	79	71
100												108	91	80	72

Heat Index	General Effect Of Heat Index
(light yellow)	*Fatigue possible with prolonged exposure and/or physical activity*
(yellow)	*Sunstroke, heat cramps and heat exhaustion possible with prolonged exposure and/or physical activity*
(orange)	*Sunstroke, heat cramps or heat exhaustion likely, and heat stroke possible with prolonged exposure and/or physical activity*
(red)	*Heat stroke highly likely with continued exposure*

Operating powered lawn and yard-care equipment

Employees should be at least 16 years old to operate powered lawn mowers and other powered yard-care equipment, such as leaf-blowers and weed-whackers in non-agricultural setting.

No employees under the age 18 should operate commercial-grade powered equipment. These include powered lawn-care equipment, such as trimmers with blades or shears; chainsaws; powered thatchers, aerators, roto-tillers and chippers, and mowers pulled with a tractor.

Operating power lawn mowers and other equipment can be hazardous under certain conditions. In addition to the sharp blades that can cause serious injuries, loose rocks and sticks can be thrown by the equipment may cause eye and body injuries.

Teen workers should be trained to operate powered lawn-care equipment safely. Always use caution while using power equipment.

Keep these safety practices in mind:

- Always use mowers and other power equipment with caution. All safety guards should be in place and they never should be removed. If the equipment is damaged or malfunctioning in any way, do not operate it and report the problem to a supervisor.
- Give complete and undivided attention to the job. No "horseplay".
- Keep the area of operation clear of all persons, particularly small children. Watch for rocks and other foreign objects in the path of the mower.
- Be sure you know how to stop the mower and motor at a moment's notice.
- Never pull the mower toward you while using a power mower, if possible.
- Fill gasoline-powered mowers outdoors. Avoid spilling gasoline and do not fill the tank while the engine is hot or running or while you are smoking. If you spill gas while filling the mower let the fumes evaporate before starting the engine or move the mower away from the fumes before starting it.
- Make sure the mower is out of gear before starting. Stand firmly with your feet away from the blade. Be sure the mower will not tip or roll during the starting operation. Stay clear of the front of self-propelling mowers during and after starting.
- If it is a self-propelled mower, keep in step with the mower. Do not lag behind or let it pull you, as you will not be in full control of the mower.
- When operating over uneven terrain and slopes, use extreme care and make sure you have a firm footing at all times.
- Don't mow when barefoot or wearing open-toed shoes or sandals. Provide protection by using boots, safety shoes or cleated rubber-soled shoes with good traction.
- Use of safety glasses is recommended when operating any of these machines.
- Lawn mowers and other lawn care equipment can be loud (> 90 dBA). Hearing protection is highly recommended when using any of these equipment. The length of time working with the equipment may need to be limited to prevent an exposure that requires hearing protection.

(adapted by B. Grisso & J. Perumpral)

New VCE Factsheet "How do Stream Buffers Reduce the Offsite Impact of Pollution" by Dr. Zach Easton… **What Is a Buffer?** Buffers take many forms, but one commonality among all buffers is that they are vegetated areas that lie between a pollution source area and a water body and are intended to reduce storm water flow and prevent pollution (such as nutrients and sediments) from entering the water body. A buffer may be made up primarily of grasses and non-woody plants (Vegetated Buffer), or include a combination of non-woody and woody plants (Riparian Buffer). The plants in a buffer absorb nutrients, trap sediments, reduce erosion, and slow down water as it moves from the land to a water body. Buffers are a low-cost and sustainable, best management practice (BMP) and are considered to be one of the most reliable practices to remove many pollutants. They are designed to function similarly to natural near-stream areas, and should require minimal maintenance to function properly.

Employing Youth in Construction

Get young workers started on their job right. Do not assign them responsibilities that are prohibited by law. To protect them from accidents and injuries, do the following:

- Provide training
- Emphasize safety
- Know their physical and decision making limits

Youth workers under 18 can be an asset to your business because they are enthusiastic, hard working, and eager to learn. However, like all new and inexperienced workers, they increase the potential for accidents and injuries unless they receive proper safety training and supervision.

Potential for a young worker getting injured increases when:

- they take on jobs without proper training,
- they lack appropriate supervision
- they work with dangerous tools or equipment, and
- they engage in jobs that are prohibited for youth workers.

Work in a construction site is hazardous. Even though the construction industry employs less than 3% of all young workers, it accounts for more than 20% of all occupational deaths in the US experienced by youth workers in the 16-17 age bracket.

State and federal child labor laws prohibit certain types of activities for youth workers. Listed below is a partial list of such activities.

Youth under 18 years of age are prohibited from:

- Driving a motor vehicle
- Operating power-driven woodworking machines (including drills and nail guns)*
- Operating forklifts, cranes, hoists or elevators
- Operating power-driven metal-forming, punching, and shearing machines
- Operating power-driven circular saws, band saws, and guillotine shears*
- Working on wrecking, demolition, and shipbreaking operations
- Working on roofing operations*
- Working more than 10 feet above ground or floor level
- Working on excavation operations*
- Working where the use of a respirator is required by the Respiratory Protection Standards
- Working where the use of hearing protection is required by the Hearing Conservation Standards
- Working where they can be exposed to hazardous chemicals.

**Jobs allowed for training purposes only on an occasional basis, with close supervision. Must be enrolled in vocational-education program.*

Checklist for employers

Some of the items in the following "do's and don'ts" list are required by law and the others can be considered as best practices for improving safety.

Do's

- Follow the state and federal laws strictly.
- Assign young workers only the jobs that are authorized and provide them with adequate training.
- Make sure young workers get clear instructions for each and every Job assigned to them.
- Enforce the rule that young workers may engage in only tasks for which they are trained.
- Familiarize the young workers with the federal and state child labor laws.
- Provide young workers with proper personal protective equipment (PPE), such as steel-toed shoes and hard hats.
- Provide adequate supervision:
- Correct mistakes.
- Stress safety to supervisors.
- Encourage supervisors to enforce high safety standards and install safe work habits.

DO NOT's

- Do not hire someone younger than 16 except for office or sales work.
- Do not assign the young workers tasks that require the use of power tools and operate heavy equip-

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Employing Youth in Construction

(Continued from page 14)

ment.

- Do not assign any work that requires them to be more than 10 feet above ground.
- Do not assign young workers any jobs if they are not trained properly.
- Do not assign young workers jobs that violate the laws.
- Do not assume that young workers understand what they have been told.
- Do not let young workers work alone.

(adapted by B. Grisso & J. Perumpral)

Five tips for young workers with summer jobs

Five workers under the age of 25 were killed on the job in Washington State last year. One worker was only 18. Estimates also show that on an average approximately 79 young workers (men and women) between 16 and 24 years are injured on the job every day.

With the summer job season fast approaching, young workers are urged to be mindful of the workplace hazards.

Injuries sustained as a young worker may have lasting effect and it could affect one rest of his/her life.

Listen to those experienced from the Injured Young Workers Speakers Program. ***http://www.lni.wa.gov/WorkplaceRights/TeenWorkers/SpeakersProgram/default.asp***

Young workers tend to experience injuries at work at a higher rate than adults. This may be due to lack of experience and in some cases carelessness. Young worker starting on their first job this summer, may use are some of the following tips to avoid accidents and injuries:

1. Always get proper training before you start on your assigned responsibility. Learn how to use the equipment properly and safely before operating them.
2. Evaluate the job assigned to you. If you are not comfortable and confident you should contact your supervisor for another assignment.
3. Look for any hazards that may be associated with the assigned work like slippery floors, hot grease, dangerous machinery or ladders. When hazards are identified, report them to the supervisor instead of attempting to fix them personally.
4. Understand the state and federal child labor laws. They clearly identify the jobs the youth workers can and cannot engage in.
5. When you experience an injury at work, be sure to report it to your supervisor even if it is a small cut. This action will qualify you for workers' compensation if the sustained injury results in more complications.

Youth workers should also seek advice from more experienced senior employees within the organization in addition to getting proper training.

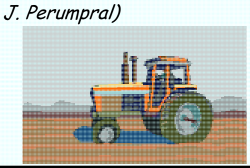
All workers under 18 are prohibited from doing the following work in agricultural jobs

- Handling, mixing, loading or applying dangerous pesticides.
- Transporting, transferring or applying anhydrous ammonia.
- Harvesting crops before the pre-harvest interval expires or within 14 days of applying chemicals, if no pre-harvest interval exists. (The pre-harvest interval is the amount of time that must pass between applying the last pesticide and harvesting the crop.)
- Work involving slaughtering and meat processing.
- Operating power saws, power-driven woodworking and metal-forming machines, and punching or shearing machines.
- Handling or using blasting agents, such as dynamite or blasting caps.
- Work involving wrecking, roofing, demolition and excavation.

Additional restrictions for 14 and 15-year-old minors working in agricultural jobs

- Operating a tractor of over 20 PTO horsepower, or connecting or disconnecting implements from such a tractor.
- Driving a bus, truck or automobile that carries passengers.
- Working from a ladder or scaffold at a height over 20 feet.
- Working in a farmyard, pen or stall occupied by a bull, boar or stud horse maintained for breeding purposes.
- Working inside a fruit or grain storage designed to retain an oxygen-deficient or toxic atmosphere, or working in a manure pit.
- Operating or helping to operate machines such as corn pickers, hay balers and mowers and grain combines.
- Performing manufacturing, meatpacking or food-processing work.
- Working in transportation, warehouse and storage or construction.
- Working in or around engine or boiler rooms.

(adapted by B. Grisso & J. Perumpral)



2011-2012 BSE Comprehensive Design Projects

Twenty-eight BSE seniors completed the requirements of the BSE Comprehensive Design Projects course sequence in May. Of these, 20 students will graduate in May and two more next December. This year's 9 design projects had a distinct environmental focus. Two dealt with biogas production from waster waters, two dealt with stormwater management, two dealt with waste water treatment, two were international projects, and the three remaining projects dealt with food engineering, forest road decommissioning, or shoreline erosion control. Projects were somewhat different this year in that almost every project was mentored by a practicing engineer in addition to a faculty advisor. Each project is briefly described below.

Design of an Appropriate Technology Peanut Processing Facility for Kampala, Uganda: Students leading this project included Ally Gay, Kelsey Langelotti, and Kelly Morgan. The goal of this project was to design an appropriate technology peanut processing and nutritional cookie processing and packaging facility to produce high energy protein supplements in the form of cookies for malnourished children and others in Uganda. The students traveled to Uganda in February and met with their local professional mentors and client. This project was advised by Kumar Mallikarjunan and the professional mentors were Drs. Manjeet Chinnan, Archileo Kaaya and Dorothy Nakimbugwe. The client was Women's Cooperative, Kampala, Uganda.

Figure 1. Peanut processing pilot plant in Kampala, Uganda.

Figure 2. Dominican Republic design team members Dana Gardner, Christina Duell and Jamey Smith (left to right) sampling household wastewater in Dominican Republic.

Dominican Republic Community Wastewater Treatment System. Student on this project included Jamey Smith, Christina Duell, and Dana Gardner. The goal of this project was to design a pilot appropriate technology wastewater treatment system for a barrio of 50 families in the town of Verón, Dominican Republic. The final design included a septic tank for primary treatment and a submerged flow wetland for secondary treatment prior to groundwater discharge. The students traveled to the Dominican Republic to visit the proposed site and meet their client and cooperators. Engineers without Borders and the Peace Corps will be involved in implementing the project during the summer of 2012. A $10,000 grant has been received for construction. The faculty advisors were BSE professors Leigh Anne Krometis and Zachary Easton and the professional mentor was Kevin Tweedy, P.E., Senior Water Resources Engineer, Michael Baker Engineering, Inc.. Kevin is also a member of the BSE Advisory Board. Cooperators included Ben Hulefeld, Virginia Tech Caribbean Center Logistics Coordinator and Sabine Bergmann, Peace Corps Volunteer, Verón, Dominican Republic and the clients were Jake Kheel, Corporate Environmental Director, GRUPO PUNTACANA and the community of Verón, Dominican Republic

USDA Forest Road Decommissioning Project. Students leading this project included Bryan Ringgold, Vivian Bui, and Jerry Sigado. Vivian was in study abroad in Brazil last fall and participated in the project during that period via the internet. This design project involved the development of a decision support tool that could be used by US Forest Service personnel to facilitate and standardize the decision process involved in design a forest road decommission-

Figure 3. Jerry Sigado of forest roads team inspecting road and culvert.

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2011-2012 BSE Comprehensive Design Projects

ing plan. Currently, the decommissioning process is based largely on individual professional judgment and experience. The students developed a series of Excel worksheets that guide the decision maker through the road assessment and road decommissioning design. The faculty advisor on the project was Conrad Heatwole, P.E., and the professional mentor was Angela Parrish, Project Engineer, USDA Forest Service. Angela is also a BSE Advisory Board member. The client was the US Forest Service.

Hanover County Yard Waste Composting Facility. Rachael Johnson, Nathan Mau, and Katie Ridgeway were the student designers. Katie also participated in study abroad in Brazil last fall and worked with her team electronically. Originally this project focused on stormwater management but halfway through the year, the stormwater problem was solved and a new project goal of improving the efficiency of the composing process at the Hanover County Yard Waste Composting Facility was developed. The final design speeds up the composting process at the facility through the use of static pile aeration and should produce higher quality compost, which can hopefully be sold at near double the current sales price according to their market analysis. The faculty advisors were David Sample, P.E. and Jactone Ogejo, P.E. and the professional mentors were Mike Flagg, Director of Public Works, Hanover County; Peter Moon, P.E., O2Compost. The client was the Hanover County Public Works Department.

Stormwater, Erosion, and Sediment Control Plan for Virginia Tech Life Sciences District: this project was led by BSE seniors Clay Parrish, David Greenspan, and James Wade. The goal of this project was twofold. The first goal involved the design of the erosion and sediment control plan for the construction of HABBI 1, the new BSE and Food Science Research building, upon which construction started in December. The second goal was to develop a long-term stormwater management of the entire Life Science District development, which will include 4 additional buildings. The designs included traditional E&S construction site BMPs as well as grass swale, bioretention areas, and a constructed wetland. The faculty advisor was Tess Thompson and the professional mentors were John Burke, P.E., Project Manager, Gay & Neel, Inc. and Chuck Dietz, P.E., Stormwater Compliance Specialist, Virginia Department of Conservation and Recreation. The client was Craig Moore, P.E. Civil Engineer, Manager, Site and Infrastructure Development, Virginia Tech.

Design of an Anaerobic Digester for Biogas Production from Brewery Waste: Students leading this project included Nick Mangili, Ryan Fahs, and Michelle Colandro. The goal of this project was two-fold. The first goal was to design a biogas production facility for the client's Fullsteam brewery in Durham, NC to recover biogas from their brewery waste and to determine if the biogas production facility would have a 5-year payback. It high solids anaerobic digestor developed did not come close. The second goal was to determine how large a microbrewery needed to be in terms of barrels of beer produced per year in order for biogas production to be profitable (5-year payback). The faculty advisors were Justin Barone, Jactone Arogo Ogejo, P.E., and Sean O'Keefe (Food Science and Technology) and the professional mentor was Eric Fitch, Purpose Energy, Inc., Boston.

Biogas Production from a Municipal Wastewater Anaerobic Digester: This project was led by Adam Barrett, Greg Nye, and David Zybak. The faculty advisor was Jactone Arogo Ogejo, P.E. The goal of this project was to design a transportable pilot-scale biogas production system that could be taken to a wastewater treatment plant to demonstrate on-site the benefits of the use of the client's proprietary microorganisms. The students designed, constructed and tested a 20L lab-scale batch model and then completed the design of a transportable 100L continuous flow production system. The professional mentor was Dr. Derrick Lewis, Novozymes Biologicals, Salem, Virginia and the client was Novozymes Biologicals.

Novozymes Denitrification System for Wastewaters: Students leading this project included BSE seniors Andrea King, Kristin Marks, Mikala Michalski, and Mary Swim. The client was Novozymes Biologicals of Salem, Virginia. The goal of this project was to design a pilot-scale denitrification system that would utilize proprietary Novozymes microorganisms to denitrify high nitrogen wastewaters. The pilot-scale system would be constructed and utilized by Novozymes to design a denitrification system at one of their facilities in China to

2011-12 Senior Capstone Design Teams

(Continued from page 17)

reduce effluent nitrogen concentrations from 2000 to 50 mg/L. The students designed and tested a lab-scale fluidized bed reactor and a preliminary design for the pilot-scale system was developed. The faculty advisor was Ryan Senger and the professional mentors were Dr. Pyong Shin, Senior Process Engineer and David McCutcheon, Novozymes Biologicals, Salem.

Shoreline Erosion Management Plan for Festival Beach, Mathews, Virginia. Katie Driscoll, Liz Luby, and Shaun Richards were the seniors on this design project. Their professional mentor was Scott Hardaway of the Virginia Institute of Marine Sciences. The goal of this project was to design a cost-effective and esthetically pleasing shoreline protection system to protect public and private shoreline from excessive erosion of Festival Beach. The final design was developed using the Mep-Bay model and required 200 additional feet of breakwater structure to protect the beach section from excessive erosion. The proposed breakwater additions are shown below. The faculty advisors were Cully Hession, P.E. and Durelle Scott. The client was Matthews County & private land owners.

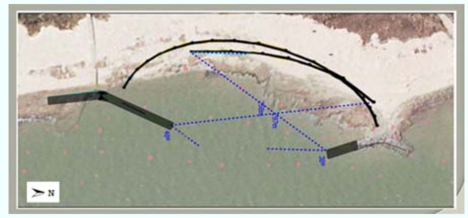

Figure 4. Festival Beach breakwater improvements.

2011 Awards for Excellence

Southern Regional Extension Forestry 2011 Awards for Excellence - Silver Award for National/International Project. "Wood Bioenergy Assessments in Support of Department of Energy's Federal Energy Management Program". Authors: J.F. Munsell (FREC), J.P. Ignosh, and M.C. Bolding (FREC). This year, a panel of four Extension Specialists provided the expertise to judge the nominations. Receiving a Southern Extension Forest Resources Specialists Silver Award for their work in the National/International Project category were Drs. John Munsell, John Ignosh and Chad Bolding Virginia Tech. The project was judged by peers to be an exceptionally integrated, interdisciplinary effort with a protocol and products that should be replicated in other areas". The judges stated that this recognition "will hopefully lead to other efforts like this". http://www.sref.info/

PLANS

In response to numerous requests, building and facility plans Iin PDF format)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://intra.ext.vt.edu/anr/bse/index.html**

ASABE Extension Awards

American Society of Agricultural and Biological Engineers (ASABE) has selected the following two extension publications developed by BSE authors for Blue Ribbon Awards during the 2012ASABE International Meeting.

"***Precision Farming Tools: Variable-Rate Application***" Authors: **Robert Grisso**, Mark Alley, Wade Thomason, David Holshouser and Gary Roberson.

"***Urban Nutrient Management Handbook***" Authors: J. Goatley, W.L. Daniels, G. Evanylo, L. Fox, K. Haering, S. Hodges, R. Maguire, **David Sample**, D. Hansen, D. Kindig, T. Sexton, R. Habel and K. Hensler .

Congratulations! BSE Class of 2012

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