Five Projects Under Way in New 'CLEAR' Lab

By Mary Price

Two years after it first received funding, the Clean Energy and Air Resources Program at VMI is now fully operational. The goal of the "CLEAR" lab is to find organic alternative energy sources that are bioengineered to produce the smallest amount of pollutants possible.

All of the projects currently under way there are seeking this goal in some fashion, from burning llama manure to creating material for a carbon filtration system to building a self-sustaining fish-and-plants ecosystem which also uses the burned llama manure as an energy source.

Cadets have been working in the lab since January, said Maj. Tim Moore '97, assistant professor of civil engineering and one of two faculty members at VMI currently involved with the project. The other is Maj. Anne Alerding, assistant professor of biology. The CLEAR lab is located in Morgan Hall, the Nichols Engineering annex.

Moore is overseeing the work of eight cadets who have five projects under way.

The cadets involved with the first project are investigating the use of llama manure as a sustainable source of carbon filtration for ground water that's been polluted with heavy metals.

This project is intended to help people in Bolivia, where Moore has led several Engineers Without Borders trips in the last few years. There, he explained, the groundwater is contaminated by heavy metals from mining operations, to the point that livestock refuse to drink the water.

In the lab, cadets Johnny Partin '14, Amber Joyner '14, Alexandria Gagnon '14, and Taylor Dowell '14 are taking manure from alpacas, a species similar to the llama, and burning it at 350 degrees Celsius, the equivalent of 662 degrees Fahrenheit, for two to three hours until all that is left is "biochar" made up mostly of carbon. The biochar is then used to filter water that the cadets have pre-treated with lead, copper, and iron to mimic what would likely be found in water near a mine.

"The quintessential definition of sustainability is to take the llama manure and use it as a filtration media," said Moore. "If these people can reproduce this manure-based biochar in the field and use it to filter their water, they can have a sustainable source of water."

Preliminary results from this project are quite favorable, showing a 90 percent removal rate for the metals in question.

A second project involves the use of soybean stems as an environmentally friendly alternative to fossil fuels. This project has two components. Alerding, along with cadets Matthew Waalkes '13 and Garrett Parsons '15, is working to find the best soybean varieties for energy production.

"[Alerding] picks the best cultivar of soybean that will do the job we want it to do, which is to drop nitrogen into the leaves and leave very little in the stems," said Moore.

The second component of the soybean project is analysis of the bean stems Alerding has selected. In the CLEAR lab, Parsons is measuring the energy content of different soybean varieties, with the goal of identifying the variety producing the lowest output of pollutants possible.

"Two of the biggest air pollutants from the conversion of fossil fuels are sulfur and nitrogen," Moore explained. "Because of that we want to look at sustainable forms of energy conversion. Lower nitrogen and sulfur in the air are goals."

Moore and the cadets hope to have publishable data on the llama manure and soybean projects in the fall.

A third project involves an aquaculture system in which fish produce nutrients for growing plants. The goal is to provide another sustainable project for developing countries," said Cadet Matt Harvey '14. He and Cadet Tyler Garvin '14 are working on the aquaculture project.

Johnny Partin begins the metals removal experiments using a wrist-action shaker. – VMI Photo by Kevin Remington.

Maj. Tim Moore and Alexandria Gagnon process manure-based biochar for metals removal experiments. – VMI Photo by Kevin Remington.

The project includes a large tank, where the fish will live, and two smaller containers above it, which will be planted with vegetables. The biochar from either the llama manure or the soybeans will be mixed with water containing fish wastes, and that will be used as a nitrogen-rich fertilizer for the plants. The fish take in nutrition by eating the plant roots, and the plants likewise are fed by the fish wastes.

"It's a really cool ecosystem where the plants are feeding the fish and the fish are feeding the plants," Moore noted.

The fourth project, which is being undertaken by Cadet Peerawat Charuwat '13, involves wastewater nitrogen recovery. The fifth project, air quality control, is a joint initiative of all the cadets.

Funding for the CLEAR lab has come from several sources. Two major pieces of equipment were paid for by a $141,457 grant from the National Science Foundation. The lab is also funded by a $40,000 grant from the Dominion Foundation, an arm of Dominion Virginia Power, and an $86,410 grant from the Jackson-Hope Fund.

Future plans include a partnership with Virginia Tech that would allow cadets to earn a master's degree from that institution after graduating from VMI, but that step will require more funding.

"The program is still in its infancy because we just got everything," said Moore. "But we're starting to ramp it up and really get more cadets involved, so it's really quite cool."