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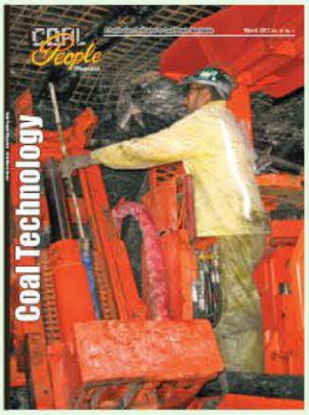
Features / Articles



On the cover.... Fletcher bolter with their new "rib access boom" design. On this machine, the boom, operator area and control locations have been re-designed, creating a "rib access" area in front of the control valves. Now, the operator could step toward the rib, and safely insert the resin and bolt in angled and horizontal holes – without leaving the operator area or protective canopy. A new rib guard was added to protect operators from hazards of nearby rib. Guards were improved and hoses were re-routed. Today, nearly all DR-style Fletcher bolters use rib access booms. The company has also designed a model for use on intermediate-seam-height machines that have booms that allow operators to remain on the ground, and still utilize the easy-access feature. photo courtesy JH Fletcher & Co.

Departments

Business Articles

This photo shows a mechanical connection.

From the first generation illuminator.

The illuminator in an MSHA approved blast proof box

When Bruce Mutter looks out on a classroom filled with students, not all of the faces of the students reflect the typical glow of most teenage college students.

"I have four or five coal miners in classes almost every semester," Mutter said.

Although he serves as an associate professor at Bluefield State College, Mutter, 47, a native of Peterstown, West Virginia, is also the executive director of CART, the Center for Applied Research and Technology. "Some of the coal miners that I teach come straight to class after working a shift, or are going to a shift. They bring a different perspective to the class," he said.

For the past 14 years, Mutter and CART have been working with the coal industries and others to discover new ways to address long-standing challenges. A few years ago, CART worked with Fenner Dunlop to develop a smart system that anticipates failures and isolates potential problems in conveyor belt systems and received the 2009 Innovation Award from the Southwestern Virginia Technology Council. But the research group didn't rest on its laurels. Rather, CART launched a new effort to address some long-standing coal mining safety issues.

During the past 18 months, Mutter and his research team along with a divergent team of some unexpected partners from various industries, have been examining the possibilities for additional applications of fiber optics in underground coal mining. The research group formed a limited liability corporation – Vandalia Technologies LLC – to bridge the gap between applied research and practical application. Mutter is the chief executive of Vandalia, Heather N. Williams is the company's project manager, and John S. Browning Jr. is its design engineer.

"Just like we do in any applied research work, we start with the problem and work our way back," Mutter said during an interview at RSL Vandalia's unassuming research facility in Princeton, West Virginia. "It does lead to some unexpected developments. The difficulties that the coal industry faces didn't happen overnight. Working with fiber optics in underground coal mines is an applied science."

Vandalia is working with a trio of high-tech companies that have already developed aspects of fiber optic technology that is in use in other non-underground coal mining applications. Vandalia worked with the leadership of Hartford, Connecticut-based RSL Fiber Systems on the creation of an encapsulated illuminator to meet stringent Mine Safety and Health Administration regulations. With that lighting power source, RSL Vandalia developed technology to outline underground mine machinery by using a passive light source. It's the fiber optic cable that lights up, from an LED bulb encased in an electrical unit.

Article and Photos by Bill Archer

New Applications for Fiber Optics in Underground Coal Mining

The group is perfecting directional fiber optic lights

Bruce Mutter with a methane detector currently in use in tunnels in the UK.

Bruce Mutter and Heather Williams in a no-light photo with fiber optic illumination

Another partner, OptoSci, based in Glasgow, Scotland, United Kingdom, has a 19-year track record of developing optoelectronic systems, components and instrumentation for a variety of industrial applications. However, OptoSci's gas-sensing equipment that detects and monitors methane in landfills has a potential, according to Mutter, to be applied to the coal mining industry.

AP Sensing, the present day incarnation of the conceptual research and application model that Bill Hewlett and his (then) partner, Dave Packard, used to build Hewlett-Packard into an internationally acclaimed technological leader, is now a global leader in distributed temperature sensing. AP Sensing is already working in fire detection, power cable monitoring, oil well sensing along with geo and hydrological research. "This partnership gives them another potential market for the products they produce," Mutter said.

The fiber optic connections constitute the conduit for the new technology to make a difference in underground coal mining. The first connection is in the outlining of personnel and equipment in low or no-light settings. Since the fiber optic material can operate on such low voltage, RSL Vandalia worked with a power take-off (PTO) connection that can draw power from the existing battery packs that coal miners carry on their belts to power the lamps they wear on their hardhats. That same passive power source is also capable of illuminating suspenders or vests that can make personnel easy to locate even in total darkness.

"This is a companion technology to the reflective material that coal miners already use," Mutter said. He pointed out that in the low light conditions, a light of some kind has to interact with reflective materials in order to illuminate the coal miner. "Obviously, with fiber optics, you don't need to shine a light directly on a person to see their location."

Vandalia, working with RSL, has also developed a fiber optic lighting system using end-omitting fiber as opposed to the side-omitting fiber optics used in personnel or equipment outlining. The center's prototype lighting unit projects a powerful beam of light, but the research team recognizes that the gear needs extensive underground testing to make sure that the equipment can withstand the rigors of use in an underground coal mine.

"We see half-inch thick steel come back from underground mine equipment bent in half," Browning, 42 and design engineer of the RSL Vandalia research team said. Browning is from Houston, Texas, but grew up in Alaska. He has worked in several different fields melding theory with practical application. Prior to joining the CART team, he was with Pemco, based in Bluefield, Virginia. "We know that is a challenge, but by using passive lighting fixtures, a machine operator might make simple repairs without having to wait for an electrician. There's nothing electrical about using fiber optics at the fixture."

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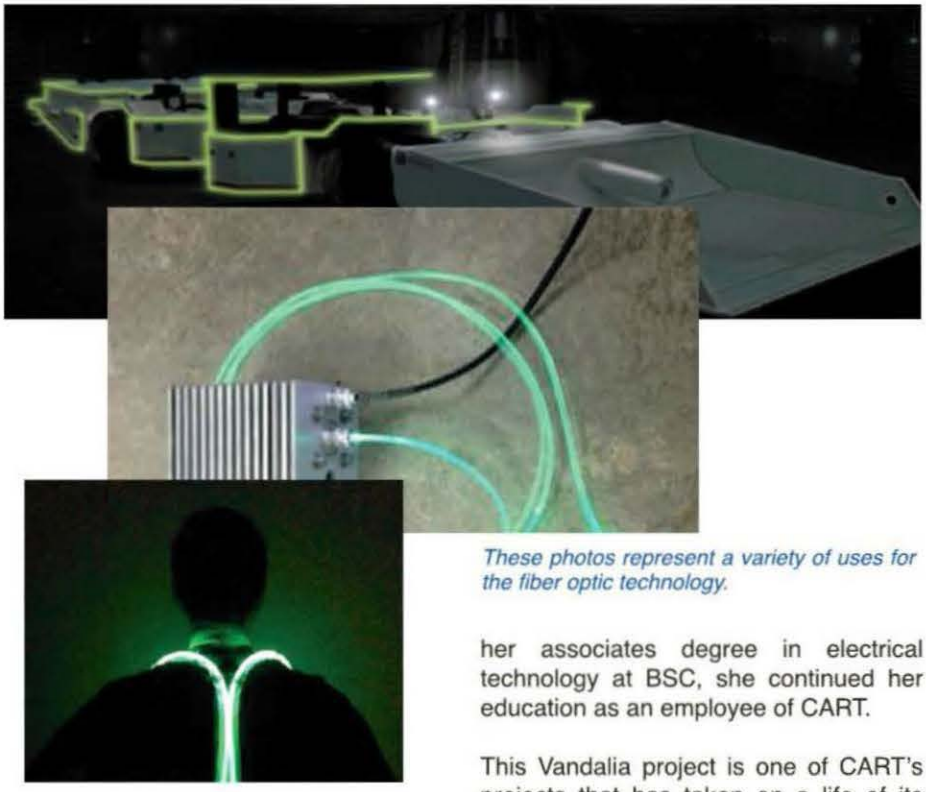

These photos represent a variety of uses for the fiber optic technology.

"That's true," Mutter said. "You can repair it mechanically rather than electrically. A passive fiber optic system has a lot of advantages. There is no power on the lines themselves. These (encapsulated illuminator) connections are in the control room. Everything else in the mine is just two lines of fiber connecting together."

To illustrate the point, Mutter cut a section of a fiber optic loop connected to one of the illuminators. The portion of the fiber connected to the box remained lit, and Mutter completed the circuit simply by touching the two ends of the fiber together. "The safety component here is obvious," Mutter said.

While Mutter didn't work as a coal miner, his father started out working at the Red Jacket and Island Creek mines before he joined the US Navy during World War II. After the war, Mutter's father operated a small truck mine, and hauled house coal to families in Monroe County, West Virginia. Mutter earned his undergraduate degree in civil engineering at BSC and his master's degree in construction management from Virginia Tech in Blacksburg, Virginia

Williams, **33**, the project manager of Vandalia's team, is also a Monroe County native from Lindside, West Virginia. Her passion has always been in the electronics field. After earning her associates degree in electrical technology at BSC, she continued her education as an employee of CART.

This Vandalia project is one of CART's projects that has taken on a life of its own," Mutter said. "Today, you have to work collaboratively with industry to find solutions for problems. When you work together, it's good for all of us."

The three technologies of fiber optic safety outlining, existing OptoSci methane detection equipment along with advanced monitoring technology from AP Sensing, are each on the cutting edge of expanding the role of fiber optics in coal mining.

"The OptoSniff 316 SS Tunnel Sensor unit (a product developed by OptoSci to detect methane levels in long vehicular tunnels in the UK) can still provide data if the screens are 90 percent blocked," Mutter said. "It will require extensive testing to see how it will function with the dust present in an underground coal mine."

In terms of interpreting the data once it is collected, Mutter said that the AP Sensing central control and Opto Sniff units can be calibrated to alert personnel in the control room when methane levels are changing and display methane and temperature differences as part of the light spectrum that it naturally occupies.

"By using fiber optics, the control room personnel can see this data in real time," Browning said. "It's not intended to replace the systems they already use. The idea is to improve them. With the heat sensing component on the discrete sensors along the fiber optic system, you could detect heat in a bearing or on a belt line early. You can see the difference in the temperatures.

"Everything we're doing with CART is so important to Bluefield State College," Mutter said. "Some of our students are coal miners, but almost all of our students here are connected directly or indirectly to coal mining. CART works with applied research. For example, we chose to use green as the color for our fiber optic outlining and safety gear because at the same level of power, the color green is about 11 times more noticeable to the human eye than a red light."

The lab where the team is working on the research is rather spartan. Williams provides insights into the practical electronic theory behind the developments, but also collates the mountains of applied research data that RSL Vandalia and CART have generated through the past 18 months. With all the colorful fiber around in the shop, it would seem only natural that the facility would have been a fanciful place during the Christmas holidays, but it wasn't.

"We had a little Charlie Brown Christmas tree in the middle of the big table in our meeting room," Williams said with a smile. "We had one LED light with green fiber optic cable on the tree.

Along with its on-going research on several levels, BSC's CART team has partnered with the Welch Post No. 1, National Mine Rescue Association – "The Smoke Eaters," on an annual mine rescue competition that is held annually in May on the Bluefield State College campus.

"We still have some work to do during the next six months," Mutter said of the RSL Vandalia project's status. "Fiber optics is already used in underground coal mine communications, so that part's not new. We're looking for the right partner and the right mine to try these technologies in an underground mine setting. We want to take this technology out of the lab, work with it in a working coal mine and see where we need to go from there.

"We would hope that the technology would become cost-effective and ultimately inexpensive," but maintenance and safety are the driving forces behind the initiative, Mutter said.