

# UTC Spotlight

University Transportation Centers Program

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Mark Peters, Fireline TCON

## “Brake-ing” Technology: Public-Private Collaboration Yields New Composite Material For Vehicle Brake Components

On May 19, 2009, President Obama announced a new federal vehicle policy, starting in 2012, that requires automobile and light-truck fleets to scale up to an average fuel economy of 35.5 miles per gallon (mpg) by 2016. In order to meet these new regulations, automobile manufacturers will need to incorporate new technologies, including the use of lightweight, high-performance materials. This is one of the areas of research funded by the Center for Transportation and Materials Engineering (CTME) at Youngstown State University (YSU), a U.S. Department of Transportation Tier II University Transportation Center.



Mark Peters

**Ed Stride - Senior Technician of FTI preparing the furnace for the next TCON run.**

To meet this mandate in 2016, passenger vehicles must attain an average fuel efficiency of 39 mpg and light trucks an average 30 mpg. In contrast, for the current 2009 model year the average fuel efficiency is 25 mpg. More efficient cars mean savings to consumers at the pump, and these new policies are expected to save 1.8 billion barrels of oil from 2012 through 2016. Also, the EPA estimates automobiles currently generate about 17 percent of greenhouse gas emissions in the United States. By 2016, the new regulations are expected to reduce greenhouse gases by 30 percent from new cars and trucks—a reduction of 900 million metric tons of greenhouse gas emissions over the 4-year period. That is equivalent to taking 177 million cars off the road or shutting down 194 coal plants.

The CTME is funding research that will utilize a unique, lightweight ceramic-metallic composite material in brake components for cars, trucks, and buses. These components are typically made out of cast iron, and it is expected that the use of this ceramic-metallic composite material will reduce the weight by nearly 50 percent. A Youngstown company, Fireline TCON, Inc. (FTi) was selected through a competitive research selection process to collaborate with the CTME to provide these new technologies.

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CTME and other YSU researchers have assisted in microstructure and composition analysis of FTi's TCON® materials, and the collaboration has also provided unique opportunities for CTME students. Two senior mechanical engineering students, Devin Wilmouth and Bill Purnell, are working directly with Mark Peters, general manager of FTi, as interns on this project. The students are visiting agencies involved with maintaining trucks and buses in Ohio – including the Ohio Department of Transportation's (ODOT's) Trumbull garage, the Western Reserve Transit Authority (WRTA) maintenance department, the Liberty School System bus maintenance department, and a local dealership – in order to learn about the issues these organizations face and to determine how composite brake components could benefit them by reducing vehicle weight and by increasing the longevity and safety of the braking systems.

conventional cast iron vehicle brake rotors. The tests will determine whether the composite materials developed through the CTME/FTi collaboration have superior corrosion resistance properties over gray cast iron, the material typically used in vehicle braking systems. Students will be involved in this testing as part of a hands-on project in YSU's new corrosion class, which was developed in conjunction with the CTME.

Another issue, brought up by the WRTA and Liberty bus garages, is that loud squeals emitted from the brakes are a major nuisance to the general public as well as drivers. It is believed that the noise is directly related to the efficiency of the brake drum in dissipating heat. Excessive heat build up in the drums during braking causes the pads to deteriorate, or glaze over, resulting in a loud squeal. The more heat generated, the lower the lifespan of the brake. It is hoped that development of lightweight composites will not only aid fuel efficiency but also increase the lifespan of the braking system.

To date, the results of the CTME's collaboration with FTi on composite braking material have been highly successful. FTi, the CTME and YSU recently won a \$2.1 million Ohio Third Frontier Project grant to fund research projects and capital equipment that would increase the scientific understanding of these materials and accelerate the development and use of these products in the transportation field. 🔄



Mark Peters

**Roger Jones - Founder of FTi with Mark Peters - General Manager of FTi**

The students have learned that the number one cause for brake rotor replacement on passenger cars and ODOT trucks is excessive corrosion, not excessive wear. As a result, Dr. Douglas Price, a faculty member in the chemical engineering program at YSU and a researcher associated with the CTME, will perform corrosion tests on new composite braking materials as well as on samples cut from

### About This Project

Dr. Cynthia Hirtzel ([cshirtzel@ysu.edu](mailto:cshirtzel@ysu.edu)) is the director of the Center for Transportation and Materials Engineering at Youngstown State University. Other CTME-affiliated faculty involved with CTME's collaboration with Fireline TCON, Inc. include Dr. Tim Wagner, Professor of Chemistry at YSU; Dr. Matt Zeller, Chemistry Department at YSU; and Dr. Darrell Wallace, Assistant Professor of Mechanical and Industrial Engineering at YSU. From its inception, the project has actively involved students as interns or researchers.

Fireline, Inc. (Fireline), located in Youngstown, Ohio, is manufacturer of ceramic components that produces high-performance ceramic shapes, including products that are used to manufacture jet turbine engine components. Fireline TCON, Inc. (FTi) is a wholly owned subsidiary of Fireline formed in 2002 to develop and commercialize a unique process to make ceramic-metallic composites with enhanced properties, which are marketed under the TCON® trademark.