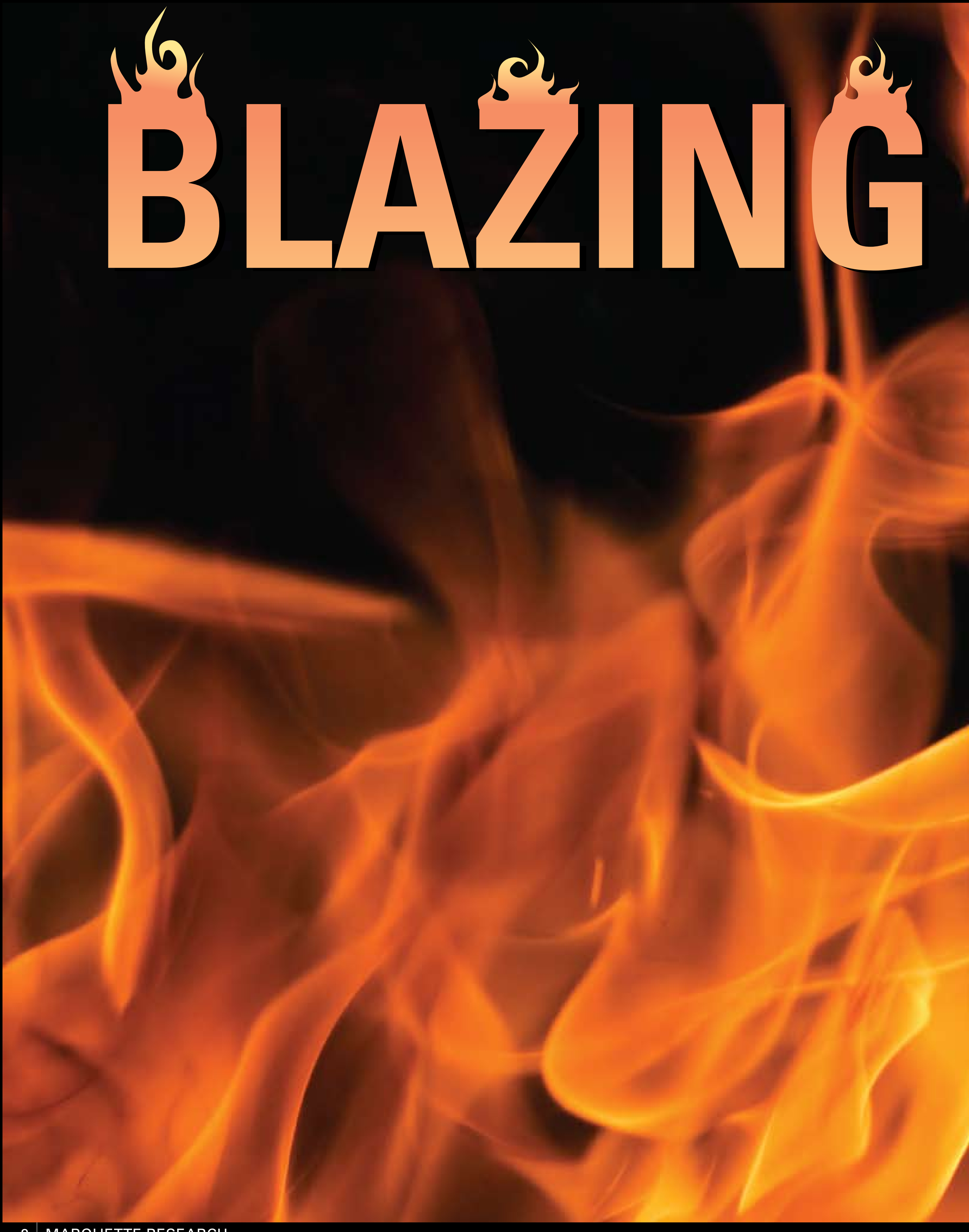
BLAZING



TRAILS

For 30 years, Dr. Charles Wilkie has studied fire retardancy. Armed with a new federal grant, this leader in his field is heating things up.

Dr. Charles Wilkie's research has earned an international reputation. He has written hundreds of journal articles, and his publications have been cited more than 2,000 times. The associate editor of *Polymers for Advanced Technologies*, he sits on the editorial boards of two other professional journals. His dedication to his field is clear to his students, who range from doctoral candidates to freshmen in Marquette's general chemistry classes. "Chuck is able to convey the excitement that he has for science, frequently inspiring undergraduates to work in his research group and motivating them for further studies in chemistry," says department chair Dr. Jeanne Hossenlopp.

If someone told Dr. Charles Wilkie at the onset of his career that he would one day be on the brink of saving countless soldiers' lives by developing a flame-retardant, anti-blast polymer, he would have shaken his head in disbelief. Today, his research on fire retardancy has the potential to revolutionize military defense.

The Pfletschinger-Habermann Professor of Chemistry, Wilkie studies fire retardancy and polymers. He is one of the foremost academic researchers in the field, and his work has been widely published in the United States and abroad. In 2007, he won Marquette's Lawrence G. Haggerty Award for Research Excellence.

Prior to 1978, Wilkie studied organometallic chemicals, which is "about as far away from polymers as you can get," he says.

It was in 1978 — his 10th year at Marquette — that Wilkie switched gears. While on sabbatical, he stumbled across a paper titled "Phosphorous-based Fire Retardants," and his focus forever changed. He published his first paper, "Fire Retardancy of Poly(methyl methacrylate)," in 1981; the research was funded a few years later by a grant from the National Bureau of Standards.

"When I started, I was an inorganic chemist dabbling in polymer science," Wilkie says. "I became a polymer scientist who used to know something about inorganic chemistry. Today I know very little about inorganic chemistry."

Underneath that humility, Wilkie is understandably serious about his research. In addition to improving military defense, it could also help the civilian sector.

"There's a big fire problem in the United States and globally," Wilkie says, underscoring the importance of his life's work. "We need to address the issue of fire-related deaths and the billions of dollars lost each year as a result of fires."

In 2006, there were more than 1.6 million recorded fires in the United States, resulting in more than 3,200 deaths and approximately $11.3 billion lost, according to the U.S. Fire Administration.

While Wilkie hopes his work will reduce those somber statistics at home, his newest undertaking is one with implications stretching far beyond U.S. borders.

Through two separate multimillion-dollar grants in as many years from the Department of Defense, Wilkie and his team have partnered with Boston-based Triton Systems to develop flame-retardant, anti-blast material tiles that can sheath military buildings and vehicles. The result could save innumerable lives among the ranks of American and allied armed services.

"There is an anti-blast material — polyurea — whose elastic properties have made it the most widely used material in military applications," "There's a big fire problem in the United States and globally. We need to address the issue of fire-related deaths and the billions of dollars lost each year as a result of fires."

Wilkie says. "However, polyurea is also highly flammable. What we're going to do is develop a material that maintains the anti-blast properties of polyurea while rendering it flame retardant."

That is no easy task — especially for an academic, according to Wilkie. "My goal has always been to develop knowledge that can be used by others, not to actually make a product," he says. However, that's exactly what he'll be doing during the next few years.

"I'm very fortunate to have some very talented students who will actually be doing the work," the ever self-effacing Wilkie says.

Wilkie's team has already made great strides. Over the span of the project, tests on the team's blast-resistant tiles have shown a 90-percent decrease in heat release rate (HRR) — the single most important variable in describing fire hazard or the "size" of a fire.

Fire is measured quantitatively by its energy output, or heat. Heat is measured in joules, but the rate at which the heat is released is of greater interest to scientists like Wilkie. Thus, HRR is measured as joules per second, or watts.

Tests on the team's first tiles yielded an HRR of 2,000 kilowatts. Wilkie has since improved the material to yield a mere 150 kilowatts, and he would like to see that number drop further.

"Those last 50 kilowatts are the biggest challenge," he says.

It's the challenge that Wilkie enjoys most. He's not motivated by recognition or prestige. It's not even the inherent allure of fire that drives him.

"The field of fire retardancy is simply interesting to me," Wilkie says. "I just feel I have something to contribute."

In fact, Wilkie is thinking beyond this latest project. He also studies nanocomposites, a growing field of inquiry that involves the addition of nano-sized particles to larger polymers to enhance their physical or mechanical properties. "I am very interested in studying the application of nanocomposites in fire retardancy," he says.

Regardless of the outcome of this project or future ones, one thing is certain: Wilkie is blazing a trail in the field of fire retardancy.

IN THE LAB

How do polymer chemists like Wilkie determine a material's fire retardancy? They use something called a cone calorimeter, the most significant bench scale instrument in the field of fire testing, which uses a truncated heating element to irradiate the test sample.

The small-scale test uses pieces of material that are approximately 4 inches by 4 inches and 1/8 inch thick. After the sample is weighed, the cone calorimeter heats it to a particular temperature — typically about 1,370 F (730 C) — and degradation begins.

The instrument measures how much oxygen is consumed, which indicates how "large" the fire is. Wilkie also determines how much smoke is produced and how the weight of the sample changes as it degrades. Smoke inhalation causes many fire-related fatalities, so the goal is to reduce both a fire's size and smoke output.