



*Could cotton be one key to  
improving toxic cleanup?  
Seshadri Ramkumar thinks so.*

# WEAPON *of* MASS PROTECTION

AN UNLIKELY PAIRING OF COTTON AND CARBON COULD CLEAN UP DANGEROUS MESSSES.

BY SCOTT SLEMMONS | PHOTOS BY NEAL HINKLE

Emergency workers responding to hazardous chemical spills typically wear protective gear that is hot, stiff and uncomfortable for extended periods of time.

Texas Tech researcher Seshadri Ramkumar is working to change that. By sandwiching particulate cleaners like activated carbon between layers of nonwoven cotton cloth, Ramkumar has designed a fabric that can be fashioned into gear that is comfortable and offers significant protection against hazardous materials.

Ramkumar, an assistant professor of environmental toxicology at The Institute of Environmental and Human Health, says his research doesn't stop at suits. The technology can be used for chemical cleanup wipes, air filters and other applications where absorbency and protection are key.

Ramkumar's use of the nonwoven fabric is already attracting attention from the United States military.

"One of their program priorities requires them to get a chemical protective material which is non-particulate and non-aqueous to clean very sensitive parts of the human body, as well as very sensitive parts of very costly equipment, like fighter planes," says Ramkumar. "If you have loose, dirty particles, if there is any toxic spill in a fighter jet, which has so many different contours, intricate parts and crevices, you need something to clean at the same time as you protect sensitive electronic parts and human skin."

Ramkumar says the fabric could eliminate the need for harsh cleaners in certain applications.

"You can't take bleach and put it on delicate electronic equipment," Ramkumar says. "It will corrode the equipment. So they are looking into something which can absorb, which is friendlier to human skin. This is possible if you use my nonwoven technology."

Ramkumar is quick to offer a demonstration, for any audience and on almost any surface. For an impromptu presentation, he splashes a little motor oil into a sink. He sprinkles some activated carbon onto it, but by itself, the carbon leaves a black,

gritty film in the sink. On another spill, Ramkumar wipes it up with a cotton cloth. It soaks straight through. If the oil were a corrosive acid, the person holding the cloth would have been burned.

But then Ramkumar sandwiches carbon between two strips of his nonwoven cloth. The first layer of cloth absorbs the spill, and the layer of carbon stops the oil from being absorbed by the second layer of cloth. The spill is cleaned quickly and efficiently, and the person doing the cleaning is protected.

"This way you preserve the functionality of the carbon and at the same time, take away the negative aspects," Ramkumar says. "It's sandwiched in a flexible cloth as a composite. In many ways, cotton is the perfect cloth to use for this. Cotton is the king of fibers because of its next-

to-skin friendly properties and its absorbency. And because it breathes well and is so comfortable, it can also form an inner liner for a chemical protective suit."

#### A TOP PRIORITY

Ramkumar says nonwoven fabrics can also be incorporated into everything from car seat upholstery to bulletproof vests. The cloth could be used as lining for protective

boots and gloves and even for filters for breathing apparatus and gas masks, as well as building air vents. Protective suits, made with an inner lining of the nonwoven fabric, could assist troops overseas, firefighters responding to terrorist attacks, and crews helping clean up the toxic sewage left behind after hurricanes.

"This Texas Tech invention using nonwoven technology is a top priority for the Department of Defense as well as first responders and Homeland Security," says Ronald Kendall, director of TIEHH. "This allows people to better function in heat, cold, whatever, to better respond to save lives."

Lance Anderson, managing director of Tech's Office of Technology Transfer and Intellectual Property, says Ramkumar's work will take biological and chemical protective gear beyond its current limitations.

// WE WERE HOPING  
FOR A GOOD RESPONSE  
TO THIS AND WE  
WEREN'T SURPRISED  
BY THE REACTION. //

— RON KENDALL



*Research staff member Senthil Chinnasami installs a needle-board into TIEHH's needlepunch loom.*

"The ability to have consistent protection and use it for extended periods of time provides for more efficient and aggressive strategies to be put into place for this new day and age," Anderson says.

Larry Hobbs, assistant to the president at Hobbs Bonded Fibers in Waco (and a 2000 graduate of Texas Tech), says his company has licensed the nonwoven fabric from Texas Tech and is working on applications for its commercial use.

"His research addresses a real need for our first responders, including homeland security personnel, police and firemen," Hobbs says. "First responders who use suits made of this material can stay in the field for a significantly longer period of time when working with hazardous substances. Someone could work six hours instead of the two hours they can work now."

The technology could be used in police work as well, Hobbs says.

"The need for this garment keeps growing," says Hobbs. "This technology is perfect for police officers in response to the growing meth lab epidemic. Other areas that can benefit from this technology include decontamination wipes and filter technology—we foresee it eventually being used to help filter the cockpits of airplanes and in mobile military hospitals."

#### **INTERNATIONAL IMPACT**

Hobbs Bonded Fibers has entered into a partnership with Remploy Frontline, a British company specializing in the manufacture of protective garments for the military and civilian use. Remploy plans to begin making chemical,



*Activated carbon between layers of nonwoven cotton cloth*

biological, radiological and nuclear protective suits using Ramkumar's composite fabric.

Ramkumar says nonwoven cloth could also help revitalize the textile industry in America, which has gone through a slump in recent years.

"We are going through a crisis in the textile field," Ramkumar says. "Roughly 26,000 jobs have been lost because the textile industry is very labor intensive. But nonwoven fabric technology could be a boon for the industry. The only segment of the textile industry that is growing right now—at a rate of 8-10% annually—is nonwoven fabric production. You can produce a lot of nonwoven fabric in a short time, and it's less labor intensive."

"Creating nonwoven cloth skips the intermediate processes of production," Ramkumar says. "You skip the conventional spinning and weaving. Because of that, you are saving costs."

"Basically, it can clean up anything it can absorb—toxic chemicals, industrial toxins—and if you add anti-microbial or anti-bacterial components into these fibers, which is possible with the needle-punch loom, it will also inhibit bacterial growth. When these fibers have metal in them, they inhibit the growth of microbes."

The Research Development and Engineering Command of the United States Army is primary sponsor of the program. Collaborative research efforts with the University of South Florida were funded by the USF Center for Biological Defense. Additional support came from the Cotton Foundation, Texas Food and Fibers Commission, The CH Foundation, South Plains Foundation and the International Cotton Research Center at Texas Tech. Preliminary work was supported by Cotton Incorporated, and other assistance was provided by Plains Cotton Growers, Inc.

Kendall says the widespread positive reaction to Ramkumar's research is proof of its possibilities.

"We were hoping for a good response to this, and we weren't surprised by the reaction," Kendall says. "This technology is truly revolutionary. It's very difficult to operate in a contaminated environment without a more functional, breathable suit, and the nonwoven fabric is a perfect solution. Development of this technology fully reflects the advancement that can be made with the interdisciplinary research that TIEHH encourages and advances." <

*The nonwoven composite fabric may soon line protective suits worldwide.*

