S-1026 (2007-2012)

Textiles & National Security

This project has developed cost-effective, environmentally friendly textile materials that protect people and property from biological and chemical hazards, fire, and other catastrophic events, thus addressing homeland security issues.

Who cares and why?

Textile materials and technologies play an important role in homeland security. Protective clothing is essential for the safety and performance of first responders, firefighters, healthcare personnel, and others who work to protect and rescue people and infrastructure from catastrophic events, biological and chemical hazards, and acts of terrorism. However, currently available protective gear is often bulky and heavy and does not adequately protect wearers from toxic chemicals and biological hazards, thus endangering the lives of those workers and jeopardizing the success of disaster response efforts. Textiles that address fire safety issues and provide barriers against biological and chemical threats are also needed for automobile interiors, furniture, bedding, and bandages. Rigorous research and testing is needed to determine the best ways to treat textile surfaces so that they repel or deactivate microbes, fungi, and chemicals and do not accelerate fires. There is also demand for textiles that can be created without using chemical solvents or resins that may be toxic to humans and the environment or petroleum-based materials that are economically and environmentally unsustainable. To make improved protective textiles widely available, reasonably priced, and sustainable, scientists must explore textiles that can be made from bio-based materials and processes as well as textiles that can be made uniquely in the U.S.

S-1026 research has produced firefighter gear that not only protects firefighters from fire, heat, and possible biological and chemical agents, but also improves comfort and mobility, allowing firefighters to perform tasks efficiently. Photo by Heather Paul, Flickr.

S-1026 researchers have also developed new textiles and fabric treatments that shield healthcare workers from biological pathogens and chemical toxins they may encounter when treating patients. Photo by Sergeant Paz Quillé, Canadian Forces Combat Camera, Flickr.

What has the project done so far?

Over the past five years, the S-1026 project has brought together expert scientists to conduct innovative research and develop new textile products. S-1026 researchers have made significant efforts to create bio-based textiles with limited chemical inputs, especially petrochemicals. As part of this effort, they have generated textile fibers from sugar cane bagasse—the fibrous matter that remains after sugar cane stalks are crushed to extract their juice—using a reusable solvent. Other S-1026 researchers have produced textile fibers from zein—a soft, yellow powder of simple proteins obtained from corn. Scientists have even identified usable fabric-like materials made by insects. Other researchers have formed biocomposites—fabric-like materials made out from plant resins reinforced by natural fibers—that have a wide range of uses including car interior carpeting and medical implants for bone and tissue repair. They have been able to form biocomposites using agricultural wastes such as soybean straws, wheat straws, hop bines, milkweed floss, switchgrass stems, and poultry feathers as reinforcement fibers and resins from soy proteins and wheat gluten. Test trials have shown that biocomposites for automobiles made out of cotton, kenaf, and hemp fibers offer higher noise absorption and moldability. Exploring new methods for making nontraditional textiles, researchers have experimented with an electrospinning apparatus, which uses an electrical charge to extract very fine fibers from a liquid. Another major focus of S-1026 in recent years has been creating fabrics with antimicrobial and antifungal finishes. Experimenting with ways to add these protective barriers to fabrics, S-1026 researchers have discovered how to use plasma to create non-toxic fabrics that kill bacteria on contact and to modify the cellular structure of fabric surfaces, resulting in better flame resistance, adhesiveness, hardness, and

other properties. Other researchers have shown that containing protective treatments in microcapsules allows control of the release and activation of protective treatments so that they are not worn out by constant exposure to heat and light, regular wear and tear, and repeated washing. Other research has focused on textiles used in medical settings. In a preclinical study with pigs, scientists have evaluated the healing properties of different textiles used to dress wounds. S-1026 researchers have also developed a new decontamination wipe that is useful in healthcare and military settings. Addressing fire safety issues in the U.S., S-1026 researchers have designed new fire retardant bedding and vehicle interior fabrics. S-1026 studies have also concentrated on developing and evaluating textiles with enhanced resistance to environmental degradation. For example, scientists have examined discoloration and loss of strength in quilting materials. S-1026 members have pursued patents, licenses, and cooperative agreements with specific industries in order to make these textile materials and technologies commercially available. They have also shared research results and insights through presentations to various industry associations, journal articles, flyers, and outreach activities.

Impact Statements

Created new protective textiles, improving the safety of workers in healthcare and homeland security positions.

Expanded new, higher value markets for fiber crops, creating new opportunities for farmers and improving the profitability and sustainability of these industries.

Decreased dependence on petroleum-based products and increased use of environmentally friendly, renewable resources, making textile production less likely to harm the environment and more sustainable.

Provided the auto industry with materials that offer better noise absorption, moldability, and fire resistance, offering comfort and safety to passengers.

Reduced the cost of and provided easier access to demanded textiles.

Helped quilters make informed decisions.

What research is needed?

To assure that the products and processes already developed by S-1026 are environmentally responsible, researchers need to perform full life cycle analyses. Researchers also need to collaborate with industry to move these products into industrial applications. Additional studies are needed to explore new, highly demanded fiber materials, including nanofiber, regenerated cellulose and protein fiber, antimicrobial fiber, thermal regulating fiber, conductive fiber, and biosensor fiber. Future research will focus on developing fiber materials using agricultural resources and advancing materials that are renewable, sustainable, carbon neutral, and functional. Continued work on these new fiber materials will facilitate lifestyle changes and living quality improvements that will impact a wide variety of industries from fashion to healthcare.

S-1026 researchers have designed new fabrics for vehicle seats and carpeting that are more fire resistant, thus improving occupant safety. Test trials have also shown that biocomposites made out of cotton, kenaf, and hemp fibers offer higher noise absorption and moldability, improving passenger comfort. Photo by GARNET, Flickr.

Want to know more?

Administrative Advisor:
Robert Shulstad (agresch@uga.edu)

This project was supported, in part, through USDA's National Institute of Food and Agriculture by the Multistate Research Fund (MRF) established in 1998 by the Agricultural Research, Extension, and Education Reform Act (an amendment to the Hatch Act of 1888) to encourage and enhance multistate, multidisciplinary research on critical issues that have a national or regional priority. Additional funds were provided by contracts and grants to participating scientists. For more information, visit *http://saaesd.ncsu.edu/*.

Compiled and designed by Sara Delheimer