Chemistry and Chemical Engineering

Southwest Research Institute develops advanced chemistry and engineering solutions to meet global challenges in a variety of areas, ranging from new energy solutions, to pharmaceutical development and fire technology. Working with industrial and government clients, we also address environmental, homeland security and food safety concerns.

SwRI is applying more than 55 years of microencapsulation expertise to the pharmaceutical industry, developing new formulations and delivery technologies for various compounds, including a nerve agent antidote (microencapsulation.swri.org). We are also developing metal-organic framework nanoporous crystalline films for use in a chemical weapons detection program (nanotechnology.swri.org).

Using a novel fluorescent monitoring system to rapidly analyze oxygen permeation through a microcapsule, we determined that a "layer-by-layer" technology we are developing enhances the oxygen barrier properties of SwRI-developed capsules (drugdelivery.swri.org). This technology has significant applications for oxygen-unstable nutraceuticals such as fish oil and vitamin A.

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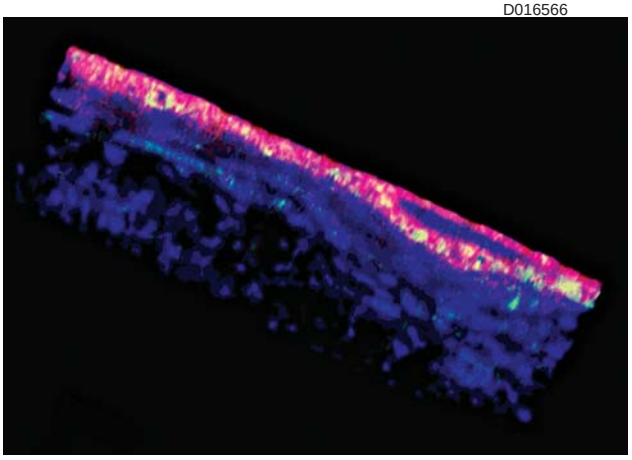

These fluorescent nanoparticles provide thermal stability and effective cellular delivery of a variety of therapeutic agents through multiple routes of administration, including delivery to the epithelial layer through topical application to the skin.

We collaborated with the U.S. Department of Agriculture to develop a specialized biological assay using live mosquitoes and computational models to predict better chemical attractants and repellents used to control mosquito populations. This program is expanding to include other disease-carrying pests, such as flies, ticks, fleas, mites and lice.

Food contamination concerns have stimulated increased requests for trace analysis in a variety of food and consumer products. SwRI provides analytical support to reduce potentially harmful compounds in food production (bioanalyticalchemistry.swri.org). We developed analytical methods sensitive enough to see parts-per-billion levels but rapid enough to allow analysis of thousands of perishable samples per week from facilities worldwide. We also develop and evaluate relatively simple techniques for use in plant-level laboratories that would allow onsite technicians to accurately screen for contaminants.

Over the past three years, our scientists and engineers have helped a startup company design and develop a process and associated equipment for carbon dioxide capture and sequestration from coal-burning power plant flue gas. We supported the fabrication of two mobile CO_2 capture demonstration laboratories and managed startup and initial operation of the labs at field locations inside coal-burning electric power plants. To spur progress in this field, SwRI started a symposium to examine chemical, process, mechanical and regulatory issues associated with carbon dioxide capture, conversion and sequestration.

In another energy-related project, SwRI developed the operating protocols for a client's patented heavy oil upgrading process. Heavy oil, including Canadian bitumen and other oils around the world, is a form of petroleum too thick to be economically transported. Heavy oil fields are typically found in remote, difficult-to-access locations and must be upgraded at the well

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After three years of research and development on a new, energy-efficient and economical carbon sequestration process for coal-burning power plants, two mobile CO_2 capture demonstration laboratories are now operating at field locations inside coal-burning electric power plants. Using this process, the carbon dioxide gas produced by burning coal is converted into an environmentally benign powder similar to baking soda in composition.

environmental engineering • materials chemistry • process engineering • fire protection engineering demilitarization • analytical & environmental chemistry • pharmaceutical chemistry • homeland security environmental sampling • analytical method development • health effects & epidemiology investigations risk & hazard analysis • fire testing & research • microencapsulation • biomaterials engineering

head for economical transport. SwRI operates a heavy oil feedstock test facility for this client to apply the technology on samples from around the world, verifying that heavy oils can be upgraded using this new cost-effective process.

SwRI continues to support the U.S. program to destroy chemical agent stockpiles. This year, the Newport demilitarization site successfully neutralized the final one-ton VX nerve agent container. After more than a decade of operations, the Pine Bluff and Umatilla chemical agent disposal facilities completed destruction of all sarin agent stockpiles, are nearly finished destroying VX nerve agent munitions and will soon transition to destroying mustard gas stockpiles.

In 2008, our fire technology specialists evaluated the density of water sprays delivered by sprinkler systems associated with high-volume, low-speed ceiling fans, and how effectively these systems control warehouse fires (fire.swri.org). We are also researching fire protection of consumer fireworks retail spaces and evaluating fire safety of compressed hydrogen cylinders used on fuel-cell-powered motor vehicles. ❖

Visit chemistry.swri.org for more information or contact Vice President Dr. Michael MacNaughton at (210) 522-5162 or michael.macnaughton@swri.org.

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Our staff is helping a client develop new technologies for innovative uses of natural gas. The technology has progressed from a laboratory-scale setup, to a small indoor pilot unit, to this large outdoor plant on the SwRI grounds.

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SwRI's fire technology staff evaluates the performance of walls under real fire conditions using room test facilities. We recently established a capability to measure thermal conductivity of fire-resistant materials at elevated temperatures and are leading an international effort to develop standards for measurement uncertainty assessment in fire tests.

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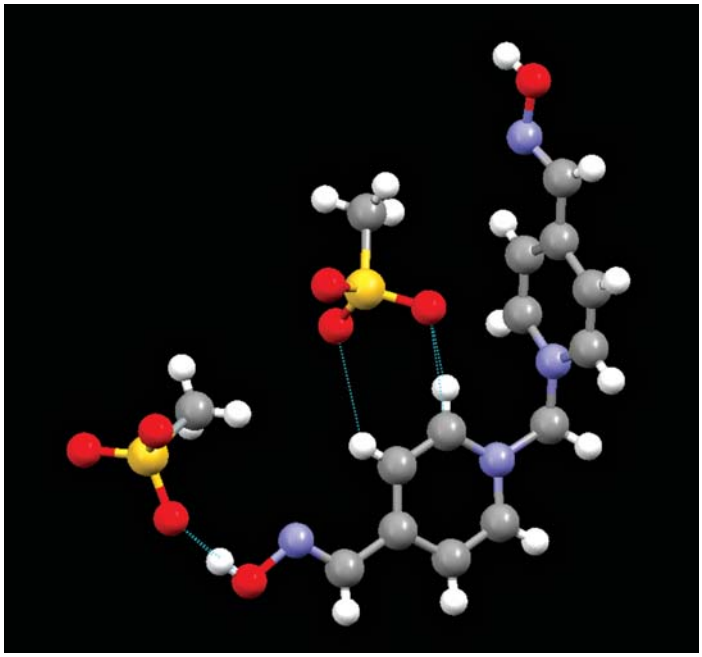

In 2008, SwRI developed new broad-spectrum nerve agent antidote formulations, the world's first operational field-stable formulations of a bis-pyridinium oxime with liquid characteristics. We are currently modifying the formulation's bioavailability and injection performance and customizing the synthesis of pharmaceutical intermediates and compounds for chemical weapons antidote combination therapies.