

Cleaning Up with

OU engineers set out to extract oil from groundwater in an environmentally friendly way—only to find a product that also can clean your clothes.

“Super Soap”

As a graduate student in the late 1970s, Jeff Harwell conducted research on ways to maximize oil field production. A few years later, David Sabatini was in graduate school studying the movement and treatment of pesticides in groundwater. Neither had any inkling that more than two decades later their collaborative research would morph into a formulation for a “super soap”: one that cleans clothing and removes stains better than most name-brand equivalents *and* is better for the environment.

It was a long and circuitous route.

Harwell, executive associate dean of the OU College of Engineering, Conoco/DuPont Professor of Chemical Engineering and George Lynn Cross Research Professor, started investigating possible methods of extracting oil from groundwater in 1979, when there was a huge worldwide demand for oil. But by 1982, the year he joined the OU faculty, oil prices plummeted and interest in the research stalled.

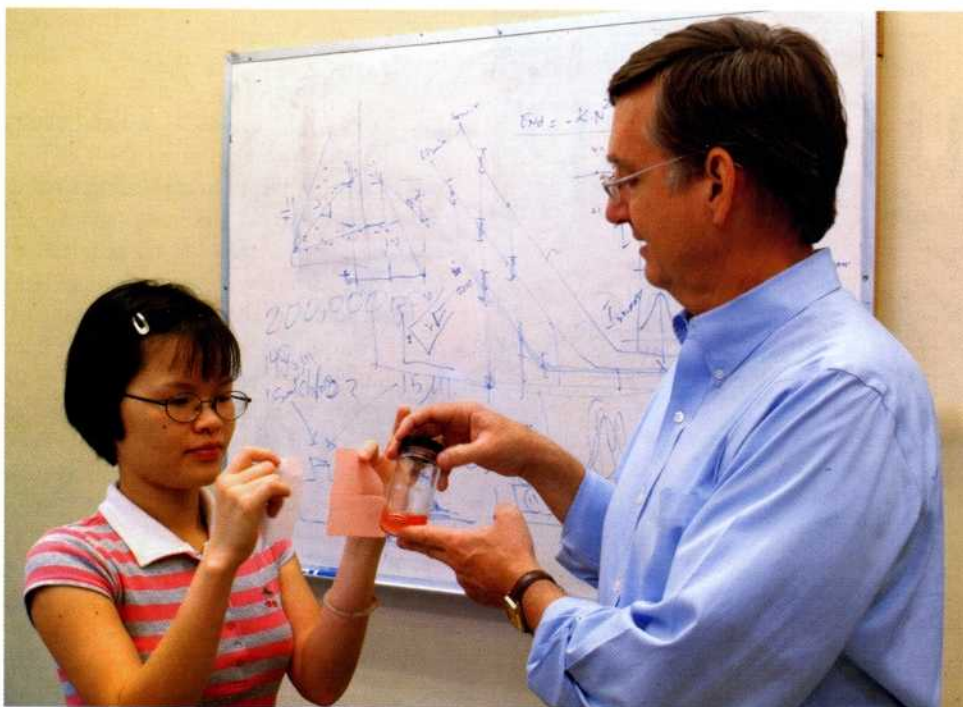
Around the same time, the impact of industry on the environment quickly was becoming part of the collective American consciousness. Two of the most famous examples were Love Canal, New York, where residents discovered that a dumpsite containing

BY DEBRA LEVY MARTINELLI

Photos by Robert Taylor

OU engineering professors Jeff Harwell, left, and David Sabatini are no strangers to laundries since their search for a safe way to remove oil from groundwater produced a veritable “super soap.”





Graduate student Phuong Do Mai, left, demonstrates “before” and “after” “super soap” samples for Professor Jeff Harwell. In similar tests, she found the OU surfactant formulation superior to grocery store products as a detergent and stain remover.

thousands of tons of chemical wastes was leaking into their neighborhood, and Woford, Massachusetts—the subject of the book and film *A Civil Action*—whose residents sued two companies for allegedly polluting the water table with a cancer-causing material.

When Sabatini, Sun Oil Company Chair of Civil Engineering and Charles L. Blackburn Presidential Professor, joined the OU faculty in 1989, he was interested in finding better ways to clean up contaminated groundwater. Collaboration with Harwell was a natural progression; the two joined forces to examine ways to make groundwater safer by removing the oil it contained. “Dave introduced me to the environmental aspect of this research,” Harwell recalls.

As funding for groundwater remediation became available in the 1990s, the pair was awarded grants from the U.S. Environmental Protection Agency with a caveat: find more environmentally friendly ways to clean. They spent the next several years refining their core technology and in 1997, together with Robert Knox, director of OU’s School of Civil Engineering and Environmental Science and John A. Myers Professor of Engineering, created a company called Surbec Environmental L.L.C. to commercialize the formula-



This little bottle in an OU engineering laboratory contains the formulation that is proving to be a wonder cleaner for home laundry and industrial clean up—as well as for its original purpose: to remove oil spills from groundwater.

tion. The company has used the core super soap technology to conduct some 20 environmental clean-ups around the country and overseas.

“Surbec has been a win-win situation. It has identified new challenges that have motivated further advances in our university research,” says Sabatini. “OU students benefit by seeing technology transfer and entrepreneurship up close and personal. And the state benefits as the company brings out-of-state money into the Oklahoma economy.”

The scientists received another grant from the EPA, this time to find a way to remove oils from vegetables for cooking oils that was safe for both humans and the environment. The resulting formulation, made by combining

known chemicals in a new way, has proven effective on a wide range of oils.

OU’s Institute for Applied Surfactant Research, a forum established 18 years ago to interact with the consumer products and surfactant manufacturing industries on the relevance and value of the University’s surfactant research, consists of faculty in such disciplines as civil engineering and environmental science, chemical engineering and chemistry. Its 17 industrial sponsors, which include Colgate Palmolive Co., Dow Chemical Co., Shell Chemical Co. and Unilever Inc., were very interested in the super soap technology.

“The IASR wanted us to develop an application for a conventional cleaning system based on information it received from an industrial cleaning company about its difficulty getting oil stains out of fabrics,” Harwell explains.

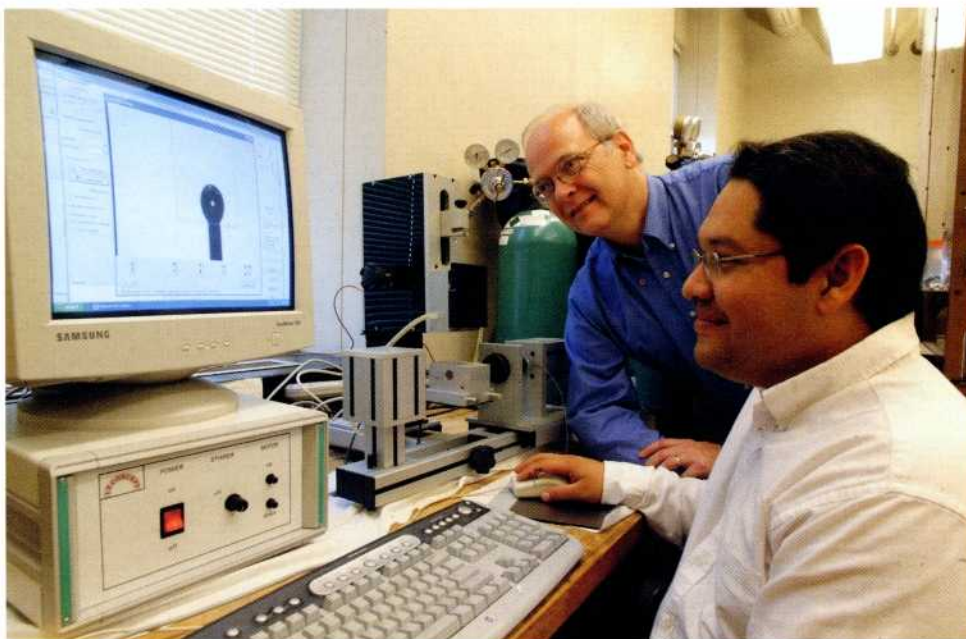
Working under the direction of Harwell and Sabatini, graduate student Edgar Acosta (who conducted the research as part of his dissertation and earned

his doctorate in May) and undergraduate student Phuong Do Mai (now an engineering graduate student at OU) tested the formulation as a detergent and stain remover. “They compared the formulation to what you buy in the grocery store, and it outperformed all of them,” Harwell says.

The super soap formulation can be used for routine household as well as heavy-duty industrial cleaning. Just as important, the reduced level of chemicals involved means a smaller amount of chemicals being released into the environment.

"It also provides more flexibility in formulating with highly biodegradable chemicals, further lowering the impact on the environment, and has the potential to have one cleaning formulation serve for a wide variety of cleaning tasks," Harwell adds.

The bottom line: It's an effective, economical and environmentally friendly all-purpose cleaner and stain remover for both industry and consumer. Harwell says several companies are interested in using their techniques to design new cleaning formulations. Similar formulations could be used for a multitude of purposes, including as a replacement for harsh industrial soaps used in the food industry and, of course, removing oil spills from groundwater.



A newly minted PhD, Edgar Acosta, right, spent five years as a graduate student working with Sabatini, left, and Harwell on the surfactant project and remains involved even after moving on to the faculty at the University of Toronto.

"It's kind of neat because you wouldn't think those two would be related, cleaning up groundwater and removing stains from clothes," Sabatini says.

"This is an example of how research in one area leads to advances in others," adds Harwell. "It's part of what makes scientific research exciting."

The OU researchers reported their findings in a recent issue of the *Journal of Surfactants and Detergents*, a publication of the American Oil Chemists' Society. The paper won the journal's 2004 Best Paper Award, sponsored by the AOCS and the Soap

and Detergent Association, a non-profit trade association representing manufacturers of household, industrial and institutional cleaning products.

Richard Sedlak, SDA vice president for Technical and International Affairs, says, "The researchers at the University of Oklahoma have cleverly found that technology originally developed to remove oil from contaminated soils can also be used to improve the removal of oil stains from our home laundry. It will be interesting to see how this knowledge affects stain removal applications in the future."

As is the case with much scientific research, the super soap project is a work in progress. "We'll continue to work on methods to remove oil from solids. We're also going to use these techniques to develop drug delivery systems," says Harwell.

The Harwell-Sabatini collaboration has been enriched through working with other faculty members in OU's IASR, two of whom, John Scamehorn, George Lynn Cross Research Professor and Asahi Glass Chair in the School of Chemical, Biological and Materials Engineering, and Edgar O'Rear, Francis W. Winn Professor of Chemical and Biomedical Engineering and director of the OU Bioengineering Center, previously have won the SDA journal's Best Paper Award.

Both Sabatini and Harwell stress that their success is only one of many at OU. "For example, nobody questions that OU's football team can compete with anybody in the country. They shouldn't be surprised that our scientists and engineers can too," says Harwell.

"One of the wonderful things about OU is how easy and fun it is to collaborate with other talented faculty," adds Sabatini. "This isn't true in many places."

Acosta, now on the faculty of the University of Toronto but still collaborating with Sabatini and Harwell, treasures the five years he has worked on the super soap project. "This research has resulted in substantial advancement in understanding the physical chemistry of surfactants and opened the possibility to formulating a wide array of products that will make our lives easier with minimal impact on the environment," he says. "It has been the opportunity of a lifetime."

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