Making pollution detection more **environmentally friendly**

BY SCOTT SISCO

INSTRUMENTS DESIGNED TO MONITOR POLLUTANTS NEED TO "SEE" HIGHER CONCENTRATIONS OF THE POLLUTANTS THAN USUALLY OCCUR IN NATURE. MOST PROCEDURES USED TO ATTAIN THESE HIGHER CONCENTRATIONS USE PRECONCENTRATION PROCEDURES TO CATCH THE POLLUTANTS. THESE PROCEDURES AREN'T USUALLY ENVIRONMENTALLY FRIENDLY. SOME SOLID PHASE EXTRACTION PROCESSES REQUIRE TOXIC SOLVENTS SUCH AS METHYLENE CHLORIDE AND BENZENE.

For the past eight years, Western Kentucky University's Eric Conte, an associate professor in the Department of Chemistry, has been looking for preconcentration procedures that are more environmentally friendly, yet will still yield the same results as other procedures in detecting pollution. "If you go out to get a sample from nature, the instruments are not going to be able to see pollutants," Dr. Conte said. "The levels are too low."

Dr. Conte's procedure works well for the more hydrophobic, or water hating, chemicals, since hydrophobic substances are easier to extract than less hydrophobic substances. The more a substance is "water hating" the more likely it will stick to other things in contact with water, like the substances Dr. Conte uses in his process.

He is still working on ways to improve trapping of less hydrophobic species by experimenting with different types of surfactants. Surfactants attached on a silica surface will make silica more hydrophobic depending upon their chemical composition.

Dr. Conte uses surfactants, a material that is a major component in soap, to remove the pollutants. He puts these surfactants on silica, and then passes environmental samples through them. The pollutants are attracted to the surfactants.

Silica is refined sand and it is a support used to hold the surfactant. Surfactants are molecules used to trap the target substances, and are molecules that have hydrophobic and hydrophilic portions. The hydrophilic portion sticks to the silica and the hydrophobic portion is exposed to the water sample and used to extract very low concentrations of hydrophobic substances.

Dr. Conte injects a sample into a gas chromatograph.

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Kyle Autry, an undergraduate student, uses electrochemical instrumentation.

Samples, such as river water, are placed in a two-liter container connected to a tube with a material inside it designed to catch any pollutants in the sample. The water drains through the material, called a sorbent, one drop at a time. "For one sample, it could take an hour or so to go through," Dr. Conte explained.

The final preconcentrate is then placed in a smaller container to make the pollutants detectable. The preconcentrate containing the concentrated pollutants is then placed in milliliter containers and placed in a machine called an autosampler. The autosampler then introduces the sample to the detection instrument that identifies the pollutants. "From there, you can tell how much of each pollutant was in that original sample," Dr. Conte said.

The instrument, a high performance liquid chromatograph, presents data in a graphical form. The pollutants show up on the graph as peaks. Each pollutant is represented by its own peak on the graph. "The bigger the peak the more the pollutant," he stated.

Dr. Conte is comparing his procedure to traditional procedures to see if his will work better as well as be safer for the environment. After the surfacants are used, they are placed in a waste container; however, the extract is less toxic than extracts produced by conventional approaches, he said.

The main pollutants he's looking at are polyaromatic hydrocarbons, produced from combustion processes like automobile exhausts and power plants. "Some of these are suspected cancer causing agents," Dr. Conte said.

Polyaromatic hydrocarbons are organic substances formed during combustion processes such as from automobile engines or coal combustion. They are also found in cigarette smoke. Some are known carcinogens. "One of these substances known to form in cigarette smoke is called benzo(a)pyrene and it is particularly carcinogenic," said Conte.

Western is Dr. Conte's first teaching job after receiving his doctoral degree — he worked for the National Center for Toxicological Research before coming to WKU. The amount of time faculty members here spend with undergraduate and master's seeking students was a major attraction to joining the Western faculty for Dr. Conte. "I've never been in a place where the faculty spent so much time, research-wise, with their undergraduate students," he said. He's currently working with two graduate students and two undergraduate students on his project.

Qing Zhao, one of Conte's students, is looking at altering the hydrophobicity of the sorbents by attaching different surfactants. She is measuring the relative hydrophobicity of each sorbent she investigates. Dr. Conte and his students will choose the sorbent system she finds that has the greatest hydrophobicity, and then apply that sorbent to less hydrophobic substances.

Another student, Kyle Autry, is using an electroactive polymer that can be manipulated electrically from a neutral to a positive state. Ideally, negatively charged surfactants will adhere to this polymer in its positive state. This material is then used to collect target substances. Then, the polymer is switched to a neutral state and the hope is that the surfactant and target substances easily fall off.

"I enjoy watching students mature as scientists," Dr. Conte said. "When one comes up with an experiment worth investigating, that tells me the student has applied his or her chemical knowledge. It also tells me that the student has a strong interest in making his or her project successful."

Photo by LaDonna Harmon

Cierra Cross, a graduate student, uses a high-performance liquid chromatograph.