

Chemists Observe A First

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A Step Toward Using Wasted Natural Gas

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Chemists from the University of Utah and Exxon Corp. have observed something never seen before: a key step in a chemical reaction used to convert deadly carbon monoxide gas into ingredients for flavorings, fragrances and medicines.

The study, published Friday in the journal *Science*, is a step toward processing wasted natural gas into industrial chemicals and less explosive fuels, said John Gladysz, a chemistry professor at the university.

The new research involves the conversion of carbon monoxide — the deadly, odorless gas in automobile exhaust — into substances called aromatic aldehydes.

Those substances include artificial vanilla flavoring; anisaldehyde, which gives perfume a hawthorn-flower scent; and naproxen, which is an anti-inflammatory drug in the same class as aspirin and ibuprofen, Gladysz said.

Chemists suspected that when carbon monoxide is converted into aromatic aldehydes, an intermediate step in the reaction involves creating an electrically charged chemical named the formyl cation. That was proved in the new study by Gladysz, and chemists Peter de Rege and Istvan Horvath at Exxon in Annandale, N.J.

Scientists want to observe the intermediate stages of chemical reactions, either to prove or disprove that the reactions happen as they suspected, said a news release from *Science*.

"The formyl cation . . . has long been considered an important intermediate in the chemistry of carbon monoxide, but it's also escaped observation — until now," the journal added.

University of Southern California chemist Surya Prakash called the Utah-Exxon work "intriguing" and "an elegant study."

That's because it opens the door to identifying other elusive chemicals formed when methane — which is natural gas — is convert-

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ed into heavier hydrocarbons.

Natural gas from remote oil and gas fields in places like Alaska and Indonesia now is burned off because it is too expensive and dangerous to transport long distances, Gladysz said. A plan to refrigerate Alaskan methane into liquefied natural gas and send it to Seattle in ships died in the 1970s due to fear of explosions.

Gladysz and the Exxon scien-

tists have a three-year, \$375,000 grant from the National Science Foundation to find ways to convert natural gas into a chemical used to manufacture less explosive substances that can be transported safely. They include ethanol, gasoline and various plastics, he said.

The chemists stumbled on the formyl cation while working on the methane conversion project.

They observed it by pumping carbon monoxide gas into thin, pencil-shaped test tubes made of sapphire.

The shatterproof tubes, which cost \$1,000 to \$2,000 each, were filled with carbon monoxide under pressure 200 times greater than normal atmospheric pressure.

In the tubes, the gas dissolved in a "superacid" more than 1,000 times stronger than hydrochloric or sulfuric acids.

The chemists then watched formation of the formyl cation in the tubes using two methods: nuclear magnetic resonance, which is similar to the magnetic resonance imaging (MRI) doctors use to look at internal body organs; and infrared spectroscopy, which reveals a molecule's makeup by showing how its atoms vibrate.

Gladysz and the Exxon chemists already wrote their study on the conversion of natural gas into industrial chemicals and less volatile fuels. They expect to publish those findings this summer.

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