

CHEMISTRY

Catalyst Combo Offers New Route for Turning Waste Products Into Fuel

With oil prices approaching \$70 a barrel and long-term oil supplies in doubt, researchers are scrambling to come up with fresh sources of transportation fuel. Now, chemists report a reaction that could squeeze fuel out of the waste from oil refineries.

When energy companies refine oil into gasoline, they break down or “crack” long-chain hydrocarbons in oil into medium-sized ones that make up an easily flowing liquid. But the process also generates many short and relatively inert hydrocarbons called alkanes that are far less useful. On page 257, researchers led by Alan Goldman, a chemist at Rutgers University in Piscataway, New Jersey, and Maurice Brookhart of the University of North Carolina (UNC), Chapel Hill, unveil a combination of two catalysts that can stitch together some of those short alkanes to make an ideal transportation fuel. Down the road, the catalysts could work the same magic on hydrocarbons from sources as diverse as renewable biomass, coal, and tar sands.

“It’s a very clever idea,” says Robert Bergman, a chemist at the University of California, Berkeley. Bergman notes that researchers have been developing both types of catalysts independently in recent years. But this is the first time they’ve been paired. The new catalysts still work too slowly for large-scale use, Bergman says, but they probably can be improved: “I don’t think this will be an industrial process tomorrow. But conceptually, it is important.”

Stitching short alkanes together is usually an arduous task, in part because both their carbon-atom “backbones” and the hydrogen atoms sprouting from them are attached by strong single bonds. So the Goldman and Brookhart groups began by looking for a way to convert alkanes into more-reactive compounds. The Rutgers and UNC labs had developed a class of compounds called dehydrogenation catalysts that can do that. But the compounds produced, called olefins, slow down the catalysts. The researchers hoped to solve that problem by adding a second set of catalysts that would take olefins out of the system.

The team turned to compounds that promote a reaction known as olefin metathesis. Last fall, three researchers in the United

States and France won the Nobel Prize in chemistry for developing these catalysts, which are now widely used to link olefins together to make everything from plastics to pharmaceuticals. The catalysts grab on to two olefin molecules at a time and rearrange the number of carbon atoms in them. Starting with hexane, a six-carbon chain, the researchers found that they could generate a wide range of compounds, including hydrocarbons up to 18 carbons long. One catalyst combo yielded primarily 10-carbon chains, an ideal component of ultraclean diesel.

The new catalytic duo is still much too slow to compete with commercial petrochemical catalysts. Goldman suspects that



Union organizer. New catalysts that link short hydrocarbons may one day transform gasoline and diesel into renewable fuels.

part of the problem is that the olefin metathesis catalysts can break down under the 125° to 175°C temperatures in their reactor. The team is working to make them more stable at high temperatures.

Another “especially interesting” path forward could be to use the new catalysts to convert agricultural waste into liquid fuels, says James Dumesic, a chemist at the University of Wisconsin, Madison. Two years ago, Dumesic’s group came up with a catalytic duo that can transform a derivative of glucose—a chief component of plant matter—into hexane. The new work shows that it’s possible to convert hexane into the hydrocarbons in gasoline and diesel. If the two processes can be put together and made commercially viable, the combination could offer energy companies a way to produce gasoline from plant wastes. That could transform gasoline into a form of renewable energy and dramatically change the world’s long-term energy outlook.

—ROBERT F. SERVICE

Data From Pesticide Tests OK’d

The Environmental Protection Agency (EPA) can use nine studies in which humans were intentionally dosed with pesticides in its decisions this year about reregulating the chemicals, a new advisory board has concluded. Activists have complained for years about the ethics of intentional-dosing studies (*Science*, 1 January 1999, p. 18), and in 2004, a report by a National Academies’ National Research Council panel called for the review board.

Meeting last week for the first time, EPA’s Human Studies Review Board was charged by the agency with examining 11 studies for scientific merit and whether there was “clear and convincing evidence that the research was intended to seriously harm participants or [purposely] failed to obtain informed consent.” The 16-member group found no such flaws but rejected two studies as scientifically inadequate; it will meet again in May and June to review more studies.

Jennifer Sass of the Natural Resources Defense Council in Washington, D.C., says all 11 studies have some ethical flaws, such as possibly harming subjects, and shouldn’t be used by the agency. But she’s pleased that the board will use a higher standard when it vets protocols for proposed research.

—ERIK STOKSTAD

Venus Rendezvous Succeeds

European Space Agency officials breathed a sigh of relief this week after their Venus Express spacecraft entered a highly elliptical orbit around Venus. Similar although riskier maneuvers have failed at Mars, and ground controllers at the European Space Operations Centre in Darmstadt, Germany, were relieved by the 10 April milestone. The 50-minute rocket burn that put the craft into orbit around Earth’s planetary neighbor was considered the most dangerous part of the mission after the launch, 5 months ago.

The \$260 million spacecraft will conduct climate and atmospheric studies of the planet’s surface in unprecedented detail using ultraviolet and visible light, radar, and infrared cameras. Magnetometers and spectrometers will study the effects of solar winds on the atmosphere.

Everyone is “very pleased,” says Fred Taylor of the University of Oxford, U.K., one of the founders of the mission. The first set of data from Venus Express is expected in about a month.

—GOVERT SCHILLING AND
LAURA BLACKBURN

has yet to restart after a 1995 sodium fire—should be a lesson for DOE. And IBM physicist Richard Garwin, who supports an expansion of nuclear energy, told Science Committee Energy Subcommittee Chair Judy Biggert (R-IL) that DOE's plan to do detailed systems and cost analysis in parallel with GNEP was akin to "driving without a map." Garwin also critiqued DOE's initial focus on the reprocessing of waste; he says showing that a fast reactor can be economical and safe is more important.

U.S. IMMIGRATION

Congress Weighs Steps to Retain Foreign Talent

Fu Chiu spent months looking for a job as a technology transfer specialist with a U.S. biotech company after he received his Ph.D. in molecular biology from the University of Illinois, Urbana-Champaign. But the native of China couldn't hang around the United States indefinitely, because his student visa expired 1 year after his 2003 graduation. So Chiu crossed the Atlantic to work for a U.K. government-funded organization, then headed home to China to join a biotech firm in Shenzhen that specializes in gene therapy.

U.S. academic and business leaders have lobbied hard to include reforms in several pending bills that would make it easier for highly skilled foreigners like Chiu to stay. Such reforms are needed, they argue, if the country is to compete effectively in today's global economy. Last week, they lost their best chance to date to see them enacted, however, when a bipartisan immigration reform bill stalled in the U.S. Senate. But supporters haven't abandoned hope: They expect the issue to be back on the table when Congress returns later this month.

One key provision in the failed immigration bill would have granted automatic permanent residency, or "green cards," to foreign students like Chiu who find a job in their field. Other measures include increasing the cap on H-1B visas—temporary visas for skilled workers—from the existing 65,000 to 115,000 annually, with a built-in provision to add 20% if the quota was filled in the preceding year, exempting spouses and minor children of foreign workers from this cap, and increasing the annual employment-based green card cap from 140,000 to 290,000 (see table, above). (Under current rules, foreign workers need their employers to sponsor them for a green card. The entire process can take several years.)

"There's a growing realization that this issue

GNEP technical manager David Hill says an outline of the research plan hashed out at the Salt Lake City meeting should be available soon. And DOE manager Shane Johnson says the department would consider Garwin's advice to save money by scaling back recycling performance goals "if upon further investigation, that was [found to be] the correct form of action." Such flexibility is exactly what Congress hopes to see as it mulls DOE's latest project.

—ELI KINTISCH

is not about immigration but about competitiveness," says Bill Bates, vice president for government affairs at the Washington, D.C.-based Council on Competitiveness. "The prospects for some of these measures going through are definitely bright." A cluster of bills introduced in January by senators Lamar Alexander (R-TN) and Jeff Bingaman (D-NM) (*Science*, 3 February, p. 594), and an upcoming measure sponsored by Senator John Cornyn (R-TX), may provide a home for such measures.

There is sharp disagreement on what those measures would do to high-tech employment, however. Ira Mehlman of the Federation for

Scientific Welcome Mat

The stalled Senate agreement on immigration contains these provisions to attract and retain scientific talent:

- Foreign students graduating from U.S. institutions with advanced science and engineering degrees would be eligible for permanent residency and exempt from a cap on H-1B visas.
- The annual number of H-1B visas issued would rise from 65,000 to 115,000.
- The annual number of employment-based green cards issued would rise from 140,000 to 290,000.

American Immigration Reform (FAIR) in Washington, D.C., which opposes the measures, says increasing high-tech immigration would dampen interest by native-born Americans in science and engineering by increasing the competition. That, in turn, depresses wages, he believes.

But Ralph Wyndrum Jr., president of the Institute of Electronic and Electrical Engineers-USA, thinks permanent residency will free well-trained foreign students from the limitations imposed by an H-1B visa and bolster salaries. "These people will be able to go around shopping for the best jobs," Wyndrum says. "The free market shall prevail."

—YUDHIJIT BHATTACHARJEE

Apes to Retire in Style

AMSTERDAM—Eighty-one chimps living at Europe's last remaining ape colony for biomedical research will retire later this year—but not under the Spanish sun, as previously planned.

Last week, the Dutch government said that 28 HIV-infected animals from the Biomedical Primate Research Centre in Rijswijk will go to a facility operated by AAP, a Dutch foundation, as planned. But the government canceled a plan to house 33 healthy chimps in a proposed AAP resort near the Spanish coast after the idea met with local opposition (*Science*, 27 August 2004, p. 1227). Instead, they will go to a "safari park" in Hilvarenbeek, the Netherlands. The remaining 20 healthy animals will go to a zoo in Amersfoort.

—MARTIN ENSERINK

Stalking Indian Ocean Illness

PARIS—Responding to a major outbreak of the crippling chikungunya virus on the island of La Réunion (*Science*, 24 February, p. 1085), the French government has announced the creation of a new research and surveillance center for emerging diseases in the Indian Ocean. France has pledged a start-up budget of \$2.7 million, but details are still sketchy. "My dream is that it will be open for researchers from around the world," says Antoine Flahault, who coordinates France's chikungunya research program. With an international scope and sufficient funding, the center could fill an important need, says epidemiologist Mark Wilson of the University of Michigan, Ann Arbor.

—MARTIN ENSERINK

Pittsburgh Goes Italian

The University of Pittsburgh Medical Center (UPMC) has joined the Italian government and its National Research Council to build a \$398 million Biomedical Research and Biotechnology Center in Palermo, Sicily. The center will host as many as 600 researchers focused on medical imaging, regenerative medicine, vaccine development, and computational biology. It will expand on the connections UPMC has established with Palermo through its ISMETT organ-transplant hospital, founded in 1997.

ISMETT Director General Bruno Gridelli says the center, funded by Italy and managed by UPMC, will provide opportunities that today are only available abroad. "We will have the control we need to make it work," says UPMC medical school dean Arthur Levine. The new research center will begin hiring this year, and the building is expected to be completed in 2011.

—JACOPO PASOTTI