

"Then the whole industry got interested."

At issue is whether Mobil's ZSM-5 and Union Carbide's silicalite are different or essentially the same material. Both are synthetic zeolites. Mobil's ZSM-5 is defined as an aluminosilicate, whereas Union Carbide's silicalite is made with silicates but without aluminum. Mobil's assertion that its patents are being infringed rests on the allegation that Union Carbide's silicalite contains aluminum and thus is indistinguishable from ZSM-5. Union Carbide vigorously denies this allegation. Silicalite is "essentially a silica polymorph, with no aluminum in it," asserts Union Carbide attorney H. M. Humphreys.

Union Carbide scientists have maintained that silicalite is free of aluminum, except for trace contamination. This contention is based partly on x-ray diffraction pattern analysis, which traditionally has been the standard technique for analyzing zeolite structure and composition.

However, in 1982 a team of chemists from the University of Guelph in Canada and the University of Cambridge in England published their analysis of several zeolites based on the technique of magic-angle-spinning nuclear magnetic resonance (NMR). They found that, contrary to Union Carbide's claims, silicalite contains more than trace amounts of aluminum. Moreover, even when present in slight amounts, the aluminum forms an integral part of the zeolite's structure. This finding has since been repeated and published in several papers.

"We have recently developed techniques to remove aluminum very efficiently from zeolites," Colin Fyfe, one of the University of Guelph chemists, told *Science*. Fyfe, who has been asked by Mobil to serve as a witness when the Union Carbide lawsuit comes to trial, says that this refined technique makes the NMR data "more meaningful." Removing most of the aluminum from a sample of ZSM-5 "transforms" it into silicalite, he asserts. "The aluminum [NMR spectral] signal stays in the same position, which suggests it [the aluminum] is in the structure. My belief is the structures [of the Mobil and Union Carbide products] are the same."

Some scientists assert that the presence of aluminum or similar metallic elements is, besides being integral to the structure, also essential for catalytic activity of the zeolites. "Aluminum is present everywhere as an impurity," points out one industry scientist whose company is not directly involved in the current lawsuits. He says that Union Carbide

scientists have argued that avoiding aluminum in silicalite is practically impossible because it is present "in all reactants." But winning this argument may not win the lawsuit for Union Carbide, he says. "I personally think that catalytic activity is proportional to the aluminum in the structure." Adds a university researcher recalling conversations with industry colleagues who have firsthand experience, "I think the [aluminum-free] zeolite is a dud as a catalyst."

In spite of this assertion, Mobil has been trying to extend its aluminosilicate line of zeolites toward the aluminum-free end of the product spectrum. Company scientists have patented an extensive series of zeolite compounds having very low levels of aluminum. The company also has had the patent office reissue an earlier document claiming, for Mobil, metal organosilicates "essentially free of group IIIA metals," such as aluminum. Although Union Carbide scientists hold several patents for zeolites, a company attorney says there is "no enforceable U.S. patent" for silicalite. But that fact "has no bearing . . . Union Carbide wants the court to look at the [Mobil] patents and our silicalite product and see that our sieve does not infringe on any valid claims of the patents."

The dispute between Mobil and Amoco sounds similar but is built around another chemical element—boron. Amoco's Marvin Klotz has obtained several U.S. patents during the past few years covering boron-containing zeolites. He and his associate Stephen Ely carefully distinguished their "crystalline borosilicate" from particular Mobil zeolites, which they describe as "synthetic crystalline aluminosilicates containing a minor amount of boria. . . ." Mobil claims that its chemists hold earlier patents than Amoco's, and thus it, rather than Amoco, is entitled to the exclusive use of boron-containing zeolites.

Amoco insists that its borosilicate molecular sieve material contains boron in its molecular framework and is thus distinct from Mobil's catalysts. Industry observers say that the presence of boron in particular formulations of zeolites is "important for catalytic activity" and that it gives "advantages when it comes to selectivity." Thus Amoco seems to be on solid scientific footing in claiming that its scientists "discovered an original, proprietary xylene isomerization catalyst." However, the company's crucial assertion that use of this catalyst "does not use any Mobil technical information or fall within any Mobil patent rights" has become a matter for the court to decide.—JEFFREY L. FOX

Two Chilean Professors Released

Word has come from Chile that two of the three mathematics professors seized by the government in November have been released unharmed (*Science*, 21 December 1984, p. 1405). The third, Douglas Fuente, is being held in a detention center.

The seizures were among thousands of arrests and detentions that have been occurring in the wake of nationwide antigovernment demonstrations in September.

The sources in Chile reportedly attribute the release of the two professors at least in part to the surge of telegrams sent to Chile's military-run government by professional societies in the United States, Canada, France, Argentina, and Brazil.

—CONSTANCE HOLDEN

Scientific Boycott Proposed to Aid Refusenik

Four American and British microbiologists have called on their colleagues to stop sending bacterial strains to Soviet scientists as a protest over the stalled emigration plans of molecular geneticist David Goldfarb.

Goldfarb was planning to leave Moscow last April when the KGB stepped in, confiscated his strains, and blocked his visa (*Science*, 11 May 1984, p. 582).

Now Max Gottesman of the National Cancer Institute and Charles Yanofsky of Stanford University have sent letters to American biologists through the Committee of Concerned Scientists in which they propose a moratorium on sending strains to the Soviet Union until Goldfarb is allowed to leave. A similar initiative has been taken by Michael Yudkin of the University of Oxford and Simon Baumberg of the University of Leeds.

Goldfarb is being detained for "security" reasons although he says he never worked with secret material. Formerly the director of the Laboratory of Molecular Genetics of Bacteria and Bacteriophages in Moscow, he obtained some of his original strains from the United States, including