chemistry

FUEL CHEMISTRY

Desulfurization kinetics

Despite reputed advances in the desulfurization of fuels, a report by the National Research Council of the National Academy of Sciences concludes that no commercially proven method for sulfur-oxide control has been devised. One of the areas recommended for Federal support was removal of the sulfur from coal by means of gasification.

Research in this line by Scientific Research Instruments Corp. in Baltimore could help in developing a successful desulfurization process. Dr. William H. Johnston and Marvin Vestal have identified five chemical reactions in 10 types of bituminous coal and worked out the rates at which they occur. This information could assist in setting up a practical reactor system for coal desulfurization.

Two of the five desulfurization reactions involve reduction by hydrogen of pyrites—iron sulfides—in coal. The other three reactions involve attacking the carbon-sulfur linkages, either by low-temperature heating or by a process of high-temperature reduction employing hydrogen.

INSTRUMENTATION

New analysis technique

One way to get information about the molecular structure of hydrocarbons is with a flame ionization detector. The hydrocarbon is burned, and the number of ions produced is an index of the number of carbon atoms in the sample.

A supplementary method has been devised by chemists at the Naval Research Laboratory in Washington, D.C. Called a catalytic ionization detector, it differs in operation from the flame detector in that instead of being burned in a flame, the hydrocarbons are oxidized on the surface of a platinum catalyst. This way, the number of ions produced depends on molecular structure, not carbon-atom number. The detector could be used to pick out highly branched hydrocarbons in petroleum mixtures.

ORGANIC CHEMISTRY

Carbonium ion hassle

For the past decade, physical organic chemists have debated the question of whether carbonium ions—positively charged hydrocarbon molecules—exist in nonclassical form. At the heart of the issue is whether or not the charge is localized (the classical form) or delocalized (the nonclassical form).

Calculations by Prof. Leland C. Allen and David Goetz of Princeton University have come up with the notion that the charge can be classical or nonclassical, depending on the state of the chemical. Calculations show that in the gas phase, the charge exists in the classical, localized form; when the ion is in solution, the charge exists in the nonclassical, delocalized form.

The difficulty with determining the nature of the charge experimentally is that carbonium ions are short-lived, although important, intermediates in organic chemical reactions. Prof. Allen hopes that a better conceptual model of reaction intermediates like the carbonium ion will lead to a greater understanding of organic reactions generally.

MEDICINAL CHEMISTRY

Fighting androgen

Androgen, a male sex hormone, has been implicated in a variety of human ills from prostate diseases to sexual precocity to baldness. To counteract these effects, chemists at the Squibb Institute for Medical Research in New Brunswick, N.J., have synthesized a model antiandrogen compound, reports Dr. Leonard J. Lerner.

Called A-norprogesterone, it has inhibited the stimulatory effects of androgen on nucleic acids and enzymes and reduced prostate size and fluid as well as seminal vesicle growth in test animals. It has also decreased the oily sebaceous glands producing acne.

Both it and other antiandrogens have side effects, such as raising the body's temperature, which must be cleared up before they are ready for human use.

ACTIVATION ANALYSIS

Seeking out the culprits

Because of excellent thermal and nuclear properties, sodium is the coolant of choice for fast breeder reactors. However, sodium can corrode and carburize (introduce carbon) into structural components it contacts. Scientists think trace amounts of carbon and oxygen are the culprits in the deterioration process, but to understand better what happens, techniques to analyze for them in the parts-per-million range are needed.

Dr. George Lutz of the National Bureau of Standards has developed such a method. Using proton activation analysis, he bombards the sodium sample with high-energy protons. This produces radioactive isotopes of carbon and oxygen, which are then chemically separated and their activity electronically measured to determine their amounts.

POLYMERS

New membrane process

Although semipermeable membranes are used in waste water purification, artificial kidneys, and industrial filtration and purification processes, their drawbacks are low flow rate due to low permeability, poor selectivity and short membrane life. A process has been developed by Drs. Robert W. Coughlin of Lehigh University and Richard D. Siegel of Northern Research & Engineering Co. in Cambridge, Mass., that can increase membrane permeability and selectivity as much as 88 percent and 24 percent respectively and substantially increase membrane life.

In the new process, the membrane absorbs a solvent and swells. It is exposed while swollen to isotopic radioactivity, which crosslinks the polymer's molecular chains. As a result, the membrane becomes more permeable to molecules of that solvent's dimensions, letting more of similarly sized molecules through while rejecting others. The crosslinking is also responsible for the greater membrane life.