CHEMISTRY

Linda Garmon and Julie Ann Miller report from Las Vegas, Nev., at the meeting of the American Chemical Society

Fiber optics for skin monitoring

Workers at synfuel plants may be exposed to coal tars and oils that are potential cancer causers. Until recently the method for monitoring such exposure has been to illuminate parts of a worker with a hand-held ultraviolet light and look to see if any areas of skin fluoresced brightly. This technique, however, is no longer recommended for routine industrial hygiene because it exposes the worker to intense UV light that may cause cancerous cells or act synergistically with chemicals. Now, an instrument for monitoring exposure to the polynuclear aromatic compounds has been developed at Oak Ridge National Laboratory.

T. Vo Binh and R. B. Gammage report that the new technique has been field-tested recently at a coal gasifier facility. The hands of six workers were examined with the luminoscope, which has a bifurcated fiber optic wave guide carrying a small amount of UV radiation to the skin and conveying the fluorescent emission back onto the detector. In the trial, two workers were found to have a doubling of fluorescence caused by residual contamination. In addition, the scientists learned that background fluorescence varies up to 35 percent between individuals and that some areas of the skin, such as calluses and finger tips, are naturally highly fluorescent. Vo Binh and Gammage say that data files will be necessary for individual workers, indicating their most fluorescent areas. The instrument, they say, is simple to operate, weighs 1 kilogram and costs about $2,000.

A magnetic 'believe it or not'

It sounds more like hocus-pocus than chemistry, but treating water magnetically lessens mineral depositions inside pipes, hot water heaters, washing machines and industrial boilers.

When heated, the calcium dissolved in water precipitates a calcium carbonate, forming scales on the interior of containers. When scales accumulate, it takes more energy to heat the water. In fact, industrial equipment that uses water vapor for manufacturing processes must be shut down periodically for scale removal. Magnetizing the containers can lessen scale formation, says Frank Ellingsen of Johns Hopkins University in Baltimore.

Magnetic water treatment devices that prevent the scale formation are available in Europe, but many scientists doubt their value. Now, Ellingsen reports that he has confirmed the beneficial magnetic effect in hard (calcium salt containing) water. He attaches a magnetic device to a boiler to treat the water. "In some cases," he says, "the amount of scale formed was reduced by a factor greater than 100." Moreover, Ellingsen says his experiment verified a "memory effect" — the magnetism was still effective against scale formation days after treatment — and "a clear dependence on the field strength." To date, however, the mechanism of the magnetic influence is still a mystery.

Polyurethane: A joint effort

A new elastic material related to the rubber used in the tire industry may work its way into kneecaps. The material, a polyurethane, has been used successfully as a cartilage replacement in rabbits, reports Edward W. C. Wong of Avco Everett Research Laboratory, Inc. in Everett, Mass.

Especially for young patients with injured joints, replacing only cartilage is an attractive and feasible alternative to total joint replacement. Although silicone is now used for such treatment, it is not strong enough to do the job, and the necessary reinforcement fillers can cause bloodclots. Polyurethane, though, has the strength and is biocompatible — reactions to foreign tissue are fewer than with silicone, Wong says.

In addition, polyurethane mimics the role cartilage plays in absorbing shocks. The bone-covering cartilage at the kneecap converts the fluid that separates the bones into a cushioning medium by absorbing the watery portion of the fluid and leaving behind a thicker fluid to protect the bones against the stress of jumping, running, walking and even standing. The "walking kneecap" sustains a force about five times a person's body weight. In tests simulating one year of walking, Wong's new implant material withstood the force and regulated the lubricating system to prevent joint damage.

Polyurethane is also under consideration for use in elbow joint replacement and as percutaneous attachments — devices that penetrate the skin to connect internal organs with external batteries or prosthetics.

Prostaglandins from the sea

Coral growing in the Caribbean Sea is a promising source of prostaglandins, says Gustavo A. García de la Mora of the University of Mexico. He has recently completed a study of 120 kilometers along the coast of the Yucatan Peninsula to examine the commercial possibility for coral-derived drugs. The black coral he studied, which grows 4 feet high, makes large quantities of PGA_2, a form of prostaglandin that is not very active. García de la Mora harvested a higher concentration of prostaglandin than other researchers have, and he suggests the difference may be that he took only the top 8 to 10 inches of the coral branch. Because he harvested only one branch per coral, he expects the coral to regenerate quickly. He found little seasonal variation in the prostaglandin content of the coral, except for a drop during coral's reproductive period in July and August. García de la Mora reported new methods to convert PGA_2 to more active forms. In Mexico, which has 300 kilometers of barrier reef along the Caribbean coast, there's great interest in using coral as a source of biologically active compounds, he says.

These soldiers make glue

Nasute soldiers are impressive defenders: Their heads are "chemical bazookas" that eject a viscous, sticky solution that irritates and mechanically disables the enemy. Even more impressive, however, is the chemically complex weapon that these glue-squirting termites manufacture.

Glen D. Prestwich of State University of New York at Stony Brook has obtained the first direct evidence that nasute termites synthesize a 20-carbon compound called diterpene from simple precursors like sodium acetate, a compound that has two carbons. Prestwich employed several analytical techniques such as chromatography and X-ray diffraction to obtain evidence of this termite activity. Biosynthesis of diterpene — a close analog of pine resin, a defensive glue in plants — has never before been seen in insects. "Although our work with tropical glue-squirting termites is unlikely to result in either an anticancer drug or a superior industrial adhesive," says Prestwich, "the unusual chemistry and biochemistry of these compounds have provided insight into the complexity of a primitive social insect and the chemical sophistication of its anti-predator defenses."

Chemical combatants for common colds

Two chemicals that inhibit the viruses responsible for the common cold have been developed by Charles J. Paget and colleagues at Eli Lilly and Co. The compounds, which are called "enviroximes," are chemicals of the benzimidazole family. In tissue culture tests, enviroximes inhibit all 63 of the cold-causing rhimovirus types tested as well as several other viruses. They are also active when administered orally in animal tests.