Chemistry

Ivars Peterson reports from Washington, D.C., at the annual meeting of the American Institute of Chemical Engineers

An effluent life-style for fungi

The unsightly colors of wastewaters that spew from pulp and paper mills may become a sight of the past if a fungus successfully adopts an effluent life-style. Colored wastewaters pass through conventional biological treatments relatively unchanged because the bacteria in these systems fail to degrade the colored compounds present in the effluent quickly enough. These colored compounds consist largely of lignin, which is a cellulose-like material that acts like a cement to bind together cellulose fibers in cells, and its degradation products. The only microorganisms capable of degrading lignin in a sufficiently short time and hence removing the color are the fungi that cause the white-rot type of wood decay.

Researchers at North Carolina State University in Raleigh and the Forest Products Laboratory in Madison, Wis., are studying the conditions under which the white-rot fungus *Phanerochaete chrysosporium* best removes wastewater color. Their recent laboratory-scale test took place in a biological reactor running at 40°C under an oxygen atmosphere and supplied with glucose and other basic nutrients. The researchers reported progress in significantly increasing the lifetime of the process, overcoming a major problem that delayed earlier commercial applications of the process. They found that if nitrogen in the form of ammonium chloride was added to colored wastewater that came from a mill's bleaching plant and if mill effluents were biologically treated first, the fungus survived for a longer time than before.

Snowpacks, thaws and acid shocks

Over the course of a winter, acids precipitated from the atmosphere build up in snowpacks. During the spring thaw, the sudden release of these acids—acid shock—can cause a rapid, temporary increase in the acidity of streams and lakes resulting in potentially grave consequences for fish and other organisms (SN: 5/21/83, p. 332). However, researchers have not agreed on the precise path followed by acids stored in and released from the snowpack.

To help clarify the situation, scientists from the General Motors Research Laboratories in Warren, Mich., spent one winter studying in detail acid levels in the snowpack at the University of Michigan Biological Station near Pellston, Mich. Their study showed that all the monitored acidic and alkaline species stayed in the snowpack until it melted. Some scientists had postulated that a portion of the acidic species migrated through the snow into underlying soil even before melting began.

The study confirmed that much of the acid trapped in snow is released in the early stages of melting. Measurements showed that during the spring thaw, about 50 percent of the acid was released in the first 20 percent of the snowmelt. However, rainfall deposited as much nitrate and double the amount of sulfate compared with the amounts released from the snowpack. This indicates that rainfall contributes to the acid shock effect.

Bacterial carbon-cleaning machines

Chemical engineers at the State University of New York at Buffalo have designed a novel biological reactor that combines the ability of activated carbon to adsorb organic chemicals from wastewaters and the ability of bacteria to regenerate the carbon by breaking down the trapped molecules. Such a system would consist of bacteria growing as films on the surfaces of uniformly sized carbon granules suspended in a liquid. As bacterial film thicknesses increased, the granules would tend to rise within the fluidized bed reactor. Washing off the bacterial coating from granules in this upper layer would allow the regenerated carbon to be recirculated, saving the cost of thermally regenerating fresh activated carbon.

Physics

Fractional charge a negative

The availability of beams of heavy ions (essentially heavy atomic nuclei) accelerated to high energies by the Bevalac at the Lawrence Berkeley Laboratory in Berkeley, Calif., has enabled physicists to mount a new kind of search for fractional electric charge, that is, bodies with fractions of the charge of an electron. The electron charge has been considered heretofore to be the quantum of charge, the minimum amount that can exist. But quarks, the objects that are supposed to be the building blocks out of which neutrons, protons and most other subatomic particles are made, are supposed to have fractional charge. Thus, the discovery of fractional charge might be also the discovery of free or at least unbalanced quarks. Such a discovery would be a serious blow to commonly accepted theory, which holds that quarks are always bound in particles with unit or zero change.

One experiment, by William H. Fairbank and others of Stanford University, claims to have found and continues to find fractional charges. Attempts all over the world to confirm this have failed. Reasoning that a high energy interaction between two quark-rich nuclei would be a favorable place to generate objects with fractional charge, Michael A. Lindgren of San Francisco State University and 14 others set up an experiment in which the Bevalac drove high-energy iron nuclei against a lead target. Behind the target was an array of wires of various metals electrically biassed to attract fractional charges. The surfaces of the wires were then dissolved in suitable solvents.

Two samples of gold dissolved in mercury have been examined so far by passing them drop by drop through a chamber where electric and magnetic fields would pick out fractional charges. None have appeared, and the data (reported in the Oct. 31 PHYSICAL REVIEW LETTERS) set very low limits, less than one fractional charge in 2 million nuclear collisions, on the possibility of their production. So the mystery of why Fairbank finds fractional charges and nobody else does, remains.

Solitons on water

Solitons, a particular kind of solitary wave, are becoming important in many branches of science such as biology, chemistry, condensed matter physics and particle physics. Usually waves come in trains, but sometimes conditions permit the formation of solitary waves, single undulations moving across flatness. If two solitary waves have the property that they can collide, pass through each other and come out of the collision with the same shape and velocity they had before, they are solitons.

In science, solitons can be purely mathematical or they can refer to things like chemical processes in a biological cell or electronic effects in solids. Sometimes, however, they can be made visible on the surface of water. Junru Wu, Robert Keolian and Isadore Rudnick of the University of California at Los Angeles described their discovery of a new kind of water soliton at this week's meeting in San Diego of the Acoustical Society of America. They take a trough 39 centimeters long and 2.5 cm wide filled with water to a depth of 2 centimeters and oscillate it vertically with an amplitude of 0.06 cm at a frequency of 10 cycles per second. A standing wave of high amplitude forms, oscillating across the width of the trough.

"It is surprising and intriguing," they point out, "that while all parts of the 15" [39 cm] long trough are oscillated with equal amplitude, the vigorous wave motion of the soliton occurs only in a space about one inch [2.5 cm] long, while the rest of the water remains quiet." The soliton can be stably positioned anywhere along the length of the trough, but if the trough is tilted, it moves toward the shallow end. More than one soliton may form. Two of opposite phase will pair up with a few inches between them. Those of like phase may combine into one or they may form pairs that attract and pass through each other and then turn around and do it again.