Energy

Wind power—what bugs cost

A wind-turbine manufacturer noticed that the performance of his devices tended to fall off notably over dry spells, then spring back following a major shower. Could it be due to bugs? He posed the question to Texas Tech University's J. Walt Oler. And the Lubbock-based mechanical engineer's new computer modeling data indeed support the manufacturer's suspicions.

Oler developed computer models to simulate the rather minor change in blade-surface roughness that might result from the buildup of insect bodies. "We've played it down in all our technical writing and called it surface roughness," Oler explains, "but really what we are talking about is bug guts like you have on your windshield." He used the models in calculations to determine how the reconfigured turbine blades—having diameters of 32, 100 and 200 feet — would affect energy-conversion efficiency. And he was rather surprised to find the devices' annual energy output could drop 20 percent or more as a result of the bugs impact. But at least for small to medium-sized systems, Oler believes there may be a cost-effective solution — hosing down buggy blades.

New lights to land in arctic nights

Airport-landing lights powered by the radioactive decay of tritium (a heavy isotope of hydrogen) are undergoing field tests in Alaska. With these radioluminescent beacons, remote arctic airfields—some of which get no more than three hours of daylight during the height of winter—may be able to extend operating hours and upgrade landing safety, according to project manager George Jensen at the Battelle Pacific Northwest Laboratories in Richland, Wash.

Each self-contained light is made up of several wands — tritium-filled tubes whose inside surface has been coated with a zinc-sulfide based phosphor. As the tritium decays, emitted beta particles excite the phosphor, causing it to glow. Though these lights have been around for decades, Jensen says that scaling them to a size and intensity that makes them visible from more than two miles — the current limit — is proving a challenge to their developers at Oak Ridge National Laboratory in Tennessee. "The phosphor has got to be thick enough to get the light you want," he notes, "but not so thick that the beta particle can't penetrate to the point where you want it to glow." And there's a limit on the tritium that can be packed into a given volume; if it's too dense, Jensen says, emitted beta particles may be absorbed by the tritium instead of the phosphor.

These lights could cost about $60,000 to light a 3,000 foot runway. Where there are no existing power lines, that's only 20 to 40 percent of what installing conventional lights would cost. And the military no doubt appreciates their rapid deployment. A runway was lit in just two hours during one Air Force test in Alaska last year. And except for needing an occasional surface cleaning, lights should require no care throughout their 8 to 10 years of continuous operation.

Heat-pipe furnace

A residential gas furnace with a seasonal efficiency of almost 85 percent (compared with the 60 to 70 percent efficency typical of conventional units only a few years old) is expected to go into commercial production later this year. The almost instantly warming furnace uses finned heat pipes (SN: 9/17/77, p. 185) to transfer a flame's heat to a circulated air stream. The heat pipes —hollow tubes filled about one-third full with a yet-undisclosed fluid—"have a thermal conductivity thousands of times that of pure copper," notes project manager Robert Hemphill, at the Gas Research Institute in Chicago. The furnace technology was developed by GRI with Thermo Electron Corporation of Waltham, Mass., and will be marketed by Borg-Warner.

Chemistry

Explosive results from fluorine, water

Two chemists have filled in a longstanding gap in fluorine chemistry knowledge by measuring the rate of the violent reaction that occurs when fluorine gas (F_2) is bubbled into water. Their results show that the reaction is half-completed in slightly less than 10^{-5} second. They also determined the intermediate reaction steps that lead to the final products, oxygen and hydrogen fluoride. This new information opens the possibility of using fluorine in water as a fluorinating agent in industrial and laboratory processes.

Evan H. Appelman of the Argonne (Ill.) National Laboratory, who worked with Richard C. Thompson of the University of Missouri in Columbia, says that although the rate is rapid, "it's not so rapid that other things can't happen." This is important because some reactions in which fluorine is added to certain compounds occur only when the compounds are dissolved in water. Appelman says, "It shows you that you have a substantial 'window of reactivity.' Any substance that can react with the fluorine at a rate greater than the water reaction can be fluorinated in aqueous solution."

In the past, chemists have done little quantitative work on the fluorine-water reaction. Appelman explains, "People who work with aqueous solutions in general don't like the idea of working with molecular fluorine. The traditional fluorine chemist is conditioned to do everything in his power to keep water out of the reaction solution." He adds, "Not only fluorine itself but a number of reactive fluorine compounds have been neglected by most fluorine chemists. . .just because it goes against the grain to put a reactive fluorine compound in the water."

In alkaline solutions, the fluorine-water reaction is faster and more complex. Because it is not understood why some fluorinations occur only in alkaline aqueous solutions, says Appelman, these reactions need further study.

Protection against 'yellow rain'

At present, the only practical way to protect against a class of natural fungal toxins found in cereal grains and possibly used in warfare ("yellow rain") is to prevent people from being exposed, says a recent National Academy of Sciences report, "Protection Against Tricothecene Mycotoxins." The study examined the environmental and biological behavior of the tricothecene class of mycotoxins, produced by certain species of fungi, to determine what protective measures can be taken. The committee did not support or refute the evidence for the military use of such toxins (SN: 6/11/83, p. 374).

The committee found that there is no specific antidote known for treating tricothecene poisoning. Protective masks and waterproof clothing or shelter can greatly reduce exposure, but because the compounds can linger in the environment for months, protecting water and food supplies becomes difficult. The committee recommended that research is needed on the toxins' natural occurrence worldwide, to develop faster, more specific detection techniques, and to identify drugs or decontamination methods that mitigate the toxins' effects.

A molybdenum short cut to hydrazine

A chemist has devised a quicker way to produce hydrazine, (N_2H_4), a chemical used in the manufacture of plastics, pharmaceuticals and other materials. The method allows the production of hydrazine directly from atmospheric nitrogen instead of going through steps that produce ammonia first.

T. Adrian George of the University of Nebraska in Lincoln reports that the method is based on a reaction that gives either ammonia or hydrazine, depending on the solvent used in the process. The reaction involves molecules containing the metallic element molybdenum, which bind atmospheric nitrogen.