Environment

Cistern water: Soft — and corrosive

Last year, the Environmental Protection Agency (EPA) proposed corrosivity limits on large drinking-water systems to control the leaching of lead from household plumbing (SN: 8/20/88, p.118) — a decision prompted in part by concerns that acid rain increased the corrosivity of drinking-water sources. But water softness may play nearly as big a role as acidity in leaching toxic metals, a new study finds.

Researchers sampled water from 50 similarly designed cistern systems — half in Kentucky and Tennessee, the rest on St. Maarten, in the Netherlands Antilles. Because sitting in plumbing overnight gives water more time to leach metals, the study's sampling included this "standing" tap water.

Results, reported in the March ENVIRONMENTAL SCIENCE AND TECHNOLOGY, show that although the Kentucky-Tennessee rainwater had a pH of about 4.5 — making it roughly 100 times more acidic than St. Maarten's — water in all the cisterns had comparable pH levels: The mean pH ranged from a neutral 7 to a slightly alkaline 7.6. It appears that concrete or plaster lining the cistern tanks neutralized the U.S. acid rain, says Harvey Olem, a Washington, D.C., consultant who led the project while working as a Tennessee Valley Authority staff scientist in Chattanooga.

Cisterns also removed metals in rain or leached from rooftop collectors, precipitating them into their tank sediment. That's why the researchers were puzzled that higher levels of 11 constituents — including lead, cadmium, zinc and copper — came out of taps where rainwater had been acidic. This, the researchers say, suggests "a causative link" between leached plumbing metals and some aspect of acid rainwater other than pH — such as water softness. High calcium levels, which typify hard water, tend to coat pipe interiors with a residue that protects plumbing metals from leaching, Olem notes. Dependent on soft (low-calcium) rainwater, both regions he studied suffered measurable leaching of plumbing metals. For example, in 72 percent of the Kentucky/Tennessee homes and 40 percent of the St. Maarten homes, lead levels in standing tap water exceeded the proposed limit — 5 micrograms per liter of lead — being considered by EPA for U.S. drinking waters.

Smog-curbing limits on gas volatility

On March 10 the EPA announced new limits on the volatility of U.S. gasoline for summer months, defined as May 1 to Sept. 15. Agency officials anticipate that the new standard, scheduled to go into effect around July 1, will reduce by roughly 13 percent emissions of pollutants that contribute to smog ozone. These limits lower the allowable vapor pressure for most states to 10.5 pounds per square inch (psi), from the 11.5 psi typical in many areas today. But based on zone categories reflecting a state's altitude, climate and average temperature, the new standard does vary by region — and sometimes by month — to a possible low of 9 psi.

Though U.S. cars have been designed to run on 9-psi fuels, volatility has crept upward recently as refiners have responded to the phaseout of octane-enhancing lead by substituting butane and other highly volatile octane boosters. Less volatile alternatives tend to be costlier.

William Becker, executive director of the State and Territorial Air Pollution Program Administrators in Washington, D.C., argues that if the Bush administration wanted to demonstrate its commitment to fighting the growing problem of urban smog (SN: 2/25/89, p.119), it should have lowered summer volatility to a maximum of 9 psi and required similarly cost-effective vapor-recovery systems on gas pumps and new cars. He notes that the wording of the new rule also makes it legally difficult for some cooler states that have set 9-psi limits to enact tougher-than-federal rules.

Space Sciences

Jonathan Eberhart reports from Houston at the 20th Lunar and Planetary Science Conference

Have Earth rocks gone to Mars?

The possibility that three meteorites named Shergotty, Nakhla and Chassigny came from Mars has intrigued planetary scientists for a decade. Geochemically they seem reasonable candidates as samples of the planet, but only in the last few years have some researchers concluded that the rocks might actually have been blasted free of Mars' gravity by other meteorites. A different question, however, is whether meteorite impacts on Earth have similarly driven rocks from this planet to Mars.

According to S.A. Phinney, now at Wright-Patterson Air Force Base in Dayton, Ohio, and colleagues from the University of Arizona in Tucson, kicking a rock hard enough to free it from Earth's gravity would require a meteorite capable of making a crater more than 60 miles across. In addition, Mars' orbit is much larger than Earth's, so the chance of an Earth rock hitting Mars is about 10 percent that of the same thing in reverse.

Phinney's group used a computer to calculate where 1,000 particles would go if ejected from Earth in random directions, moving about 2.5 kilometers per second faster than the minimum speed necessary to escape. Of the 1,000 hypothetical particles, 291 hit Venus and 165 returned to Earth; 20 went to Mercury, 17 to Mars, 14 to Jupiter and 1 to Saturn. Another 492 left the solar system completely, primarily due to gravitational close encounters with either Jupiter or Mercury that "slingshot" them on their way. Other computer runs showed the same general trend.

The group found fewer particles seemed likely to get to Mars than suggested by some previous analyses. Even so, the authors point out, "it could be further argued that if Mars material reached Earth, Earth material might have reached Mars and other planets, perhaps carrying with it viable microorganisms and spores residing in the near-surface rock and soil. Thus Mars may in fact have already been contaminated with Earth life." On the other hand, Phinney and his co-workers say, "the conditions on Mars are sufficiently extreme that any microbes that survived the trip in space would probably be killed on its desolate surface. Thus we are still unlikely to find life on Mars."

Here's looking at you, Triton — probably

The last major planetary body photographed during the Voyager 2 spacecraft's 12-year grand tour of the solar system most likely will be Neptune's big satellite Triton, late in August. The only major moon not clearly visible during the mission so far is Saturn's Titan, which is masked by a dense methane haze, but Earth-based observations have detected methane on Triton, too. Will the surface of this strange, backwards-orbiting satellite (the only one known around any major planet) pass unseen?

Scientists know little about Triton. Estimates of its diameter range from 2,200 to 4,800 kilometers, and its apparently steeply tilted axis may produce unusual seasonal variations in its atmosphere. John A. Stansberry, Jonathan I. Lunine and Martin G. Tomasko of the University of Arizona in Tucson note that the atmosphere's optical depth, essentially a measure of its opacity, is likely to have increased nearly tenfold since the first spectral observations of Triton in 1975, but probably not enough to hide its surface.

The optical depth is expected to have changed from 0.06 in 1975 to 0.6 by 1990, the year after Voyager's flyby, because Triton's south polar cap will be pointed directly at the sun. By comparison, the optical depth of the Martian atmosphere is typically about 0.2, suggesting that the optical depth during the Triton encounter will be "not large enough to obscure the surface, but large enough that it may be measurable by Voyager's cameras."