The minute you start talking about what you're going to do if you lose, you have lost.
George Schulz, U.S. Secretary of State

DRINKING WATER QUALITY

Taking the Lead and Copper Rule to Task

When testing in 2003 found higher-than-allowable lead levels in the District of Columbia's drinking water, it hit awfully close to home for some law makers, prompting three U.S. legislators to direct the Government Accountability Office (GAO) to evaluate how well the EPA regulates lead levels in drinking water. In January 2006, after a year-long investigation, the GAO reported that although the EPA says lead levels in drinking water systems have dropped since the early 1990s, the agency in fact has no data—which states are supposed to provide—to support that finding for about 30% of medium and large municipal systems. Additionally, although the EPA requires states to report on lead-in-water "milestones," or measures that must be met, the agency lacks those data for 72% of water systems.

The report centered around the question of how well the agency enforces its 1991 Lead and Copper Rule. This rule requires water utilities to sample lead levels in homes and, at certain trigger points, to notify customers and sometimes take remedial action.

The Lead and Copper Rule is unusually tricky to enforce, because the contaminants in question are out of the control of the water utilities. "What makes lead so unique is that it's picked up in the distribution system; everything else, like *E. coli*, is treated at the water treatment facility," says John Stephenson, director of natural resources and environment at the GAO.

Usually lead is introduced to drinking water in the service lines, which connect individual buildings to main water lines. These service lines are often owned by individuals rather than utilities. Lead may also be introduced within the house itself, from lead pipes or solder that connects copper pipes in the house. Because lead enters drinking water so late in the pipeline, samples must be taken from the taps of individual structures rather than from a central distribution point. Typically, building owners are asked to provide these samples.

Cloudy on the details. A GAO report on the EPA Lead and Copper Rule shows that enforcement is not a clear-cut outcome.

The Lead and Copper Rule stipulates that in the largest systems—50,000 or more users—only 100 homes have to be tested, says Stephenson. Generally speaking, testing is done every three years. "We didn't get into the reasonableness of the samples, but it isn't a very large sample in the first place," he says. "It's not until more than ten percent of those tests are above acceptable levels that you have to do anything about it."

That was the case in Washington, where 40,000 water service lines were replaced after the District of Columbia Water and Sewer Authority found drinking water lead above the action level of 15 parts per billion in 73% of the 4,613 homes tested. All of the homes tested had lead service lines.

One reason the EPA was short on data may have been that some states decided to concentrate their scant resources on lead management rather than lead reporting, says Steve Via, a regulatory engineer for the nonprofit American Water Works Association, whose membership is drawn from water utilities. "Would you rather see a state with limited resources spending a lot of time managing the data up the chain so that somebody can have a relatively simple time compiling a report? Or would you rather see them put the money into having their people in the field helping people who have problems either complying or trying to do a better job?" he asks.

An appendix to the report notes that the agency continued to assess penalties during the period in question. As for the future, the EPA has developed a plan to improve its enforcement of the rule, and is preparing revisions that will address some of the issues raised in the GAO report, says Veronica Blette, a special assistant to the director of the EPA Office of Ground Water and Drinking Water. The agency must also notify Congress as to how it will address the GAO's recommendations, and will periodically report on its progress.

For now, Stephenson says, the GAO has no further role to play in the process. "It's really up to the Congress to keep oversight pressure on the GAO to stay involved, to ask us again to look at it—and they may down the road." **–Scott Fields**

Muriel Lasure/ShutterStock

The Beat

edited by **Erin E. Dooley**

MERCURY

Cleaner Air on the Fly?

The coal industry represents more than half of America's energy production, and DOE estimates place the recoverable reserve at more than 250 billion short tons. Coal is notorious for its drawbacks, however, including emissions of sulfur (which in the form of sulfur dioxide can react with atmospheric water to form sulfuric acid) and mercury (a known neurotoxicant). Now scientists from the Energy Research Center at Lehigh University, led by Carlos Romero, have shown that it may be possible to reduce mercury emissions by up to 70% without a lot of costly modifications, simply by optimizing boiler operation.

The USGS report *Mercury in U.S. Coal: Abundance, Distribution, and Modes of Occurrence* states, "The mercury emitted directly from power plants is not considered harmful; however, in the natural environment, mercury can go through a series of chemical transformations that convert elemental mercury to a highly toxic form [methylmercury] that is concentrated in fish and birds." In large doses, methylmercury can cause mental retardation, seizures, cerebral palsy, and death in humans. Though some mercury is removed by cleaning the coal before burning, and more is recaptured in the stack, the EPA estimates that coal-fired power plants release 40 to 52 tons of mercury each year.

Cutting coal's costs. New boiler configurations may lead to fewer mercury emissions.

Currently, according to Romero, the industry relies on techniques such as injecting activated carbon into the flue gas stream to adsorb the mercury. One costly problem with this approach is that a typical 250-megawatt power plant can use significant amounts of activated carbon, at a cost of about 50¢ per pound.

The goal of Romero's optimization technique is to leave more unburned carbon in the fly ash, the residue left after combustion of pulverized coal. The more carbon the fly ash contains, the better able it is to capture oxidized mercury (formed when mercury combines with chlorine, also found in coal). It's not clearly understood why fly ash captures mercury, Romero admits, and more research is being done to explain this interaction.

"Our testing has shown that if you lower the amount of excess air in the boiler [and thus lower the flue gas temperature], you increase the level of unburned carbon," he explains. "You can also increase the level of unburned carbon by grinding the coal more coarsely." Results vary depending on the type of coal used and the boiler configuration.

Further tweaking will address a couple of potential drawbacks to the approach. Fly ash is used in Canada and the United States in the manufacture of cement, but due to the physical qualities of the unburned carbon, fly ash can contain only a certain amount (about 4–6%). Plus, flue gas temperatures must not be lowered too dramatically, says Romero, lest acids form in the gas, creating corrosion in the smokestack.

Under the Clean Air Interstate Rule of March 2005, the EPA has mandated a 23% reduction of mercury by 2010 and a 69% reduction by 2018. Romero thinks some boilers could achieve the first reduction through boiler optimization. "The sixty-nine percent [reduction] will be tough to achieve with combustion optimization," he says, "but I believe this approach can be a valuable tool in industry's efforts to reduce mercury emissions."

George Offen, senior technical leader for air emissions and combustion product management at the Electric Power Research Institute, says that while this may be a low-cost approach to achieving moderate reductions in mercury emissions, larger plants will retrofit with other technologies to meet the requirements of the Clean Air Interstate Rule. "However," he adds, "many smaller plants, or those located far away from locations that use fly ash in concrete, could find this process very attractive." **–Lance Frazer**

Easy Rider, Easy Polluter

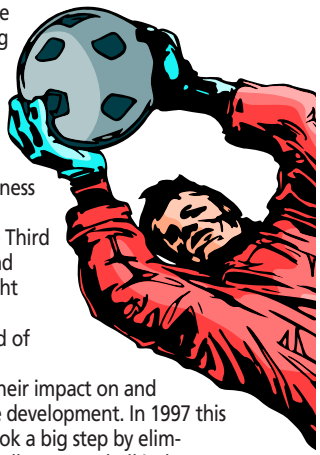
A Swiss study published in the 1 January 2006 issue of *Environmental Science & Technology* shows that motorcycles collectively emit 16 times more hydrocarbons, 3 times more carbon monoxide, and "disproportionately high" levels of other air pollutants, compared with passenger cars. Two- and three-wheeled vehicles are widely used in Asia. Because they are not a primary means of transportation in developed countries, however, not a great deal of attentionhas been paid to emissions from these vehicles. But a U.S. EPA rule that took effect in January 2006 requires manufacturers to reduce emissions of hydrocarbons and nitrogen oxides by 60%. By 2010 the EPA estimates the rule will save about 54,000 tons of emissions and 12 million gallons of fuel per year.

Beverages Doing Better

Last year, the EU commissioner for health and consumer affairs called on drink and food companies to take steps to fight the growing problem of child obesity. In response, the Union of European Beverages Associations (UNESDA) announced in January 2006 that it would limit advertising targeted at youth, control sales in schools, and improve nutritional labels. It further agreed to provide drinks, including sugar-free and low-calorie options, in smaller container sizes to limit intake. Also, vending machines in schools will carry images of a healthy, active lifestyle and a balanced diet, rather than brand logos. Global drink firms including The Coca-Cola Company and Cadbury Schweppes European Beverages are members of UNESDA.

Score for the Environment

In November 2005, sporting goods manufacturers from Sialkot, Pakistan, who produce 60% of the world's soccer balls, pledged to reduce and improve the use of water and energy during their manufacturing processes. They also agreed to introduce cleaner technology, reduce toxic wastes, and raise environmental awareness among their workers. This agreement was part of the Third Global Forum for Sports and Environment, which brought together more than 200 participants from the world of sports and sporting goods manufacturing to discuss their impact on and contribution to sustainable development. In 1997 this group of manufacturers took a big step by eliminating child labor in the Sialkot soccer ball industry.



Clockwise from left: Corbis; Juuce/iStockphoto; Vallentin Vassileff/ShutterStock

PHARMACEUTICALS

A Headache for Water Treatment

Acetaminophen is turned into at least two toxic compounds by chlorination treatment, researchers report in the 15 January 2006 issue of *Environmental Science & Technology*, raising concerns about the fate of this and other pharmaceuticals that end up in water supplies. Acetaminophen is one of the most widely used over-the-counter painkillers in the world—in the United States alone, some 37,000 metric tons are produced each year, says coauthor Mary Bedner, a research chemist at the National Institute of Standards and Technology. "Some of this is reaching the environment," she says, "but no one really knows what happens to it or what effect it might ultimately have on ecosystems or people."

Remedy or pain? The presence of toxic metabolites in water supplies makes you wonder.

Reports of acetaminophen in European rivers have appeared since the 1990s, and in the 15 March 2002 issue of *Environmental Science & Technology* a USGS team reported detecting it in nearly a quarter of the water bodies it sampled. "It gets there through wastewater [i.e., via human excretion] and in some cases through poor disposal practices," says Nick Voulvoulis, a senior lecturer in natural sciences at Imperial College London. Only 22% of Britons and just 1.4% of Americans return unwanted medicines to pharmacies, says Voulvoulis. More than 35% of U.S. nonreturners flush unused drugs down the toilet, while most British drugs end up in landfills, from which they can leach into water bodies.

Concerned that acetaminophen's structure renders it likely to react with chlorine, Bedner and colleague William MacCrehan used reversed-phase liquid chromatography to follow its interaction with the chlorinating agent hypochlorite. Under simulated treatment conditions in samples of distilled water and wastewater, 11 new compounds were formed from acetaminophen within an hour, the time the reactants would likely be in contact at any plant. Among them were 1,4-benzoquinone (a mutagen) and *N*-acetyl-*p*-benzoquinone imine (a hepatotoxicant also produced during acetaminophen metabolism that is responsible for overdose deaths). Together, these compounds represented the fate of nearly 27% of the original drug concentration.

"Fortunately, these are unstable compounds, especially in the presence of sulfite, which is sometimes used to dechlorinate treated water, so they are unlikely to persist long in the environment," Bedner says. "However, they could accumulate where treated wastewater is returned to rivers, and the effects of resupply over long periods are unknown." The results also raise the question of what other drug-derived toxicants are out there, she says.

"This work shows we need to know much more about the fate of the drugs that contaminate our water supplies," says Damià Barceló, a professor of environmental chemistry at Barcelona's Centre for Research and Development. "We also have to look for what they turn into. Searching only for the original compounds themselves will not reveal all the dangers these contaminants may pose." **–Adrian Burton**

CANCER

Genetic Basis of UVB Sensitivity

More than 1 million new U.S. cases of basal cell carcinoma (BCC) and squamous cell carcinoma (SCC) will be diagnosed this year, according to the American Cancer Society, and most will be highly curable. New melanoma will be diagnosed in only about 62,000 Americans, but will be far more fatal if not caught early; five-year survival for melanoma that has aggressively spread is only 16%. A study in the 21 December 2005 *Journal of the National Cancer Institute* now shows a genetic difference between melanoma patients and those with other skin cancers: melanoma patients' chromosomal DNA (chromatin) suffers less damage than other skin cancer patients' when cells are irradiated with ultraviolet B (UVB) light, the part of UV that causes sunburn.

The work, led by epidemiologist Qingyi Wei of the University of Texas M.D. Anderson Cancer Center, examined how susceptibility to large-scale DNA damage in the form of chromosome breaks differed among patients with different types of skin cancer. "At the chromosomal level, BCC and SCC patients seem more sensitive in terms of the number of chromosomal breaks per cell," Wei says. In earlier work, his laboratory established that people with melanoma and BCC are less efficient at repairing UV-induced DNA damage than are cancer-free controls; he's now working on a similar study on SCC.

BCC and SCC have clear dose–response curves with sun exposure, says Nick Hayward, a human geneticist at the Queensland Institute of Medical Research in Brisbane. In contrast, melanoma is more associated with acute intermittent doses. "Instead of going out and getting sunlight every day," he says, "people who get melanoma tend to be those who go to the beach without a tan, stay out too long, and get absolutely cooked."

Although most skin cancers derive from either melanocytes or keratinocytes, the assay looks for physical breaks in the chromosomes of lymphocytes—nucleated blood cells—taken from skin cancer patients and cancer-free controls to estimate an individual's sensitivity to UVB. Blood cells are collected, grown in culture, irradiated under controlled conditions, and allowed to recover for a day for cellular repair to occur. Then researchers count gaps in the cells' chromatin. Cancer patients whose cells showed more chromosome breaks after UVB irradiation were 3 times more likely than the general population to have BCC or SCC, but were not more likely to have melanoma.

"One thing that's satisfying about this study is that it fits nicely with some of the known genetic and environmental causes, particularly of BCC, but also of SCC," says Graham Mann, a geneticist at the University of Sydney's Westmead Institute for Cancer Research. "It's been known for years that people with a severe familial form of BCC are very prone to BCC formation after ionizing radiation, presumably because they get much more chromosomal damage."

The assay is not on its way to development as a diagnostic, but rather adds to our understanding of the genetics of cancer. "If you want to diagnose patients," Wei says, "you have to have a thorough, specific assay. You don't want to make mistakes."

And in case sunbathers think they are safe against melanoma, they should remember that UVA radiation can still damage the DNA in melanocytes. **–Victoria McGovern**

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ehpnet

Global Sports Alliance

Sports speak a universal language, bridging class, nationality, and religion around the world. Many sports figures are better known than movie stars or prominent politicians. To capitalize on the importance of sports to billions of people around the world, the Global Sports Alliance (GSA) was formed in 1999 to serve as an international network of sports enthusiasts who care about the environment. The English version of the GSA website, available at http://www.gsa.or.jp/en/index.html, describes the work of this group.

From the GSA homepage, visitors can access information on the alliance's Ecoflag and Sports-eco.net projects. The Ecoflag, created by the GSA with the support of the UN Environment Programme (UNEP), is flown at sporting events around the world to symbolize the commitment of sporting enthusiasts to preserving the environment. Another component of Ecoflag is RECYCL'art, a movement to create works of art from used sports equipment, including balls, rackets, and shoes. The RECYCL'art website features a virtual gallery of such artwork. Sports-eco.net focuses on promoting the recycling of sports equipment. One alliance program collects used tennis balls and sends them to schools to put on the legs of school furniture to reduce noise in classrooms.

Another GSA project is the Global Forum for Sports and the Environment (G-ForSE), an archive of environmental action in sports from around the world. From a pull-down menu on the G-ForSE homepage, visitors can find information on how sports participants can protect the environment, as well as reviews of eco-friendly sporting goods such as battery-assisted bicycles, biodegradable fishing line, solar battery rechargers, and a portable ultraviolet measuring device.

As part of G-ForSe, the GSA sponsors Dream Camps in collaboration with UNEP, where children and teenagers are taught not only to play soccer and tennis, but also to be good environmental stewards. Camp activities include recycling and tree-planting projects. To date the camps have only taken place in Kenya, but the GSA is looking for other camp locations and organizers.

Through G-ForSE, the GSA also organizes global forums where world sport federation representatives, sporting goods manufacturers, athletes, and others join to discuss how the sports industry can bring environmental issues to the awareness of the global population and how to integrate sustainable practices into the industry itself. In July 2005, the Sports Summit for the Environment, held in Aichi, Japan, highlighted grassroots environmental initiatives through sports. Participants at the summit drew up the Joint Declaration on Sports and the Environment, which calls on the sports industry to become a partner in promoting sustainable development. **–Erin E. Dooley**

A "Cowabunga!" Moment for Farmers

Penn State researchers have come up with a cheaper, safer way to clean and disinfect milking equipment. Conventional cleaning systems use expensive acids and chlorinated chemicals that can burn the eyes and skin and damage the environment. The new process uses electrolyzed oxidizing water, produced when electric current flows through two electrodes immersed in a weak saline solution and separated by a membrane. Tests showed that the electrolyzed oxidizing water was as effective as conventional treatments at removing organic matter from a series of pipes set up to simulate real milking equipment. Electrolyzed oxidizing water is also effective for cleaning other agricultural products such as fresh produce and eggs.

Of Minors and Miners

Ghana's Institute of Journalism is objecting to a public relations campaign in a weekly children's newspaper, *Junior Graphic*, that focuses on promoting positive information about the gold mining industry. The campaign is funded by the mining company Newmont Ghana. The journalists decry the fact that the campaign targets children, and question its timing, months after the company was accused of knowingly dumping human waste into a river that provides drinking water for local communities. The Denver, Colorado–based mining company is the world's largest gold mining organization.

Arsenic and Old Decks

Two papers published by Florida researchers in the 1 February 2006 issue of *Environmental Science & Technology* highlight the threat posed by arsenic from treated lumber used in decks, utility poles, and fences. Though chromated copper arsenate (CCA)–treated wood was phased out of residential use in 2003, arsenic from wood already in use will likely leach into the environment for years to come, possibly threatening groundwater. One of the papers estimated that of 28,000 tons of arsenic used in Florida as of 2000 for CCA-treated wood, 5,000 tons had already leached to underlying soils. The paper added that over 12,000 more tons will leach from structures by 2040. Currently Florida law does not require that construction and demolition landfills be equipped with linings.

Clockwise from top right: Mark William Penny/ShutterStock; Aron Hsiao/ShutterStock; GSA (all EHPnet images)