

Environmental News

Rapidly rising PBDE levels in North America

The most comprehensive assessment to date of polybrominated diphenyl ethers (PBDEs) in the breast milk of North American women indicates that the body burden of Americans and Canadians is the highest in the world, 40 times greater than the highest levels reported for women in Sweden. Some scientists are alarmed because North American levels of PBDEs, which are used as flame retardants in consumer goods and have been banned by the European Union (EU), appear to be rising at an exponential rate.

The levels of PBDEs in North Americans appear to be doubling every two to five years, says Mehran Alaee, a research scientist with Environment Canada. As the principal investigator for the toxic substance research grant being used to investigate PBDE exposure in North America, Alaee is the author of a previously unpublished graph that pulls together all of the human milk data amassed on the continent thus

far (see Figure 1). Alaee stresses that this graph is based on preliminary data. Still, he says, the data indicate that "PBDEs will become a problem" if nothing is done to limit the release of the chemicals into the environment.

"This is clear evidence for an urgent need for a systematic study [to determine the] spatial distribution and temporal trends of PBDEs in human breast milk in North America," Alaee adds. "This new data from Canada strongly supports the need for more information on the levels of PBDEs in breast milk in the United States and Canada," agrees Linda Birnbaum, director of the Human Studies Division of the U.S. EPA's National Health and Environmental Effects Research Laboratory.

However, "due to the limited number of samples and their diverse collection, the data [in Alaee's graph] are only indicative and not demonstrative of any trend," cautions Jake Ryan, a senior

research scientist at Health Canada who collected some of the data presented in the graph.

The toxicology of PBDEs is currently under investigation, but research has established that PBDEs can be persistent, bioaccumulative, and toxic (*Environ. Sci. Technol.* **2001**, *35*, 274A–275A). They can cause liver and neurodevelopmental toxicity and affect thyroid hormone levels, Birnbaum says. Tests on mice conducted by Per Eriksson of Sweden's Uppsala University show that PBDEs can cause neurotoxic effects similar to polychlorinated biphenyls (PCBs).

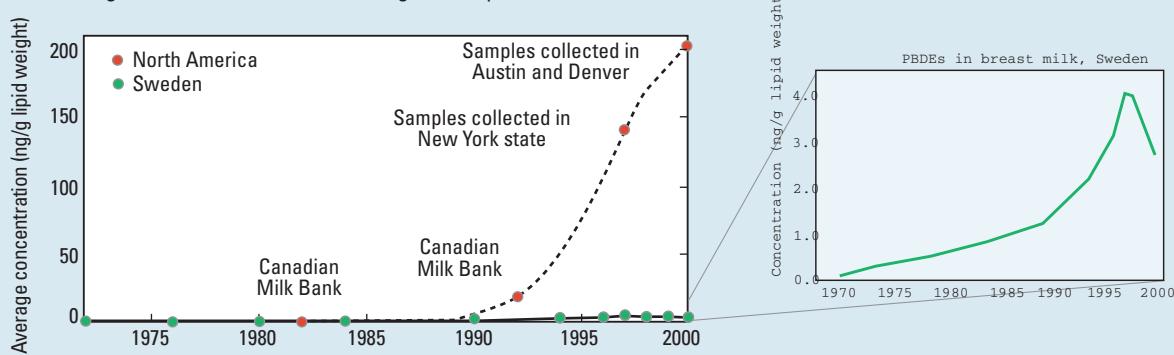
The new Canadian data are important because they show that PBDE levels are approaching those of PCBs, which have been proven to cause developmental problems in children, says Åke Bergman, chair of the environmental chemistry department at Sweden's Stockholm University and one of the world's leading PBDE researchers.

Scientists agree that some of the

FIGURE 1

Accelerating PBDE concentrations in breast milk: North America versus Europe

In the mid-1990s, documentation of the rapidly rising levels of brominated flame retardants in the breast milk of Swedish women led to sharply reduced usage, and eventually a ban, on many PBDE formulations. Now, preliminary North American data point to much higher levels, which are increasing at an exponential rate.



Source: Canadian Milk Bank and New York state data: Ryan and Patry; Denver, Colo. and Austin, Tex. data: Päpkö; Swedish data: Norén.

PBDE formulations used to protect consumer products from spontaneously igniting are more problematic than others (*Environ. Sci. Technol.* 2000, 34, 223A). The penta brominated diphenyl ether (penta-BDE) formulation that is used almost exclusively in the United States is associated with the greatest number of health effects. According to Alaee, most of the PBDEs measured in the North American samples are from the penta-BDE formulation.

Working in collaboration with Benoit Patry of Health Canada, Ryan has been trying to amass more data by collecting human milk samples from across Canada. However, Ryan says that the process is taking much longer than anticipated. Researchers hope that a workshop on breast-milk monitoring for environmental chemicals being held at Pennsylvania State University's Hershey Medical Center later this month will expedite the development of a method for collecting human milk samples. The industrial producers of brominated flame retardants are supporting the workshop, says Bob Campbell, director of corporate regulatory affairs for Great Lakes Chemical Corp.

Some of the data on the graph come from human "milk bank" samples that have been collected in Canada every 10 years (the next year that data are scheduled to be collected is 2002). The graph also includes pooled samples from New York state, Austin, Texas, and Denver, Colo.

The levels of 200 nanograms of PBDEs per gram of fat (ng/g) reported as the highest data point on the graph are so high that Olaf Päpke, the German scientist who collected the milk from women in Austin and Denver, sent samples to colleagues in Germany and Sweden to have them analyzed independently. Before those confirmations came back, Päpke "didn't believe the result," recalls Bergman, who says he was shocked when his lab verified the samples' PBDE concentrations.

The North American data are "consistent with the higher concentrations of PBDEs measured in

other environmental media—air, fish, biosolids, etc.—in North America versus Europe," says Tom Harner, a research scientist with Environment Canada. Birnbaum agrees that the high levels are "not a surprise".

As is the case with PCBs and dioxins, the main way people take up PBDEs is by consuming fatty animal foods such as meat, fish, poultry, eggs, and dairy products, Ryan says. "However, there may be additional food exposure routes for PBDEs, possibly in food processing, which are not found with dioxins or PCBs," he notes.

The California EPA also has been collecting data on PBDEs, and the levels the state agency is finding in adipose tissue of women, 85 ng/g, are on a par with the data Ryan, Patry, and Päpke have collected, says Tom McDonald, a staff toxicologist at the agency's Office of Environmental Health Hazard Assessment.

Environment Canada's commercial chemical branches are currently evaluating the PBDE data, and the end result could be a recommendation to ban the chemicals, Alaee says. Based in part on the evidence that the levels of PBDEs were growing exponentially in Swedish women, the EU has voted to ban two PBDE formulations, octa-BDE and penta-BDE, by July 1, 2003, and a third formulation, deca-BDE, could be banned by 2006 (*Environ. Sci. Technol.* 2002, 36, 11A).

The graph showing that PBDEs were increasing exponentially as contaminants in Swedish breast milk samples over the past 25 years (see inset to Figure 1) was instrumental in getting EU lawmakers to agree to the ban, Bergman says. "It was one of the very last nails in the coffin [of PBDEs in the EU]," he recalls.

McDonald says the rapidly rising levels of PBDEs in human tissues illustrate the value of human milk monitoring programs to identify important emerging contaminants. He says that his colleagues at California EPA have been agitating for such a program for years, but there is as yet no U.S. program for

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Legislating effectively in the European Union

Is European environmental legislation effective? It's hard to say, finds a report by the European Environment Agency. For the bulk of European Union (EU) measures, greater efforts are needed to show a causal relationship between them and their effects on the environment. Moreover, much of the information EU member states currently collect is not being reported in a way that allows useful comparison to environmental impacts.

A goal of the EU's Sixth Environmental Action Program (*Environ. Sci. Technol.* 2001, 35, 139A) is to devise a reporting system to glean more useful information, while lowering the reporting burden on governments. *Reporting on Environmental Measures: Are We Being Effective?* can be downloaded at <http://reports.eea.eu.int/rem/en>.

Swiss tax pushes "sulfur-free" fuels

Switzerland is using financial incentives to make very low sulfur fuels market-competitive by 2004, similar to programs already in place in Denmark, Germany, Finland, Sweden, and the United Kingdom. The Swiss action puts the country ahead of European Union (EU) efforts to bring about a mandatory switch.

With sulfur removal cost estimates hovering around a few cents per liter, the new Swiss law calls for an additional tax of 3 to 5 cents per liter to be levied, beginning in 2004, on fuels containing more than 10 parts per million (ppm) of sulfur. Fuels with a sulfur content of less than 10 ppm, which the Swiss consider sulfur-free, will be exempt from the tax. In the United States, the EPA will require refiners to produce fuels with an annual average



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regularly monitoring women's breast milk.

Campbell, who is on the Brominated Flame Retardants Industry Panel of the American Chemistry Council, an industry organization, stresses that more

data will be needed to convince the industry that any PBDE formulations must be removed from the market. But he says that his company would "do the right thing" if faced with sufficient evidence that its products were causing harm.

In the meantime, Campbell stresses his belief that the high level of fire safety afforded by adding PBDEs to U.S. consumer goods outweighs the risk they pose to human health and the environment. —KELLYN S. BETTS

U.S. electronics recycling stance challenged

Last November, a broad-based coalition launched a campaign to lobby for better stewardship of obsolete electronics goods in the United States. One of the campaign's goals is to put the United States on the same trajectory for dealing with electronics recycling as countries in Europe and Asia, according to its organizers.

Electronics waste "is one of the fastest growing and most toxic waste streams," says Ted Smith, director of the Silicon Valley Toxics Coalition, one of the 16 organizations in the coalition. The U.S. National Safety Council estimates that 315 million computers will have become obsolete by 2004. Smith estimates that those computers contain a total of 4 billion pounds (lbs) of plastic, 1.5 billion lbs of cadmium, 1.2 billion lbs of chromium, 1 billion lbs of lead, and unknown amounts of mercury and brominated flame retardants. Only 11% of those computers were recycled in 1998, according to the latest figures available from the National Safety Council.

Concern over the impacts of how electronics products are handled at the end of their lives has been growing in the United States over the past two years. Initiatives to ban computer monitors from landfills have now been passed by local governments in Massachusetts and California, says Gary Davis, director of the Center for Clean Products & Clean Technologies at the University of Tennessee in Knoxville, which is not affiliated with the new campaign. A total of 19 electronics recycling bills were also launched in 12 states this year, adds Jerry Powell, editor of *E-Scrap News*, an industry publication. And

a number of other states have been investigating the issue, says Scott Cassel, director of the Product Stewardship Institute at the University of Massachusetts-Lowell, which is also not affiliated with the new campaign.



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Smith's coalition charges that the United States is behind the Netherlands, Taiwan, Switzerland, Norway, Germany, and Japan, where electronics recycling programs that require what has become known as product take-back through "extended producer responsibility (EPR)" are already well established. In fact, "electronics recycling is growing in popularity in developed nations worldwide," Davis says. This year, the movement gained ground in Australia, Canada, the European Union (EU)—which is pursuing legislation in addition to what some individual EU nations have already passed—Italy, and Korea, as well as the United States, he says. International figures for how many computers are recycled are not available, according to Peter Muscanelli, president of the International Association of Electronics Recyclers, Inc., but he says the number continues to increase.

The new "Computer TakeBack Campaign" urges the United States to follow these existing programs' leads. The campaign calls for U.S. manufacturers and distributors of electronic equipment to "take financial and/or physical responsibility for their products throughout the entire product life cycle." It also demands "collection, disassembly, reuse and recycling of discarded computer equipment to the highest degree practicable, and requirements that recycling is done in a sound manner."

The electronics industry is lobbying hard against the EPR approach, Smith says. The Electronics Industries Alliance (EIA) advocates "shared responsibility" that does not place all of the financial burden for electronics recycling on industry, says Heather Bowman, EIA's manager of environmental affairs. Smith says the U.S. government's trade representative has challenged the EU's take-back initiative because of industry lobbying.

The National Electronics Product Stewardship Initiative (NEPSI) that began this year is trying to reconcile the positions of U.S. manufacturers with the stands taken by environmental groups and the needs of state and local governments and agencies, Davis says. The Product Stewardship Institute is coordinating the participation of more than 20 states and about a dozen local agencies in the NEPSI dialogue, and most parties are concerned about how electronics recycling projects are financed, Cassel says. NEPSI's goal is to develop "long-term and viable end-of-life solutions" that can be implemented nationwide, Davis says.

At present, electronics scrap in the United States is handled by a

hodgepodge of local governments, waste handlers, some companies—notably Best Buy, Frye Electronics, IBM, and Hewlett-Packard—and consumers. There are approximately 400 U.S. electronics “processors”, at least one in every medium to large city, Powell says.

The environmental performance of these processors varies drastically, Powell says, noting that a recently discovered abandoned electronics processing site in Oregon contained barrels of the acid used to extract precious metals like gold, silver, platinum, and palladium from computing equipment. Cleaning up the site is expected to cost the state \$500,000, he says. “There are probably people who claim to be recycling who actually put [the electronics products] in a container and ship it away,” Cassel adds.

The ultimate disposition of obsolete electronics products is also a concern of the Organization for Economic Cooperation and Development (OECD), which has been developing recommendations and guidelines for countries embracing electronics recycling. When electronics products collected for recycling end up in developing countries like China, they may not be processed in the most environ-

mentally friendly ways, says Davis, who is working with the OECD.

Burning is the easiest way to harvest the precious metals hidden inside electronic equipment, says Dan Millison, an environmental consultant familiar with hazardous waste issues in the Pacific Basin. Millison says “it’s a pretty safe bet” that much of the electronic junk reprocessed in China goes up in smoke, sending toxic dioxins, dibenzofurans, and metals into the atmosphere.

Figures for how much waste actually ends up in places like China are hard to come by, experts agree. But Powell estimates that at least one-third of all U.S. scrapped electronics are exported offshore. Smith points out that government studies have shown that it costs 10 times less to process scrapped electronics materials in China than in the United States because Chinese labor costs are so much lower and environmental regulations are not well enforced.

The Computer TakeBack Campaign addresses such concerns by calling on the federal government to “ban exports of hazardous materials from discarded electronic waste equipment.” —KELLYN S. BETTS

Nutrient trading advocated to improve water quality

With a final rule revising the U.S. EPA's total maximum daily load (TMDL) program expected in 2003, water quality experts are looking at market-based nutrient trading systems as a way to improve water quality at lower costs. A number of obstacles, however, stand in the way of getting nutrient trading off the ground.

Under the TMDL program, states set caps on the amount of pollution that can enter a water body and then allocate this amount among pollution sources. Under a trading scheme, sources with low-cost pollution reduction options have an incentive to reduce nutrient loadings beyond

what is required and in doing so generate pollution reduction “credits”. They can then sell any excess credits earned but not needed to sources with higher control costs, says Suzie Greenhalgh of the World Resources Institute (WRI), a non-profit environmental organization.



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sulfur content of 120 ppm as of 2004, with a limit of 30 ppm by 2006. For diesel, EPA will require a sulfur content of 15 ppm by 2007.

Within Europe, the upper limit for sulfur in fuels is currently 150 ppm for gasoline and 350 ppm for diesel. The EU mandates a 50-ppm limit in 2005 for both fuels. However, an ongoing EU debate could force a complete switch to much lower sulfur content fuels, as low as 10 ppm, by 2008. The European Commission proposed a 2005 deadline for some “sulfur-free” fuels to be available to consumers and 2011 for a complete switch, but the European Parliament rejected these deadlines calling instead for a complete switch by 2008.

If past experience is any indication, the Swiss expect results from the new law similar to those obtained from an earlier rule levying higher taxes on sulfur-containing heating oils. Within weeks after that rule went into effect, only very low sulfur-containing heating oil was sold on the open market.

Canada cracks down on road salt

Canada is on its way to becoming the first nation in the world to regulate road salt as a hazardous substance. The country was expected to officially add road salt to its list of toxic substances in January.

Road salt is harmful to the environment and should be added to Canada's list of toxic substances, Canada's Environment Minister David Anderson announced on November 30. The finding of harm to the environment triggers a two-year process to develop measures, possibly including regulations.

The 5 million metric tons of salt used to deice Canadian roads each winter raises chloride concentrations from a background average of 50 mg per liter (mg/L) up to 13,500 mg/L in wetlands and 4310 mg/L in small rivers, killing

Through a series of trades, pollution reduction efforts shift to the sources with the lowest-cost opportunities to reduce pollution. For example, engineers at a wastewater treatment plant might delay installing expensive treatment equipment and instead buy credits from a farmer upstream who has just planted a new buffer strip of trees.

Some of the biggest hurdles for a nutrient trading program include consistency of credit estimations, trade transparency, and the high costs involved with buyers and sellers actually finding each other, according to Greenhalgh. To get around these difficulties, WRI has developed a marketplace on the Web (www.nutrientnet.org). The idea is that potential traders can go there, find their actual site or facility, and work out an estimate of how many credits they might be eligible to sell or buy and at what price. For example, farmers can input any best management practices implemented, input financial information such as interest rates,

and work out how much of a particular nutrient makes it from a certain field to a stream. Then, current practices can be overlain with various mitigation options such as changing tillage practices. The Web site then determines the reduction in nutrient loss and how much it would cost to implement those mitigation options.

Industrial pollution sources can also use this exercise, inputting nutrient removal levels at their plants to calculate how much it would cost to meet a stricter regulation. Once both "traders" have this information, they can go to the marketplace and list what credits they want to buy or sell and at what price.

"The Web site is very adaptable, depending on the rules and regulations that the body governing the program puts in," Greenhalgh says. The site also includes a registry that tracks trades.

Not only does trading provide more opportunities to reduce the cost of meeting regulations for stationary sources, it's also a way

to get the owners of unregulated, nonpoint sources involved, particularly the agricultural sector, which EPA now cites as the leading cause of water quality impairments. Trading gives unregulated pollution sources a chance to earn additional funds through the sale of nutrient credits, Greenhalgh says. EPA supports trading programs to reduce compliance costs and is developing trading systems that can work in the context of discharge permits and TMDLs, says EPA's Dave Batchelor.

Several states have pilot projects under way. Michigan, which is probably the furthest along, is expected to go statewide with a nutrient trading program in February, says Batchelor, who worked for the state's Department of Environmental Quality before being summoned to EPA to help craft national guidelines. In the Chesapeake Bay region, officials are close to implementing a multi-state nitrogen-trading program, according to Greenhalgh. —KRIS CHRISTEN

Evidence that perfluorinated surfactants bioaccumulate

Bioconcentration factors for perfluorooctane sulfonate (PFOS) in fish in a contaminated stream have been found that range from 6300 to 125,000, indicating that in addition to being extremely persistent, PFOS is a contaminant with significant potential to bioaccumulate, scientist Cheryl Moody and colleagues report in the February 15 issue of *ES&T* (ASAP article ES011001+). The field-determined values, which are based on analysis of PFOS concentrations in fish livers and surface water, are much higher than the scientists' laboratory-determined bioconcentration factor of 5400, she says.

According to Moody, the discrepancy may be attributed to the creek fish having accumulated other compounds capable of breaking down to PFOS that were not

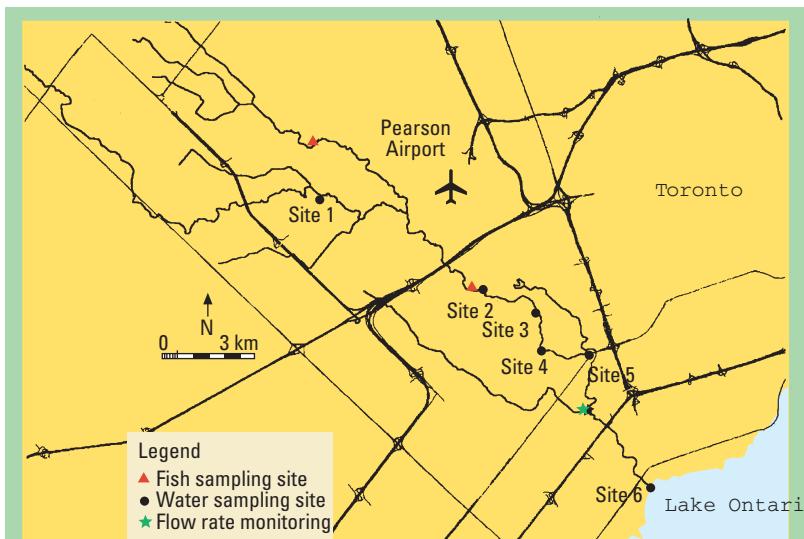
measured in the water samples and therefore not accounted for.

In addition to determining bioconcentration factors, the scientists also identified, for the first time in environmental samples, long-chain (10-, 11-, and 14-carbons in the backbone of the molecule) perfluorocarboxylates in fish livers. The presence of these compounds has implications for the toxicity of perfluorinated surfactants in the environment because perfluorinated carboxylic acids, particularly perfluorooctanoic acid and perfluorodecanoic acid, are known peroxisome proliferators at relatively low concentrations; such compounds elevate rates of cell proliferation and cause liver cancer in rodents.

Perfluorinated surfactants have emerged as priority environmental

contaminants recently as a result of reports about their detection in humans and wildlife, as well as concerns about their persistence and toxicity (*Environ. Sci. Technol.* 2001, 35, 154A–160A). The analysis performed by Moody and co-workers at the University of Toronto and other Canadian institutions is based on sampling water and fish in Etobicoke Creek, near Toronto in Canada. On June 8, 2000, an accidental spill of fire-fighting foam containing perfluorinated surfactants occurred at the Toronto airport and dumped over 20,000 liters of fire-fighting foam into the stream.

Beginning the day after the spill, the researchers sampled water at the creek for 153 days. They also sampled small fish, first three weeks then seven months after the spill, and used liquid chromatography/mass spectrometry/mass spectrometry (LC/MS/MS) to analyze the fish livers for perfluo-



Map of study region indicating location of Etobicoke Creek, fish and surface water sample sites, and Lake Ontario

Source: *Environ. Sci. Technol.* 2001, 35 154A–160A.

roalkanesulfonates and perfluorocarboxylates, compounds of concern that are known to be or thought to be present in the foam.

Water samples were analyzed by using LC/MS/MS and ^{19}F NMR (nuclear magnetic resonance).

—REBECCA RENNER

Atrazine linked to endocrine disruption in frogs

Low part-per-billion (ppb) doses of atrazine disrupt the sexual development of frogs in laboratory experiments, with gonadal alterations starting at 0.1 ppb, say developmental endocrinologist Tyrone Hayes, of the University of California, Berkeley, and colleagues. The observed effects occur at atrazine concentrations frequently found in the environment, and such exposures may account for gonadal abnormalities observed in frogs in the wild, Hayes says.

The findings, presented at the Society of Environmental Toxicology and Chemistry's annual meeting in Baltimore last November, suggest that the herbicide apparently modifies the steroid hormones balance in frogs at a sensitive time in their development.

The study performed by Hayes's group involved dosing African clawed frog larvae (*Xenopus laevis*) from hatching until metamorpho-

sis. At doses as low as 1 ppb, they observed laryngeal muscle size reduction in 80% of exposed males. Twenty percent of dosed males developed into hermaphrodites having both testes and ovaries. Atrazine exposure at these levels did not affect mortality, developmental rates, or time to metamorphosis in the experiments.

Hayes proposes that atrazine affects frog sexual development because it increases levels of aromatase, an enzyme that converts testosterone to estrogen, and results in partial male frog feminization. The affected males have high levels of aromatase in their gonadal tissues and have blood plasma testosterone levels that are unusually low—comparable to levels typically found in female frogs. As mentioned in an article appearing in this journal (*Environ. Sci. Technol.* 2000, 34, 415A), the sug-

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fish, aquatic insects, and vegetation, according to the federal government report *Assessment Report*

Road Salts

A 60-day public comment period was launched on Anderson's recommendation. Road salt is expected to be officially listed at the end of the comment period, giving the federal government authority to set enforceable limits on its use. Control measures will include better storage and handling techniques, Anderson says.

A copy of the report is available at www.ec.gc.ca/substances/ese/eng/psap/final/roadsalts.cfm.



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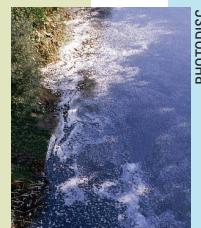
Coming clean with alkylphenols

Norway will ban the production, import, use, and distribution of most uses of two ubiquitous industrial surfactants that are toxic to aquatic organisms and are suspected endocrine disrupters—namely, nonylphenol ethoxylates and octylphenol ethoxylates—as of Jan. 1, 2002.

Although Norway's ban is the first in Europe, other countries have also restricted the use of these chemicals, primarily through voluntary phaseouts. The European Union as a whole is moving toward a ban.

Paints, varnishes, and lubricating oils are exempt from Norway's ban because of the lack of suitable alternatives. Moreover, use of these products results in only a small proportion of total discharges to the environment, according to Norway's Pollution Control Authority. Alternatives exist for many of the other industrial uses, the most relevant being fatty alcohol ethoxylates.

Companies are under no regulatory pressure in the United States to move toward alternatives, but some are doing so.



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gested mechanism has been investigated previously. In 1997, Louis Guillette and co-workers found that atrazine induced aromatase activity in male hatchling alligators, and in 2000, Thomas Sanderson and co-workers, found that atrazine could induce aromatase activity and modify hormonal balance in cell line in vitro experiments.

"This is an intriguing set of observations," says EPA scientist Gary Ankley, who heads the toxic effects research team at EPA's Duluth, Minn., research center. "The effects observed by Hayes are more subtle than the sort of endpoints, such as gross malformations (multiple or missing arms and legs), that we usually look for in the field. As a result, it's quite possible that these effects could have been missed by other researchers," Ankley says.

Because his laboratory experiments indicate that *X. laevis* males are vulnerable to atrazine exposure when they are larvae, Hayes compared the time when wild frogs spawn with when atrazine levels in surface waters are highest and found that the two coincide—surface water concentrations are highest at the time of the first heavy



working on a controlled lab study to determine whether atrazine produces this effect in *R. pipiens*. "We do know that it is not a normal part of development for the species, as animals in the lab do not develop this way," he observes.

Atrazine (2-chloro-4-ethyl-amino-6-isopropylamine-1,2,5-triazine), with an annual usage of 60 million pounds in 1993, is the most commonly used herbicide in the United States and is also used in more than 80 countries. Despite its widespread presence in U.S. surface waters, a 1996 ecological risk assessment led by Keith Solomon, director of the Centre for Toxicology, University of Guelph, Ontario, estimated that the herbicide does not pose a risk to the aquatic environment (*Environ. Sci. Technol.* 1996, 30, 110A). Atrazine producer Syngenta, formed by the merger of Novartis Agribusiness and Zeneca Agrochemicals, has, since 1997, been sponsoring an independent, multimillion-dollar research program into ecological endocrine effects. A special review of atrazine begun by EPA in 1994 because of concerns about the health risks to people and the environment is expected to conclude soon.

—REBECCA RENNER

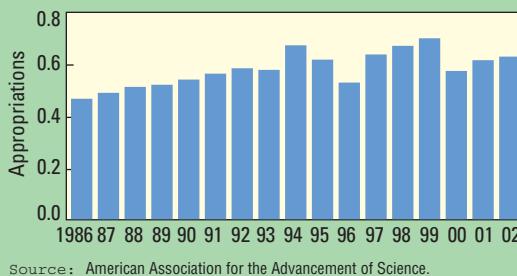
Congress boosts EPA's R&D funding

Researchers and environmentalists directed loud criticism last summer at President Bush's proposed budget cuts for the U.S. EPA. But the final budget, signed by Bush on Nov. 26, actually boosts the agency's budget and provides additional funds for research and development (R&D).

Bush signed a \$7.9 billion bill providing funds for EPA, granting the agency a 1.2% increase over last year's level and \$597 million more than Bush had requested. The agency's R&D efforts will receive \$632 million for this fiscal year (FY 2002), which is 3.8% more than in last year's budget.

Trends in EPA R&D, FY 1986–2002

After a steep cut in R&D funding in FY 2000, Congress is slowly returning money to the program. Appropriations are given in billions of constant FY 2001 dollars.



The legislation moved steadily through Congress, and once agreement was reached on restoring many of the monetary cuts Bush

proposed in his \$7.3 billion budget (*Environ. Sci. Technol.* 2001, 35, 226A), there was little controversy.

Congress provided the Science and Technology account, through which most of the agency's R&D activities are funded, with \$698 million. This is nearly \$60 million over the White House's request, issued because Bush wanted to eliminate scores of congressional "earmarks", or funding requests for hometown projects. The

bill does change some earmarks, but the 107th Congress included nearly 70 congressionally designated research projects. The final

appropriation for R&D is \$23 million more than the FY 2001 level.

Nearly \$98 million, identical to Bush's request, is provided for the Brownfields program, which supports projects to clean hazardous waste sites, turning them into useable land. EPA's Superfund program stays steady at \$1.27 billion, but research on environmental health related to Superfund sites, in a separate appropriation bill for the National Institute of Environmental Health Sciences, is increased from \$63 million in FY 2001 to \$70 million. This funding also matches Bush's request.

The White House's proposal that \$25 million be shifted from EPA's enforcement activities into a new state grant policing program was shelved. Instead, Congress restored \$15 million for enforcement programs that Bush proposed be cut, then generally stayed the course with overall EPA enforcement funding by approving \$464 million, just slightly more than the FY 2001 amount.

Bush's effort to slash funding for the state funds used for sewage and drinking water treatment was ignored. Congress included \$1.35 billion for the clean water revolving

fund and \$850 million for the drinking water revolving fund.

Nearly \$237 million is marked for state grants to control nonpoint source pollution, such as parking lot runoff, and \$222 million will go to the states in air quality grants.

Overall, EPA's core regulatory, research, and enforcement activities, funded by the operating program, will receive \$3.7 billion, the second highest funding level in EPA's history, according to agency figures.

The final law does include language barring EPA from setting a level for arsenic in drinking water that is higher than 10 parts per billion, even though EPA Administrator Christie Whitman announced a 10-ppb standard in October. Concerns raised by Sen. Pete Domenici (R-N.M.) that the costs of compliance with the arsenic rule to small and rural communities could be as high as \$1 million were satisfied with language ordering EPA to provide Congress with a plan indicating steps that Congress can take to help these communities. The final budget law can be found at www.epa.gov/ocfopage/budget/budget.htm. —CATHERINE M. COONEY

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Wood preservatives under fire

On the basis of recent scientific studies, the European Commission (EC) is mulling a possible ban on wood preservatives containing arsenic.

A risk assessment confirmed by the European Union's (EU's) Scientific Committee for Toxicity, Ecotoxicity, and the Environment (SCTEE) identified unacceptable risks to children's health from exposure to wood treated with chromated copper arsenate (CCA), the most commonly used wood preservative. CCA-treated wood is used in playground equipment, and children can be exposed to it in sandpits, as well as through the disposal of wood containing arsenic from household waste burning and home heating.

The SCTEE considers CCA to be genotoxic and a carcinogenic, finding that no safe threshold limit exists. The U.S. EPA, which also has CCA under review, released a report in mid-December from a scientific advisory panel recommending that a more complex probabilistic model for assessing exposure to treated wood replace the simpler, deterministic approach the agency had been using. EPA says the new tack should make the exposure analyses "more realistic and scientifically sound". The agency expects to have a preliminary risk assessment for children's exposure, as well as for occupational exposures and ecological effects, available for public comment in the spring.

The ban under consideration in the EU would prohibit the sale of arsenic-treated wood to consumers and restrict its use to essential industrial applications, namely utility poles, railway ties, and industrial cooling towers. Possible alternatives to CCA wood preservatives include products based on copper and boron, chromium trioxide, copper and phosphoric acid, and didylophethoxyammonium borate.

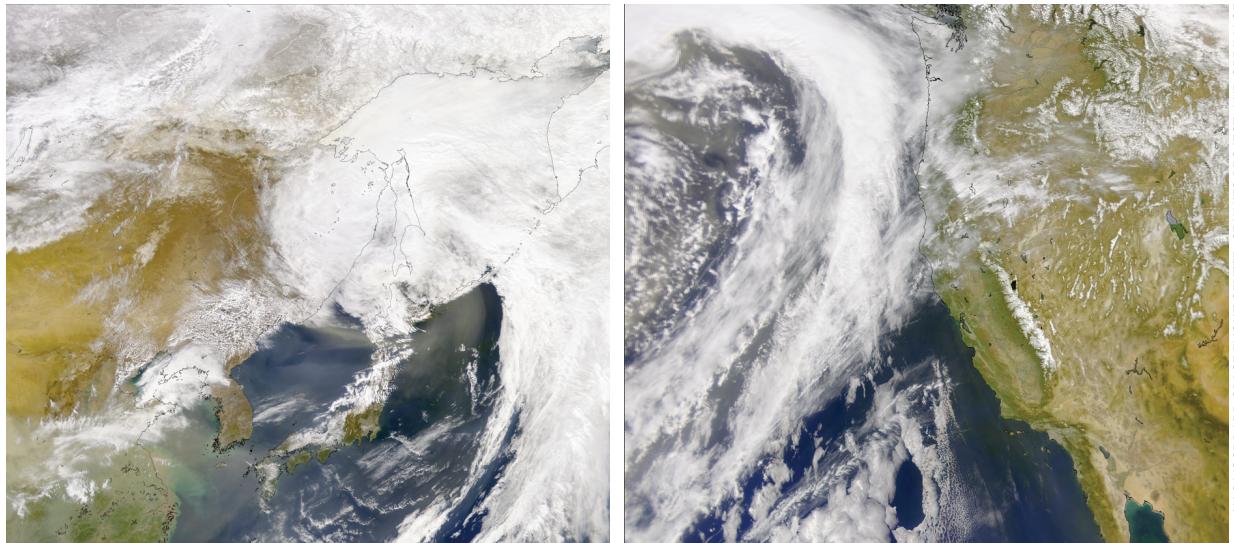
Dust storm provides clues to aerosol mixing

Dust carried on winds from Asia supplies calcium and phosphorus to Hawaiian flora and is a primary source of iron for North Pacific fisheries. But along with those nutrients, Asian dust also carries pollutants, according to new data from the Asian Pacific Regional Aerosol Characterization Experiment (ACE-Asia). The findings, which were presented in December at the American Geophysical Union's Fall Meeting, provide new information regarding aerosol sources, transport, and sinks, and could help reduce uncertainties associated with aerosols in climate-change models.

ACE-Asia is part of a series of experiments designed to investigate how aerosols affect the earth's climate, both directly through light

absorption and scattering and indirectly by acting as cloud condensation nuclei (*Environ. Sci. Technol.* 2001, 35, 332A–340A). The intensive field-monitoring phase of ACE-Asia took place last spring, during which a team of scientists from 13 nations, from aircraft, ships, satellites, and ground-based stations, simultaneously measured the chemical and physical properties of aerosols coming out of Asia.

ACE-Asia probably is the largest surface-based aerosol study ever conducted in terms of geographical extent, number of samples collected, and number of analyses performed on each sample, according to Thomas Cahill, director of the DELTA Group (Detection and Evaluation of Long-Range Transport



(Left) An unusually intense Asian dust storm flows eastward on April 13, 2001, and (right) makes its way to the West Coast of the United States on April 15, 2001.

NASA/GODDARD SPACE FLIGHT CENTER, SEAWIFS PROJECT, AND ORBIMAGE

of Aerosols) at the University of California–Davis, who examined aerosol transport during ACE-Asia from China to as far away as Washington and Oregon. “We covered 41% of the circumference of the earth simultaneously,” says Cahill.

The region off the coasts of China, Japan, and Korea was chosen because of the known complexity of the aerosols in that area, says Barry Huebert of the University of Hawaii and lead scientist of ACE-Asia. Asian aerosols are much different than those in Europe and North America, because in Asia there is more coal and biomass burning and fewer emissions controls. In spring, dust storms originating in the deserts of Mongolia and China make their way to populated cities in China, Japan, and Korea, adding a large dust component to the aerosol mix. Sea salt also adds to the aerosol’s complexity.

The timing of ACE-Asia couldn’t have been better, say those involved in the project. Thanks to a 50-year drought in China and Korea, the region experienced one of the largest dust storms in years, says Young-Joon Kim, director of the Advanced Environmental Monitoring Research Center at the Kwanju Institute of Science and Technology in Korea, who monitored the aerosols using a multichannel lidar system.

Dust and sea salt can be associated with secondary species such as nitrate, sulfate, and carbon. Such chemical transformations affect the radiative properties of aerosols and therefore must be understood in order to accurately model climate change. Analyzing Asian aerosol samples at the single-particle level helps scientists understand how aerosol particles interact with one another.

During ACE-Asia, Kim Prather and colleagues from the University of California–San Diego obtained real-time, continuous measurements of the size and chemical composition of single particles using aerosol time-of-flight mass spectrometry. “Very few of the particles were pure,” says Prather, indicating that dust carries a variety of pollutants along with the minerals. The group observed calcium-rich particles coated with secondary sulfate and nitrate. After the large dust event, there was more nitrate than sulfate, nitrite unexpectedly dominated, and iron and aluminum levels increased.

Additionally, Jim Anderson and colleagues from Arizona State University’s Environmental Fluid Dynamics Program observed mixing of anthropogenic particles with mineral dusts in aerosol samples collected during ACE-Asia.

Anderson’s group used scanning electron microscopy to determine the chemical composition, size, shape, and degree of mixing. They frequently observed mineral particles covered with elemental carbon in the form of soot in the low-altitude samples. Soot alters the optical properties of mineral dust, which ultimately could affect climate.

Scientists have only just begun interpreting the data from ACE-Asia, which could take several years, but the study has already confirmed the complexity of Asian aerosols. Kim’s lidar data show extensive layering of clean air, polluted air, and dust. As many as 14 different layers were observed in an altitude of 2 kilometers. “This kind of layering is going to be a tremendous challenge to model,” says Huebert.

Previous experiments in the ACE series, which is organized by the International Global Atmospheric Chemistry Program, were conducted in the pristine environment of Tasmania and in the Canary Islands to study Saharan dust merging with European pollution. “The Saharan dust tends to be much less associated with pollution than what comes out of Asia,” says Huebert. “The Asian dust is really unique.”

—BRITT E. ERICKSON

CO₂ emissions are on the rise, according to a report from the U.S. Department of Energy's Energy Information Administration. The 3.1% growth rate in 2000 is well above the average annual growth rate of 1.6% in CO₂ emissions in the United States over the past decade. Although CO₂ is the largest contributor to U.S. greenhouse gas emissions, accounting for more than 80% of the total, emissions of other greenhouse gases, including methane and nitrous oxide, fell during 2000. *Emissions of Greenhouse Gases in the United States 2000* is available at <ftp://ftp.eia.doe.gov/pub/oiaf/1605/cdrom/pdf/ggrpt/057300.pdf>.

Canon, Toshiba, and IBM are the computer manufacturers with the most responsible environmental performance, according to the third annual *Computer Report Card*. Produced by the Silicon Valley Toxics Coalition, a nonprofit environmental organization, the report card illuminates a "widening chasm" between the practices of U.S. and Japanese computer companies. It documents that companies including IBM, Apple, and Sony maintain "double standards" by offering free product take-back programs in Europe that are not available, or are only available for a fee, in the United States. To see the report card, go to www.svtc.org/cleancc/pubs/2001report.htm.

Industrialized countries take a large toll on oceans and coastal areas through their unsustainable consumption patterns, finds a report by the United Nations Environment Programme (UNEP). The most serious problems affecting marine and coastal environments include habitat destruction and alteration, sewage discharges, eutrophication, overfishing, and changes in sediment flows due to hydrological alterations. The report also blames widespread poverty and population growth worldwide for undermining the sustainable use of ocean resources. *Protecting the Oceans From Land-Based Activities* can be accessed at www.gpa.unep.org/documents.



Germany achieved the greatest advances in renewable energy use between 1993 and 1999 among European Union (EU) countries, finds a report by the European Environment Agency. The report analyzes factors that influence the success of renewable energy schemes and facilitate their widespread penetration into the energy market, which include strong political, legislative, and financial support. The EU has set a goal of producing 22.1% of its electricity from renewable sources by 2010. *Renewable Energies: Success Stories* can be downloaded at http://reports.eea.eu.int/environmental_issue_report_2001_27/en.

Few corporations fully take advantage of the Web for reporting information about their efforts to become more sustainable, claims SustainAbility, an international management consulting group. "Sustainability reporting on the Web has a different agenda from paper-based reporting, and the old tools and styles just aren't good enough," according to *Virtual SustainAbility: Using the Internet To Implement the Triple Bottom Line*. The report argues that readers need to be confident that corporate Web sites are relevant, reliable, and appropriate. The report can be found at www.virtualsustainability.com.

Efforts to increase the use of geographic information systems (GIS) in African countries are starting to pay off, according to a study sponsored by the U.S. Agency for International Development (USAID) and the World Resources Institute (WRI), a nonprofit environmental group. *GIS: Supporting Environmental Planning and Management in West Africa* documents how the technology helped

guide environmental planning by the governments of Burkina Faso, Côte d'Ivoire, and The Gambia. For more information about the program, go to www.wri.org/press/gis_westafrica.html.

The world's reservoirs are shrinking, finds a book being touted by the United Nations Environment Programme. As much as 1% of the freshwater is lost annually to silt buildup, further exacerbating water shortage problems. The loss of reservoir storage capacity already exceeds that to be gained from new dams under construction. The worldwide rate of loss could increase if current deforestation rates continue unchecked and global warming predictions come to pass, with heavier rainfall accelerating erosion rates. *Evacuation of Sediments from Reservoirs* by Rodney White can be purchased at www.thomastelford.com.

The European Commission's new targets for recycling and recovering packaging waste are believed to be the most ambitious in the world. The EC's draft directive, which needs approval by the European Parliament and the European Union Council, requires member states to recycle 55–65% of packaging by June 2006, up from 25–45% by 2001 under current regulations. Portugal, Ireland, and Greece have until 2009 to meet the new standards. For more information, see <http://europa.eu.int/comm>.

Urban development will consume roughly 15% of southeastern U.S. forests between 1992 and 2040, making sprawl the most serious threat to the region's forests, according to a study from the U.S. Forest Service. Despite inroads from sprawl, the current forest cover of 214 million acres will only decline by about 2% because more farmland will be converted to pine plantations, the study predicts. As pine plantations grow by 67% through 2040, natural forests will continue to decline. The *Southern Forest Resource Assessment* is available at www.srs.fs.fed.us/sustain.