

## AIR POLLUTION

## Dryer Vents: An Overlooked Source of Pollution?

It's easy to tell when your neighbors are doing the wash: just sniff the outdoor air for the scent of laundry products. In a new study, researchers have identified components of those scented emissions that are classified as hazardous air pollutants and known or probable carcinogens.<sup>1</sup> The bottom line, says first author Anne Steinemann, is that "there are hazardous chemicals coming out of dryer vents." However, very little research has examined whether exposure to these chemicals in the context of dryer-vent emissions has adverse health effects.

Toxicological studies have shown that many individual fragrance ingredients are safe at the concentrations used in consumer products.<sup>2</sup> However, exposure to scented products has been documented to cause irritation of the eyes and airways, contact dermatitis, migraines, and asthmatic reactions, particularly in sensitive individuals.<sup>3,4,5,6,7</sup> According to one 2000 article, mice exposed to emissions from five fabric-softener products experienced sensory and pulmonary irritation and airflow limitation.<sup>8</sup> And in a 2005–2006 national telephone survey, Steinemann and colleague Stanley M. Caress found that 10.9% of 1,058 U.S. respondents reported being irritated by the scent from laundry products vented outdoors.<sup>9</sup>

In the current study, Steinemann, a professor of civil and environmental engineering and public affairs at the University of Washington, and colleagues identified compounds in a top-selling brand each of laundry detergent and dryer sheet by conducting gas chromatography/mass spectrometry (GC/MS) headspace analysis—sampling the air above 2 g of product placed inside a sealed glass container for 24 hours. Using the washing machine and dryer at two Seattle-area homes, the investigators ran a total of six loads of new, pre-rinsed organic cotton

towels. They conducted GC/MC analysis on dryer-vent emissions from loads that used no laundry products, detergent only, and detergent followed by two dryer sheets.

The investigators identified a total of 29 unique volatile organic compounds (VOCs) in the dryer-vent emissions. Ten VOCs identified in the headspace analyses also appeared in the emissions when laundry products were used. The U.S. Environmental Protection Agency (EPA) classifies seven of the VOCs found in dryer-vent emissions—acetaldehyde, benzene, ethylbenzene, methanol, *m/p*-xylene, *o*-xylene, and toluene—as hazardous air pollutants.<sup>10</sup> The EPA considers acetaldehyde a probable human carcinogen<sup>11</sup> and benzene (found in two dryer-vent emission samples) a known human carcinogen.<sup>12</sup>

The three VOCs present at the highest concentrations were acetaldehyde at a maximum of 47  $\mu\text{g}/\text{m}^3$  (0.03 ppm), acetone at a maximum of 36  $\mu\text{g}/\text{m}^3$  (0.02 ppm), and ethanol at a maximum of 50  $\mu\text{g}/\text{m}^3$  (0.03 ppm). These values exceeded average annual ambient concentrations for the local area by more than 10 times for acetone and more than 25 times for acetaldehyde.<sup>1</sup> Although an actual exposure assessment would need to be conducted before any predictions could be made about health effects of dryer-vent emissions, the values are well below Acute Exposure Guideline Levels established by the EPA for these chemicals (200 ppm/10 min for acetone and 45 ppm/10 min for acetaldehyde).<sup>13</sup> For ethanol the American Industrial Hygiene Association set a comparable guideline of 1,800 ppm/1 hr.<sup>14</sup>

Charles Weschler, a chemist specializing in air pollutants with the University of Medicine and Dentistry of New Jersey who was not involved with the current study, called it "a nice demonstration that indoor activities can potentially make a contribution to outdoor pollutants." It also makes a persuasive case that some of the VOCs in the vent emissions probably did come from the laundry products, he says. "You see them in the headspace analysis, and you turn around and see some of these same constituents in the emissions."

## The Beat

by Erin E. Dooley

### Mercury Levels Lower in Great Lakes, but Still High

Although mercury concentrations have decreased about 20% in fish, fish-eating birds, and inland lake sediments across the Great Lakes region in recent decades, levels in top predator fish and wildlife are still dangerously high, and in some places concentrations in some fish and wildlife may now be increasing, according to a new report.<sup>1</sup> Levels of mercury in fillets of six

commonly consumed game fish species were above the U.S. EPA's designated human health advisory level of 0.3 ppm across much of the region. The report cited controls on mercury emissions from medical and municipal waste incinerators, chlor-alkali facilities, and other sources as the main reason for decreases in mercury in the region.

### Sweet Solution for Polluted Soil

Recent news reports bring fresh attention to a sweet ingredient for remediating solvent-laden soils: molasses.<sup>2</sup> The syrup is diluted and pumped into injection wells from which the solution flows into polluted soil. Once in the soil, the molasses feeds naturally occurring microbes that metabolize solvents into nontoxic by-products. The process has been studied for over a decade and is currently being used in New Jersey and several other states. DuPont recently scratched a pilot study on a similar process that would have used soybean oil to remove perchloroethylene and trichloroethylene from groundwater.<sup>3</sup>

### Dengue Now Endemic in Miami-Dade County

In late September 2011 Florida health officials received confirmation of the second case of locally acquired dengue fever in the Miami-Dade County area for 2011.<sup>5</sup> The fact that both cases were acquired locally confirms the disease has become endemic in the area. The two cases occurred in widely separated areas within Dade County, so they are probably unrelated (the first case occurred in March). Florida's Key West experienced several cases



Walleye is one of six Great Lakes region game fish species with consistently high mercury levels.



*Aedes aegypti* is the chief mosquito vector of dengue viruses.

Weschler says the reported acetaldehyde concentrations are high enough to cause concern about sensory irritation if dryers are vented indoors, as sometimes happens intentionally with the use of indoor dryer-vent kits, or unintentionally if equipment malfunctions.

Ladd Smith, president of the industry group the Research Institute for Fragrance Materials in Woodcliff Lake, New Jersey, which issued a press release criticizing the study,<sup>15</sup> is much more skeptical. He expresses concern that the study points a suggestive finger at the laundry products without proving that's where the VOCs came from or ruling out ambient air, the towels, or the dryers themselves as potential sources. To do that, he says, a much bigger, controlled study is necessary. Barring that, he says, the current study provided insufficient detail about brands, models, and settings of the washers and dryers used even to allow independent researchers to reproduce it.

"You don't really see trends that are easily explained" in the data, Smith says. For instance, certain chemicals appeared at higher concentrations in the vent air when detergent alone was used than when both it and dryer sheets were, or when no products were used than when one or both were used. He also points out that only a handful of the identified chemicals—including acetaldehyde, acetone, and ethanol—are fragrance ingredients, and that some of these occur naturally.

Steinemann agrees that more work is needed. Her next step, she says, will be a study comparing dryer-vent emissions during the use of fragranced and fragrance-free products.

The International Fragrance Association has published a list of more than 3,100 materials reported by manufacturers to be used in fragrance compounds.<sup>16</sup> However, neither the Food and Drug Administration<sup>17</sup> nor the Consumer Product Safety Commission<sup>18</sup> require that individual fragrance ingredients be listed on labels or Material Safety Data Sheets. Steinemann and colleagues note that, of the VOCs they identified, only ethanol was listed on the label or sheet of either product.<sup>1</sup>

**Rebecca Kessler**, based in Providence, RI, writes about science and the environment for various publications. She is a member of the National Association of Science Writers and the Society of Environmental Journalists.

#### REFERENCES

1. Steinemann AC, et al. Chemical emissions from residential dryer vents during use of fragranced laundry products. *Air Qual Atmos Health*; <http://dx.doi.org/10.1007/s11869-011-0156-1> [online 19 Aug 2011].
2. Belsito D, et al. A safety assessment of branched chain saturated alcohols when used as fragrance ingredients. *Food Chem Toxicol* 48(suppl 4):S1–S46 (2010); <http://dx.doi.org/10.1016/j.fct.2010.05.046>.
3. Elberling J, et al. Mucosal symptoms elicited by fragrance products in a population-based sample in relation to atopy and bronchial hyper-reactivity. *Clin Exp Allergy* 35(1):75–81 (2005); <http://dx.doi.org/10.1111/j.1365-2222.2005.02138.x>.
4. Johansen JD. Fragrance contact allergy: a clinical review. *Am J Clin Dermatol* 4(11):789–798 (2003); <http://www.ncbi.nlm.nih.gov/pubmed/14572300>.
5. Kelman L. Osmophobia and taste abnormality in migraineurs: a tertiary care study. *Headache* 44(10):1019–1023 (2004); <http://dx.doi.org/10.1111/j.1526-4610.2004.04197.x>.
6. Kumar P, et al. Inhalation challenge effects of perfume scent strips in patients with asthma. *Ann Allergy Asthma Immunol* 75(5):429–433 (1995); <http://www.ncbi.nlm.nih.gov/pubmed/77583865>.
7. Millqvist E, Löwhagen O. Placebo-controlled challenges with perfume in patients with asthma-like symptoms. *Allergy* 51(6):434–439 (1996); <http://dx.doi.org/10.1111/j.1398-9995.1996.tb04644.x>.
8. Anderson RC, Anderson JH. Respiratory toxicity of fabric softener emissions. *J Toxicol Environ Health Part A* 60(2):121–136 (2000); <http://dx.doi.org/10.1080/009841000156538>.
9. Caress SM, Steinemann AC. Prevalence of fragrance sensitivity in the American population. *J Environ Health* 71(7):46–50 (2009); <http://www.ncbi.nlm.nih.gov/pubmed/19326669>.
10. EPA. Technology Transfer Network. Air Toxics Web Site. Original List of Hazardous Air Pollutants [website]. Washington, DC:U.S. Environmental Protection Agency (updated 12 Nov 2008). Available: <http://tinyurl.com/yjunv3o> [accessed 29 Sep 2011].
11. EPA Technology Transfer Network. Acetaldehyde [website]. Washington, DC:U.S. Environmental Protection Agency (updated 6 Nov 2007). Available: <http://tinyurl.com/6aloadj> [accessed 29 Sep 2011].
12. EPA Technology Transfer Network. Benzene [website]. Washington, DC:U.S. Environmental Protection Agency (updated 4 Feb 2011). Available: <http://tinyurl.com/kt77mz> [accessed 29 Sep 2011].
13. EPA. Acute Exposure Guideline Levels (AEGLS). AEGL Chemical Data [website]. Washington, DC:U.S. Environmental Protection Agency (updated 4 Aug 2010). Available: <http://tinyurl.com/66kxjph> [accessed 29 Sep 2011].
14. AIHA Guideline Foundation. 2011 DRPG/WHEEL Handbook. Current ERPG™ Values (2011). Fairfax, VA:American Industrial Hygiene Guideline Foundation (2011). Available: <http://tinyurl.com/4x576w2> [accessed 29 Sep 2011].
15. RIFM. Attack on Fragranced Laundry Products: "Non-Scents" [press release]. Woodcliff Lake, NJ:Research Institute for Fragrance Materials, Inc. (26 Aug 2011). Available: <http://tinyurl.com/3vyzh2f> [accessed 29 Sep 2011].
16. IFRA. Public. Issues. Ingredients [website]. Geneva, Switzerland:International Fragrance Association (2011). Available: <http://tinyurl.com/6chusk6> [accessed 29 Sep 2011].
17. FDA. Code of Federal Regulations, Title 21, Part 701. Cosmetic Labeling, §701.2–§701.9. Washington, DC:U.S. Food and Drug Administration (2001). Available: <http://tinyurl.com/3224kko> [accessed 29 Sep 2011].
18. Consumer Product Safety Act, Public Law 92-573, 86 Stat. 1207 (1972). Available: <http://tinyurl.com/32b4duc> [accessed 29 Sep 2011].

of locally acquired dengue in 2009 and 2010, the first time the disease had been seen in the United States since 1934.<sup>6</sup>

## BPA and Mammary Tumors in Mice

A new study has found an association between prenatal exposure to low-dose bisphenol A (BPA) and development of mammary tumors in adult female mice.<sup>4</sup> Mammary epithelial cell numbers were increased to an extent comparable to that seen with diethylbestrol (DES), an agent for which *in utero* exposure has been linked to increased breast cancer risk in humans. BPA, an industrial chemical used to manufacture epoxy resins, polycarbonate plastics, and thermal paper, has not been linked to breast cancer in humans.

## NIEHS to Lead Effort on Climate Change and Human Health

The National Institutes of Health recently announced a new research program to study human health impacts of climate

change.<sup>7</sup> Areas to be addressed include vulnerability to heat-related impacts, changing weather patterns, climate-influenced changes in toxic exposures, and adverse health effects resulting from climate change adaptation and mitigation efforts. Funded studies will help to develop data, methods, and models to support health impact predictions. The program is led by the National Institute of Environmental Health Sciences and includes support from the National Institute



New studies will help refine predictions of health impacts of climate change.

on Aging and the Fogarty International Center. Eight grants have been funded.

#### REFERENCES

1. Evers DC, et al. Great Lakes Mercury Connections: The Extent and Effects of Mercury Pollution in the Great Lakes Region. Report BRI 2011-18. Gorham, ME:Biodiversity Research Institute (2011). Available: <http://tinyurl.com/6ye7n2q> [accessed 17 Oct 2011].
2. O'Neill JM. Molasses Used in Cleanup of Polluted Sites. *NorthJersey.com*, News section, Environment & Energy subsection (12 Oct 2011). Available: <http://tinyurl.com/65aoq53> [accessed 17 Oct 2011].
3. O'Neill JM. Dupont Says Soybean Oil Plan No Good. *NorthJersey.com*, News section (14 Oct 2011). Available: <http://tinyurl.com/3mc9uu5> [accessed 17 Oct 2011].
4. Ayyanan A, et al. Perinatal exposure to bisphenol A increases adult mammary gland progesterone response and cell number. *Mol Endocrinol*; <http://dx.doi.org/10.1210/me.2011-1129> [online 8 Sep 2011].
5. Miami-Dade County Health Department. Second Locally Acquired Case of Dengue Fever in Miami-Dade County [press release]. Miami, FL:Miami-Dade County Health Department (28 Sep 2011). Available: <http://tinyurl.com/5scabgl> [accessed 17 Oct 2011].
6. Florida Department of Public Health. Dengue Fever [website]. Tallahassee, FL:Division of Environmental Health, Bureau of Environmental Public Health Medicine, Florida Department of Public Health. Available: <http://tinyurl.com/42wnngb> [accessed 17 Oct 2011].
7. NIEHS. NIH Launches Research Program to Explore Health Effects from Climate Change [press release]. Research Triangle Park, NC:National Institute of Environmental Health Sciences (6 Oct 2011). Available: <http://tinyurl.com/6jy7y94> [accessed 17 Oct 2011].