



# Reducing Cremation Emissions

## How much do they harm the environment?

Despite some public misperception, cremation emission news is actually good – and getting better. Already, cremation output has only a very minor impact on air and water quality. Fortunately, the pollutants generated by almost any incineration process can be lowered, particularly with careful monitoring and very up-to-date equipment. The products of incineration that cause concern include sulfur dioxide, nitrous oxide, carbon monoxide, metals, dioxins (PCDDs) and particles. The poisonous compounds known as PCBs (polychlorinated biphenyls) are another category of unwelcome emissions. “These are typically produced when you burn organic matter in the presence of chlorine,” said Neil Donahue, associate professor of chemistry and chemical engineering at Carnegie Mellon University in Pittsburgh.

The human body is 90 percent water, which contains ample salt (sodium chloride). PCBs are probably made during the cremation process itself, said Donahue, who is also director of the new Center for Atmospheric Particle Studies.

### Mercury and Other Metals

Mercury has been widely publicized as a supposed danger from cremation, particularly with the metal that escapes from silver amalgam dental fillings in human bodies. When exposed to intense heat, mercury alloys used in fillings become volatile and are emitted into the air.

What causes the negative image and public concern? Mercury that winds up as particles outside the chimney stack poses the greatest risk to any susceptible nearby population. Elemental mercury is not soluble. This means it will simply float in the atmosphere until it oxidizes and is then dispersed by rain, eventually ending up in water, where fish may ingest it. The current belief, according to Donahue, is that once in water, mercury can return to its volatile state and could re-enter the atmosphere.

In April, the U.S. Environmental Protection Agency determined, based on 1999 Cremation Association of North America (CANA) data, that all U.S. crematories combined would have emitted a total of 239 pounds of mercury annually. Using 2004 rates, and including Canadian crematories, the EPA calculated mercury emissions at

approximately 320 pounds.

With about 2,050 North American crematories, this amounts to each emitting roughly 0.15 pounds of mercury annually. Based on an average of 400 cremations per year, a single crematory’s total mercury emissions (if they could be captured) would be smaller than a household sugar cube.

Fortunately, use of silver amalgam fillings is declining. At one time, these fillings were chosen for nearly 90 percent of dental cavities. Within the last decade, though, the Center for Disease Control estimates their use has already decreased by 38 percent.

Jack Springer, former executive director of CANA, called these mercury concerns “a red herring.”

“It’s not a problem,” he added. “Just a perceived problem. The EPA reported that cremation represents zero percent of mercury emissions.” Several states have considered legislation to require removal of teeth before cremation (which would necessitate hazardous waste disposal for them). “I know of no one going ahead and doing that,” said Springer. “No law has been enacted.”

Some other metals are also known hazards. Cadmium, for example, is a



major toxin at even very low levels. However, “though the body contains many heavy metals – lead, cadmium, arsenic, etc. – the quantities are so small that they typically aren’t a problem,” said Burton Ogle, director of the environmental health program, department of health sciences, at Western Carolina University in Cullowhee, N.C.

### The Matter of Particulate Matter

Particulate matter (PM) – common emissions from power plants and diesel engines – are very dangerous. They contain microscopic particles (typically described as soot), to which highly toxic chemicals can bond. “When under 10 microns, these particles are small enough to be inhaled,” said Ogle, who is a certified industrial hygienist and safety professional. “At less than 2.5 microns, they can be inhaled very deeply. They are some of the most potent carcinogens.”

The specific chemicals aren’t even the greatest risk – it’s the actual particle, said Donahue. “We know that particles of almost any composition are dangerous because they can lodge in the lungs and have serious cardiovascular impact, such as edema or extra stress on the heart.”

Are unsafe particles emitted during human cremation? “I think no one has that kind of data from crematories, but my best guess is that it’s not a big

problem (when compared to other emission sources). For comparison, I’d say particulate matter from crematories is much lower than from most residential fireplaces,” explained Ogle.

### Temperatures, Tools and Equipment

Specific, appropriate temperatures and tools are the crucial factors in keeping emissions low. Each piece of crematory apparatus has precise functions, and equipment designed to catch particles will not capture vapors or gases.

Mercury that winds up as a particle outside a chimney stack will probably be rained out nearby, said Donahue. He added that PCBs are semi-volatile, able to move around and go in different directions. Lower temperatures maintain them as particles in the exhaust, making them easier to remove.

In Japan, where cremation is widely practiced, a team of scientists has researched measures to prevent certain dangerous emissions. The study, at Kyoto University’s graduate school of engineering, found that maintaining a temperature of 800 degrees Celsius in both main and secondary chambers, in addition to lowering the temperature in the dust collector, would reduce emission of PCDDs/DFs. Donahue agreed with the study’s guidelines: keep the flame hot and the filter cold.

“The cold filter is a good idea because it gets mercury, PCBs and

particles,” he said. “The Japanese study suggests a fine-particle filter would help remove these and give you a good chance to capture PCBs and dioxins. I think it would also help trap mercury when it’s still semi-volatile. You’ll still have some gunk, but it’s more controllable.”

However, he differs on the Japanese researchers’ finding “that a hot filter will produce dioxin.” He said, “I think that the hotter the temperature, the less dioxin would be produced.” Instead, Donahue believes that raising temperatures is likely to reduce the emitted amounts of both dioxins and PCBs.

For any kind of pollutant, he said, “Rule No. 1 is, reduce the amount you make. Rule No. 2 is, if you made it, get it before it escapes. Because you don’t want to emit gases and particles that will be moved by rain, choose from various forms of filters.” Generally, it is the smaller particles that are of greatest concern. Removing them usually requires a more sophisticated filter.

### Obeying the Rules and Regulations

The federal EPA regulates particulate matter emissions. The legal maximum is 15 micrograms per cubic meter. While the EPA recognizes that crematories do indeed exist, no specific rules apply to them. In the late 1990s, Ogle said, the EPA studied cremation emissions and attempted to regulate them under Hazardous Air Pollutants (HAP) laws.

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However, subsequent pilot studies found no special concerns.

Now, state and sometimes county environmental agencies set their own terms, which vary quite a bit. Usually, each facility is required to have its emissions tested to maintain its permit. Crematories fall under the same category as solid waste incinerators, most of which are regulated. Crematory operators need to check with their own states' EPA agencies, which enforce HAP requirements. These are part of the Clean Air Act, which Ogle called, "the most effective environmental regulations ever enacted."

### Anti-Aging

Ogle sees a wide range in undesirable output. "The high end [crematory] will have the appropriate temperatures, so emissions will be significantly lower. Older crematories are not quite as efficient, so they'll have slightly more emissions."

Springer agreed. "Most of the older crematories have either closed or upgraded as much as possible – they've added pollution monitors and TV screens."

Any smoke that isn't white is a warning signal. "Black smoke means you have not had complete combustion," said Springer. Today, he added, many machines "are programmed to respond to visible smoke and shut down. The cause may be something as simple as a casket with a faster burning finish." Promptly call the equipment manufacturer to inspect, he advised.

However, "when you first start, there's always a little smoke because the stack is not fully heated yet," noted Ogle. "But once it's heated up, there should be no visible emissions. With less frequent use, efficiency may be a little lower, so especially check if you're not a very busy crematory. It will take longer to heat up, so you may need to introduce added fuel, like natural gas or propane, to quickly build up efficiency."

### Recommendations

The Kyoto University researchers' advice for reducing emissions includes connecting one secondary chamber to one main chamber and installing a

sampling point for monitoring of PCDDs and DFs.

Also, cautioned Ogle: always maintain combustion at the manufacturers' suggested temperatures, as closely as possible, because they designed them to work at certain temperatures. If those efficiency numbers are not being met, Ogle said to check for leaks, because the retort may be emitting carbon monoxide.

The latest equipment is all very efficient, exceeding any government requirements, said Springer. However, "make sure you're trained in how to use it! More and more states are requiring crematory operators to be certified and trained in their operation." For example, Arizona, Illinois, Texas and Virginia already have certification regulations; Florida and New York are currently considering them. Some states even specify the accepted training provider.

CANA's model state law suggests requiring certification. The association has already trained and certified several thousand operators, with five-year renewals. A supplier may also stipulate certification for its users.

"If you're better trained, everything is done better – you're more aware of how the equipment works. You'll know that if something is too hot for a

particular item, high heat may add to the problems," said Springer. "Even if you have good equipment, a worker may not be aware of all the factors. For example, an obese body is not the same as cremating a smaller person."

### Experts Offer Encouragement

Demand for cremation is rising: In 2004, the number of cremations in the United States exceeded 700,000 for the first time. Current projections call for nearly 1.5 million by 2025. Costs are coming down because the technology is there, said Ogle.

As a result, Springer has even seen some groups of funeral homes banding together to buy one crematory they can all use. This would keep volume high enough to make the facility both efficient and cost-effective.

"The industry is very concerned that the public understand these are well-run machines, not spreaders of pollutants or mercury," said Springer. By following every suggestion to keep crematory emissions at their absolute minimum, operators will help contribute to a greater public acceptance of the cremation process. •

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