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COVER STORIES 

Asbestos: Still a global menace

Health concerns prompt calls to end production and use of deadly substance in the U.S. and beyond

By Britt E. Erickson

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Asbestos: Still a global menace 

Asbestos 101 

Asbestos in the wild 

Superfund research center studies asbestos from all angles 

Cancer-causing asbestos may trigger autoimmune diseases too 

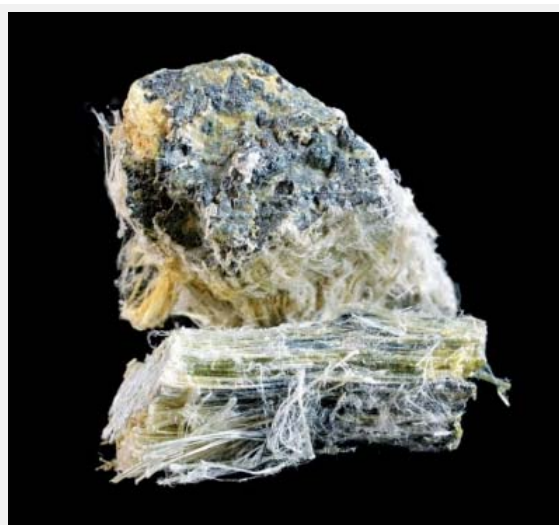
Salucci was diagnosed with mesothelioma in 2007, 30 years after her likely exposure to asbestos. She has outlived her doctor's prognosis and now spends her time raising awareness about the disease and the threat of asbestos in older buildings like houses, hospitals, and schools. If asbestos fibers become airborne, there's a risk of exposure, she says. "We must safely get rid of it."

Salucci joined hundreds of other people seeking to eradicate asbestos exposure around the world at an Australian government conference earlier this month. Production and use of asbestos was banned in Australia in 2003, but approximately one-third of all homes in the country contain the substance. Australia had the highest per capita rate of asbestos use in the world from the 1950s to the 1970s.

Salucci, now 47, is one of hundreds of Australians diagnosed with mesothelioma every year. Like many other kids that grew up during the 1960s and 1970s, she never worked around asbestos nor did any home renovations herself. She was exposed to asbestos while playing as a child.

While Australia, like many other countries, faces

As a 7-year-old child in suburban Sydney, Australia, Serafina Salucci recalls playing with white wall sheeting material leftover from her dad's renovation of the family's garage. She used it like chalk to draw on the driveway, and threw chunks of it back and forth with her brothers. Little did anyone know at the time that the sheeting contained carcinogenic asbestos fibers that would later be blamed for giving Salucci mesothelioma, an incurable cancer attacking the lining of her lungs.



Credit: Shutterstock

In brief

More than 50 countries around the world have banned the use of asbestos, a known human carcinogen linked to lung cancer, mesothelioma, and other diseases. But two Western industrialized countries—the U.S. and Canada—have not taken such steps. Anti-asbestos activists are ramping up pressure on regulators in the U.S. and elsewhere to stop the production and use of the fibrous material. Meanwhile, scientists would like to better understand the basic science of the substance in order to deal with remediation at hazardous sites and to treat those who are susceptible to asbestos-related diseases. An NIH-funded research center at the University of Pennsylvania is leading the charge (**see page 32** <<http://cen.acs.org/articles/94/i47/Superfund-research-center-studies-asbestos.html>>).

huge challenges related to its former use of asbestos, more than 100 countries face even greater problems because they have yet to ban the fibrous material. The U.S., Canada, and many countries in the Asia-Pacific region, for instance, still allow some use of asbestos, despite the substance's known adverse health effects.

That could all be about to change, however, as regulators face mounting calls from trade unions, patient advocacy groups, and environmental activists to cut off any further use of the material. Such groups are urging the liberal Canadian government, which took office last year, to keep its campaign promise and ban all uses of asbestos. In the U.S., recent changes to the law that governs commercial chemicals have prompted activists to intensify pressure on the Environmental Protection Agency to do the same.

Asbestos 101

Asbestos is a group of six fibrous silicate minerals known for their high tensile strength, flexibility, and resistance to heat and chemicals.



Chrysotile: $\text{Mg}_3(\text{Si}_2\text{O}_5)(\text{OH})_4$. Has been used more than any other type of asbestos. Accounts for most of the asbestos found in U.S. and Canadian buildings.



Amosite: $\text{Fe}_7\text{Si}_8\text{O}_{22}(\text{OH})_2$. Mined predominantly in South Africa.



Crocidolite: $\text{Na}_2(\text{Fe}^{2+}_3\text{Fe}^{3+}_2)\text{Si}_8\text{O}_{22}(\text{OH})_2$. Often referred to as blue asbestos. Considered the most hazardous form of the six minerals.



Tremolite: $\text{Ca}_2(\text{Mg}_{5.0-4.5}\text{Fe}^{2+}_{0.0-0.5})\text{Si}_8\text{O}_{22}(\text{OH})_2$. Typically found as a contaminant in vermiculite, chrysotile, and talc. Responsible for asbestos-related ailments in Libby, Mont.



Anthophyllite: $\text{Mg}_2\text{Mg}_5\text{Si}_8\text{O}_{22}(\text{OH})_2$. Formerly mined in Finland and Japan.



Actinolite: $\text{Ca}_2(\text{Mg}_{4.5-2.5}\text{Fe}^{2+}_{0.5-2.5})\text{Si}_8\text{O}_{22}(\text{OH})_2$. Formerly mined in Australia.

The problem with asbestos



Asbestos is defined by regulators worldwide as a group of six naturally occurring fibrous silicate minerals—actinolite, amosite, anthophyllite, chrysotile, crocidolite, and tremolite (see page 30). More than 90% of all asbestos used historically and nearly all of it used today is chrysotile, according to the World Health Organization (WHO).

The substance was once mined and used extensively throughout the world in a wide range of construction materials and other consumer products, including thermal insulation, vinyl floor tiles, cement sheeting, brake pads, gaskets, and roofing materials. Although these products are now banned in many countries, they still remain as so-called legacy sources in homes and other buildings or lurk in hazardous waste sites.

Asbestos is known for its high tensile strength, flexibility, and resistance to heat and chemicals. But those same properties make it deadly when its fibers get lodged within the human lung. Inhalation of asbestos has been linked to the mesothelioma that Salucci battles, as well as lung cancer and asbestosis, which is a severe scarring of the lungs.

Worldwide, more than 100,000 people die each year from occupational exposure to asbestos, and hundreds more die each year from nonoccupational exposures, **according to WHO** <http://apps.who.int/iris/bitstream/10665/143649/1/9789241564816_eng.pdf?ua=1> .

Iceland became the first country to ban the production and use of all types of asbestos in 1983. Since then, more than 50 countries have followed suit, according to the International Ban Asbestos Secretariat, an advocacy group founded in 1999 that seeks to prohibit production and use of asbestos worldwide.

Despite health concerns, asbestos is still found in many places.



Credit: Shutterstock
For example, many buildings throughout the world still have corrugated roofing materials made with asbestos.



Credit: Shutterstock
Meanwhile, countries that have banned certain asbestos-containing products, such as brake pads, still struggle to control illegal imports.

Asbestos and U.S. law

The U.S. EPA banned most uses of asbestos in 1989 under the Toxic Substances Control Act (TSCA). Industry sued, however, and in 1991, a federal appeals court overturned the regulation.

Now that TSCA has been revised, an action that was signed into law on June 22, EPA faces renewed pressure to use its new authority to ban all uses of asbestos in the U.S. Pushing the agency to do so are federal lawmakers, environmental and public health groups, and the motor equipment manufacturing industry. Many observers view asbestos as the poster child for why this year's congressional overhaul of TSCA was needed.

"EPA spent more than a decade developing a rule to ban existing uses of asbestos," recalls



Richard Denison, a lead senior scientist at the Environmental Defense Fund, an advocacy group. In the 1980s, it sunk millions of dollars into the effort and compiled nearly 100,000 pages of documentation showing why the ban was needed. Nonetheless, the court ruled that EPA had not demonstrated what was legally required under TSCA to justify regulation. Denison says EPA is likely to have an easier time justifying a ban on asbestos under the revised TSCA.

That's because under TSCA as it was originally passed in 1976, EPA had to show that the benefits of regulation outweigh the costs. The agency also had to show that restriction of each use was the least burdensome way to reduce the risk. The new law forbids EPA from considering costs when determining whether a chemical poses an "unreasonable risk." It also strikes the "least burdensome" requirement, allowing EPA to restrict a chemical "to the extent necessary" to reduce the risk.

The chemical industry is anxiously waiting to see whether EPA will include asbestos in the first group of chemicals it reassesses under the revised TSCA. Under that new law, Congress gave EPA until Dec. 22 to choose 10 high-risk chemicals that are currently on the market for further risk evaluation. Those 10 must be taken from a list of about 90 chemicals that EPA has already designated as high-priority substances. Asbestos is one of those 90.

Chlor-alkali industry and asbestos

Although asbestos use in the U.S. has declined by 99% since the 1970s, when there was extensive litigation around its adverse health effects, the chlor-alkali industry still uses asbestos diaphragms to produce chlorine. The process involves passing an electric current through a NaCl solution in an electrolytic cell. The diaphragm separates the anode from the cathode, preventing OH^- generated at the cathode from reacting with the chlorine gas generated at the anode.

The chlor-alkali industry is phasing out the use of asbestos-based diaphragms. Newer industrial plants have replaced them with ion-exchange membranes, which require less energy and have less environmental impact. But such technology is more expensive to replace than asbestos-based diaphragms, so much of the industry has been reluctant to switch.

About 60% of the U.S. chlor-alkali industry still uses asbestos diaphragms, according to the American Chemistry Council's Chlorine Chemistry Division, which represents chlorine manufacturers.

Chemical companies were successful in getting EPA to make an exception for the chlor-alkali process in the agency's now-defunct 1989 ban of asbestos. So too were they successful in getting an exemption when asbestos was banned in the European Union in 2005.

The chlor-alkali industry uses most of the asbestos sold in the U.S.—about 90%, according to the U.S. Geological Survey. USGS figures show approximately 360 metric tons of asbestos was imported and consumed in the U.S. in 2015.

Today, as EPA is under pressure to revisit the safety of asbestos under the revised TSCA, the U.S. chemical industry is once again urging regulators not to impose restrictions on chlor-alkali manufacturers.

"Because the use of asbestos in the chlor-alkali industry is confined in the production

process, worker exposure risk is essentially eliminated,” ACC claimed in an **August letter** <<https://www.regulations.gov/document?D=EPA-HQ-OPPT-2016-0400-0049>> to EPA. In its 1989 rule, the agency concluded that “a ban on this product category would result in only minimal benefits because asbestos exposure is limited,” the lobbying group noted.

Anti-asbestos activists double down

Meanwhile, activists who want EPA to ban all uses of asbestos are ramping up their efforts to persuade the agency to include asbestos in the first group of chemicals it reassesses under the revised TSCA.

In a Nov. 9 letter to EPA Administrator Gina McCarthy, international trade unions, patient advocacy groups, environmental activists, and others who want to rid society of asbestos urged EPA to act quickly to ban all uses of the substance. The groups, led by the Asbestos Disease Awareness Organization (ADAO), are concerned that President-Elect Donald Trump will eviscerate EPA and hamstring the agency’s efforts to ban dangerous chemicals.

Trump has “made clear, time and time again, his affinity for continuing the use of asbestos,” says Linda Reinstein, cofounder of ADAO. Reinstein began raising awareness about the dangers of asbestos after her husband, Alan, was diagnosed with mesothelioma in 2003. “Trump’s Administration could well usher in a resurgence in rampant use of this known human carcinogen by encouraging development and further deregulating industry,” she says.

Some U.S. lawmakers, including Sens. Barbara Boxer (D-Calif.), Dianne Feinstein (D-Calif.), Dick Durbin (D-Ill.), and Jon Tester (D-Mont.), are also pushing EPA to act swiftly to ban asbestos. “Now that the impediments in the original TSCA law are gone, completing the job started by EPA in 1989 would send a strong signal that the new law can be effective in addressing the most dangerous chemicals in commerce,” **Boxer writes in an August letter to EPA.** <<http://www.epw.senate.gov/public/index.cfm/2016/8/senator-barbara-boxer-calls-on-epa-to-act-now-on-dangerous-asbestos-under-the-new-tsc-law>> Boxer’s letter also raises concerns about asbestos-containing products being imported into the U.S. at various ports.

There have been reports of asbestos-containing brake pads and insulation tiles being imported into the U.S., Denison says. Because of these imports, at least two states, California and Washington, have banned asbestos-containing brake pads, he says.

Imports of asbestos-containing products are a growing problem worldwide, said several participants at the **conference** <<https://www.asbestossafety.gov.au/asbestosconference2016>> Salucci attended in Australia. During that meeting, trade unions representing workers across Australia posted on Twitter about the need for more action to stop illegal asbestos imports. “E-commerce and complex supply chains make testing for asbestos at our borders a nightmare,” tweeted Australia’s Electrical Trades Union, which represents electrical and communications workers.

125 million

The number of people worldwide who are exposed to asbestos in the workplace each year.

>100,000

The number of people who die each year from asbestos-related diseases linked to occupational exposures.

Sources: World Health Organization, U.S. Geological Survey

To prevent more people from being exposed to asbestos, governments around the world need to stop the production of asbestos, Salucci warned during a panel discussion at the meeting. “We need to tackle the global problem,” she said.

Asbestos in the wild



Credit: Brenda Buck
In arid regions of the western U.S., asbestos can be carried by wind in dust storms. Shown here is a view looking south from the University of Nevada, Las Vegas.

In the past, most concern about asbestos was related to exposure on the job or from buildings that contain the fibrous material. But in some places, such as parts of the western U.S., asbestos and asbestos-like minerals in the environment can be just as worrying. These minerals, which are found in the rock and soil, can become airborne by construction-site digging or even wind.

As commercial development expands in areas where the soil geology permits the formation of asbestos, human exposure to this substance increases, says Christopher Weis, toxicology **liaison at the National Institute of Environmental Health Sciences.**

<[http://cen.acs.org/articles/93/i43/Ending-Mercury-Based-Chlorine-](http://cen.acs.org/articles/93/i43/Ending-Mercury-Based-Chlorine-Production.html)

Production.html> Such development, he says, includes hydraulic fracturing operations in North Dakota and highway construction in the Las Vegas area.

Rodney Metcalf and Brenda J. Buck, geologists at the University of Nevada, Las Vegas, are mapping the distribution of asbestiform minerals in that state, where such minerals are part of the bedrock. Through wind and water erosion, asbestos is distributed across the landscape in soil and dust.

“Out here, you don’t need a big bulldozer to disturb it. You just need a windy day,” Buck says. “Sand, silt, gravel, dust—it all has asbestos in it.”

In their mapping project, Metcalf and Buck have found areas with unexpectedly high levels of asbestiform minerals.

“The old models for geologic predictions about where we would find it wouldn’t have predicted this,” Metcalf says. Those models were designed to locate concentrations high



enough to support mining. The levels researchers are now finding aren't that concentrated, but they represent "a fairly sizable footprint of low-concentration asbestos."

And some areas have the potential to affect people who might not otherwise be exposed to asbestos. "There's a dry lake bed that's a favorite place for driving off-road vehicles that has quite a bit of asbestos in it," Buck says.

People can protect themselves by avoiding those areas. "If you're an off-road driver, don't drive on that lake bed. Go to a different one where asbestos hasn't been found or isn't predicted to occur."—Celia Arnaud

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Comments

Joanna Hinton (November 28, 2016 10:46 AM)

Thank you for this timely article, the photos of natural asbestos minerals, the human side of asbestos carcinogenicity, and the urgent need for EPA & world to ban asbestos production & use.

» **Reply**

Duncan Rimmer (November 30, 2016 4:02 AM)

Excellent article very interesting and supported with some good photos of asbestos specimens. Thanks

» **Reply**

Miguel Rodas (November 30, 2016 4:22 PM)

Great article, very informative. What will it take for US and Canada not to process it in any type of products? Let's call our representatives in Washington; let's put them to work.

» **Reply**

Krishna Prasad K.N. (December 4, 2016 12:41 AM)

True, in the chlor-alkali asbestos-based diaphragms, exposure to asbestos is insignificant. But, think of the process for manufacturing the diaphragms. So also, about the use of asbestos in the brake-liners and the like. In all such cases, workers are very much exposed to asbestos. Here lies the necessity to ban the use of asbestos.

K.N.Krishna Prasad
Chartered engineer; EHS Consultant & Trainer; Mysuru, India.

» **Reply**