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## Short-Chain Chlorinated Paraffins Draw EPA Scrutiny--After 70 Years

**A family of chemicals virtually unknown to the public but important to industry is now under EPA review**

By Ferris Jabr and Environmental Health News

An obscure family of chemicals – important to the metalworking industry but virtually unknown to the public – is suddenly the subject of scrutiny from the U.S. Environmental Protection Agency.

The chemicals, called short-chain chlorinated paraffins, persist in the environment, accumulate in human breast milk, can kill small aquatic creatures and travel to remote regions of the globe.

Since their introduction in the 1930s, the chemicals, known as SCCPs, have received little attention from U.S. authorities. But now the EPA, in an unprecedented move, has placed them on a short list of worrisome chemicals that the agency may regulate because of the risks they pose to wildlife and the environment.

"We find SCCPs worldwide," said Tala Henry, acting deputy director of the EPA's National Program Chemicals Division. "We've found them in animals in the Arctic and we have measured them in human tissues in several places around the globe."

Despite evidence of widespread exposure, few scientists are actively studying the prevalence, toxicity and ecological impact of SCCPs. In contrast, other chemicals that persist in the environment – such as DDT and dioxins – have received far more attention from researchers.

"There is minimal awareness of these compounds," said Gregg Tomy, an environmental chemist at the University of Manitoba in Canada. "It's certainly not a chemical that's on people's radar screens."

Chlorinated paraffins are a complex group of manmade compounds, primarily used as coolants and lubricants in metal forming and cutting. They also are used as plasticizers and flame retardants in rubber, paints, adhesives, sealants and plastics. The family of chemicals is organized into short, medium and long-chain paraffins, based on the length of their carbon backbones.

About 150 million pounds of chlorinated paraffins are used annually in the United States, according to the EPA. Ohio-based Dover Chemical Corp., the sole manufacturer of SCCPs in the United States, did not respond to requests for an interview.

Although Europe has restricted use of SCCPs, their manufacture is growing in China and possibly in India, raising concerns that worldwide exposure levels for people and wildlife might be increasing.

China's production of the chemicals has increased 30-fold in fewer than 20 years.

"We are pretty worried at the moment," said Jacob Boer, head of the department of chemistry and biology of the Institute for Environmental Studies at the Vrije Universiteit (VU University) in Amsterdam. "The increase of chlorinated paraffin production in China is exponential."

In an unprecedented use of the 1976 Toxic Control Substances Act, the EPA in December placed SCCPs on a list of four chemicals that may pose unreasonable risks to health and the environment. In its action plan, the EPA announced its intentions to investigate and manage those risks, possibly restricting or banning future use of SCCPs in the United States.



It is the first time that the EPA has investigated the compounds, which are already regulated in Europe and under review in Canada.

Scientists have found the chemicals in the air, on land, in foods, in wastewater and in river and ocean sediments in North America, Asia, Europe and the Arctic, according to a report by a United Nations review committee for the Stockholm Convention, an international treaty that restricts toxic compounds.

"You find them pretty much wherever you go to look for them," said Tomy, who found significant concentrations in sediments around the Great Lakes region.

SCCPs are accumulating in the fat tissues of freshwater fish such as trout and carp in North America and Europe, marine mammals including Beluga whales, ringed seals and walrus in the Canadian Arctic, land animals including rabbit, moose and reindeer in Sweden, and birds and seabird eggs in the United Kingdom.

Furthermore, certain SCCPs may biomagnify – meaning their concentration increases as they move through food chains, according to a 2008 field study on Lake Ontario trout.

Researchers have also measured SCCPs in human livers, kidneys, fat tissue and breast milk, according to the EPA action plan. Traces were found in 21 out of 25 samples of breast milk from women in London and Lancaster in a 2006 study in the United Kingdom. They also were measured in breast milk from Inuit women in Arctic Canada in a 1997 study by Tomy and colleagues.

However, since so few scientists are studying the toxicity of SCCPs and their impact on health and the environment, the consequences of the widespread exposure remain unclear.

SCCPs are highly toxic to small aquatic invertebrates and plants that fish and other animals feed on, so the chemicals may endanger aquatic ecosystems. But toxicity to humans and other mammals has been more difficult to determine.

"Whether these compounds are now challenging organisms, I can't say for certain," said Tomy. "But because they are so persistent, we can expect them to continue to accumulate. At some point there is going to be serious cause for concern."

Laboratory tests show that SCCPs are highly toxic to Daphnia, tiny aquatic crustaceans known as water fleas that are important food sources in lakes, streams and other ecosystems, according to a 2000 European Union risk assessment.

To fish, the compounds are less acutely toxic, but chronic exposure damages them. Rainbow trout fed SCCPs in their food developed severe liver tumors, according to a study by Canadian researchers.

The concentrations that caused the fish tumors "were at levels that have been reported in invertebrates and fish from contaminated sites in the Great Lakes. However, the exposure concentrations were likely much greater in these experiments compared with the environment and require further study," according to the 1999 study, whose senior author was Derek Muir, one of the world's leading experts on persistent pollutants in fish and wildlife. Requests to interview Muir were denied by Environment Canada.

Other studies have found that SCCPs can cause slight egg shell thinning in mallard ducks and can damage the livers of otters.

Although there are no human studies on their effects, SCCPs can cause cancer in laboratory rats and mice, specifically damaging the liver, thyroid and kidney. Still, the EPA's action plan and the UN report note that the mechanisms by which these cancers were induced in rodents are not relevant to human health.

For people who do not work in the metal industry, a primary route of exposure to the chemicals is food, according to the EPA action plan.

Researchers in 2002 measured SCCPs in cow's milk and butter from Europe. They also have been found in many different foods in Japan, including grains, sugar, sweets and snacks, vegetables, fruit, fish, meats and milk. The concentrations were particularly high in shellfish, meat and fats, such as margarines and oils, according to the 2005 study in Japan.

How the chemicals got in the environment is not well understood. "We can confidently say there has been exposure, but exactly how they got there is a difficult question," said Henry of the EPA.

Possible routes include accidental spills, runoff from disposal, and effluents of sewage treatment plants, states the EPA action plan. "SCCPs can be released during production, transportation, storage, and industrial use," Tomy said.

The chemicals also might leach out of commercial plastic and rubber products in which they are used as flame retardants and plasticizers, he said. Once in the environment, SCCPs – which do not dissolve in water – bind to sediments and to tiny aquatic organisms, working their way up food chains.

According to Tomy, the inherent complexity of chlorinated paraffins makes it difficult to identify and analyze them.

"There are only a few labs in the world, and you can count them on one hand, that are actively working in this area because of the complexity," Tomy said. "This makes PCBs [polychlorinated biphenyls] and PBDEs [polybrominated diphenyl ethers] seem like a walk in the park in terms of detection and quantification."

"They are difficult to characterize," Henry agreed. "There's a difference in interpretation about what a short-chain chlorinated paraffin is."

The result is that the EPA knows far less about SCCPs than other chemicals such as DDT that persist in the environment and accumulate in people and wildlife. "Compared with other persistent chemicals, there's the least amount of toxicity and exposure data," Henry said.

Nevertheless, several authorities already have regulated them. Their use and marketing are restricted in Europe. Both Health Canada and Environment Canada have deemed all chlorinated paraffins "toxic" under the Canadian Environmental Protection Act of 1999. Requests to interview Environment Canada scientists who have studied SCCPs were denied.

According to their new action plan, the EPA will consider using the Toxic Substances Control Act to "ban or restrict the manufacture, import, processing or distribution in commerce, export, and use of SCCPs" based on evidence about their environmental and health effects.

Although the EPA says it wants to move quickly to address the risks posed by SCCPs, the agency does not know when it will reach any regulatory decisions.

Under the federal toxics law, the EPA maintains an inventory of over 80,000 chemicals authorized for use in the United States. If a company wants to produce or use a chemical not found on that inventory, they must receive EPA approval by submitting a premanufacture notice that describes its environmental effects.

According to the EPA, some U.S. companies are using chlorinated paraffins that do not appear on the inventory. Tala said the EPA's first step is to find out why.

Robert Fensterheim, executive director of the Chlorinated Paraffins Industry Association and President of RegNet Environmental Services, said he is not particularly concerned about the potential outcomes of the EPA's action plan.

"The effects on industry are not going to be broad scale," Fensterheim said. "Given the limited amount that is produced and used, our assumption is that most people using the product already have responsible management in place. They won't need to do anything they're not already doing."

Fensterheim disputes the EPA's estimate that 150 million pounds are used annually in the United States. The demand, he said, is closer to 50 or 60 million pounds per year and decreasing.

"This is not a high volume chemical," he said. "It's been declining in its production value for quite some time." The reason for the disagreement may be due to difficulty in defining exactly what a short-chain chlorinated paraffin is.

Manufacture and use of SCCPs have decreased in Canada, Europe and the United States but production is increasing at a rapid rate in China.

"If that production would have to be limited, it would be a major problem for the China metal industry," said Boer of Amsterdam's Vrije Universiteit. The increased production rate could also aggravate the ecological risks of the chemicals, he said.

The production of chlorinated paraffins in China soared from 20,000 tons in 1990 to over 600,000 tons in 2007, according to a 2009 presentation by Jiang Gui-bin of the State Key Laboratory of Environmental Chemistry and Ecotoxicology in

Beijing, China. If this rate continues, production in China alone could soon surpass the entire historic, worldwide usage of PCBs, which remain a contaminant of global concern even though they were banned 32 years ago. Total worldwide PCB production was 1.3 million tons.

India also may be increasing its production of SCCPs, Boer said.

Although SCCPs are specifically defined as having a carbon backbone between 10 and 13 atoms long, there is still plenty of room for disagreement about which industrial products contain which chlorinated paraffins. The TSCA inventory, for example, does not distinguish between chlorinated paraffins of different carbon chain lengths.

Fensterheim said the companies believe the chemicals they use are already covered by the TSCA inventory, but the EPA disagrees.

Despite the inherent difficulties in studying the complex chemicals, Tomy said researchers need to keep monitoring their environmental levels and the toxicity to people and wildlife.

"I would like to believe in the coming years you are going to see more research," he said.

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