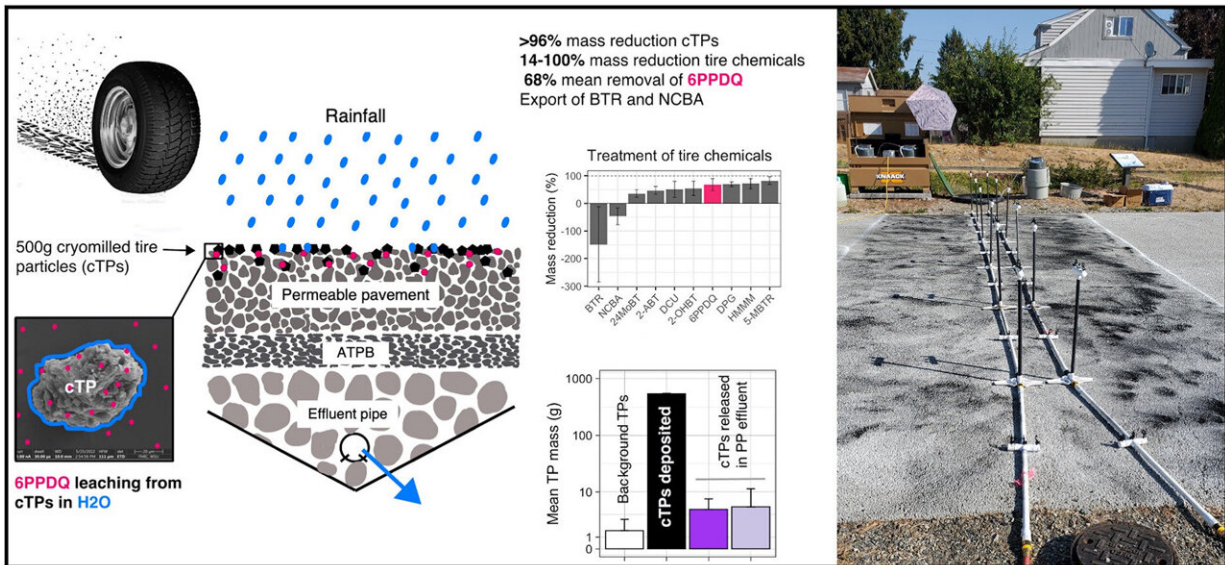


Permeable pavements could reduce salmon-killing tire pollutants

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Credit: *Science of The Total Environment* (2023). DOI: 10.1016/j.scitotenv.2023.168236

The pore-like structure of permeable pavements may help protect coho salmon by preventing tire wear particles and related contaminants from entering stormwater runoff, according to a Washington State University study.

Researchers have demonstrated that four types of permeable pavements can act as giant filters, retaining more than 96% of applied [tire](#) particle

mass. They also captured several tire-associated chemicals, resulting in a 68% average reduction of 6PPD-quinone, a contaminant shown to kill coho salmon in urban streams. The study findings were [published](#) in the journal *Science of the Total Environment*.

"The pressure on existing stormwater management technologies is becoming problematic, especially with [climate change](#) and increased development," said lead author Chelsea Mitchell, who recently earned a Ph.D. in environmental and natural resource sciences from WSU.

"Permeable pavements are a very promising type of green stormwater infrastructure because they could treat this type of pollution where it's generated, rather than downstream."

In 2020, a team led by WSU and University of Washington scientists at the Washington Stormwater Center discovered that 6PPD, a chemical found in tires, transforms into 6PPD-quinone when exposed to ozone or sunlight. Even in small concentrations, 6PPD-quinone is deadly to salmon.

For the latest study, WSU scientists led by Ani Jayakaran, a professor at WSU's Puyallup Research and Extension Center, worked in an active parking lot at the School of Industrial Design, Engineering and Art in Tacoma, Wash., running a series of tests on four permeable pavements made of either asphalt or concrete. The pavements were created in collaboration with Boeing, as well as Tacoma Public Schools and the City of Tacoma.

First, the researchers mimicked a rain event by flushing water through the pavements, measuring the background level of existing pollutants. The next day, they deposited ground-up used tire tread across a dosing area. They again simulated a rainstorm, measuring the quantity of retained deposited particles and associated chemicals.

A third water-flushing experiment helped the researchers measure the likelihood that 6PPD-quinone and other chemicals would continue leaching off retained tire particles during future rainstorms.

"Permeable pavements make a difference in managing 6PPD-quinone and its source—tire wear particles," said study co-author Jayakaran. "6PPD-quinone is hydrophobic, and we think the chemical is being absorbed into the internal surfaces of the [pavement](#) system."

Because of their void spaces, permeable pavements are inherently weaker than their traditional counterparts, making it hard for them to withstand heavy traffic flows. Researchers in the WSU Voiland College of Engineering and Architecture had previously demonstrated that using carbon fiber composite scraps derived from Boeing airplane wings could make the pavements stronger.

The new research could have a vast impact, the authors said. Salmon are significant to Native nations' culture and to upholding their treaty rights to harvest salmon from streams. The technology could also have human health implications.

"Tire particles are so fine they can become airborne and possibly enter the human body through even a gentle breeze. And even in small doses, 6PPD-quinone is toxic to salmon," Jayakaran said. "Both could impact human health, especially in communities who live near busy roads."

Though the study findings are encouraging, Mitchell and Jayakaran emphasize that more testing is necessary, and widespread use of the novel infrastructure presents some challenges. Permeable pavements are sometimes installed in a new subdivision or a road undergoing repair, but the cost of replacing existing roads and [parking lots](#) is high.

"We're not suggesting that permeable pavements are an appropriate

replacement for all roadways," Jayakaran said. "There's still a lot of work to be done to increase their strength and utility, and this is certainly not a silver bullet. However, our research holds great promise, and we're pointing in a very hopeful direction for future management of 6PPD-quinone and tire wear particles."

More information: Chelsea J. Mitchell et al, Mitigating tire wear particles and tire additive chemicals in stormwater with permeable pavements, *Science of The Total Environment* (2023). [DOI: 10.1016/j.scitotenv.2023.168236](https://doi.org/10.1016/j.scitotenv.2023.168236)

Provided by Washington State University

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