

Focus on: Reducing Sources of 6PPD



Figure 1. A car driving on a road near a storm drain. Tires are a primary source of 6PPD-quinone in the environment.

The 6PPD Tire Problem

In 2020, scientists at the University of Washington-Tacoma, Washington State University, and other collaborators identified the chemical that causes pre-spawn mortality in coho salmon: 6PPD-quinone (pronounced “qui-KNOWN”), also known as 6PPD-q.¹ This chemical is a transformation product of 6PPD, a compound used in tires.

Tire manufacturers use 6PPD to reduce tire cracking and prevent tire blowouts, which keeps passengers safe. 6PPD also increases tire longevity, making them more economical and reducing the number of tires that end up in landfills.

As 6PPD performs these functions, it reacts with ozone in the air and turns to 6PPD-q. Tire dust holding 6PPD-q then washes into rivers and streams when it rains, killing coho salmon before they can spawn. Coho salmon are currently known to be the most sensitive to 6PPD-q, but this chemical is also harmful to other fish, like rainbow trout and brook trout, and possibly other aquatic species.

The discovery of 6PPD-q presents a complex problem: the best way to protect aquatic species is to reduce sources of 6PPD, but tire manufacturers can’t abruptly stop using this chemical because it plays a critical role in tire longevity and performance.

To find a solution, we’re working closely with research institutions; tire manufacturers; federal, state, local, and tribal governments; and other interested parties. Our long-term goal is to identify safer alternatives to 6PPD so we can reduce sources of 6PPD-q. To accomplish this, we must learn more about 6PPD, its toxicity to aquatic species and humans, and the chemicals that can potentially replace it.

6PPD Alternatives Research

Ecology is looking for alternatives and funding research with the Center for Urban Waters (UW-Tacoma), Washington State University, Emissions Analytics, Enthalpy Analytical, and ToxServices to:

- Prepare a hazards assessment for 6PPD and nine other antioxidants/antiozonants (completed in 2021).
- Compare the toxicity of 6PPD on coho salmon to other tire chemicals that could replace 6PPD.

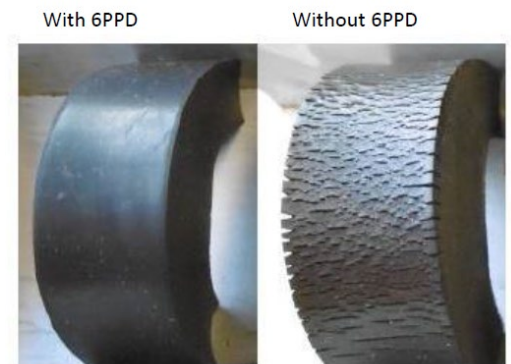


Figure 2: A tire with and without 6PPD. Photo by the U.S. Tire Manufacturers Association.

¹ Tian, Z. et al. 2020. A ubiquitous tire rubber-derived chemical induces acute mortality in coho salmon. *Science* 371 (6525): 185-189. doi.org/10.1126/science.abd6951.

- Learn how environmental conditions (like water pH) impact the toxicity of 6PPD-q.
- Measure the presence of 6PPD, 6PPD-q, and other chemicals present in tires (including assorted brands of passenger car, light truck, and commercial truck tires).
- Test the toxicity of 6PPD on rainbow trout and potentially other aquatic species in the future.

Our goal in funding this research is to answer questions such as:

- Are there chemicals that meet the same tire performance requirements as 6PPD?
- Are the potential replacement chemicals safe for fish, other aquatic species, and humans?
- What criteria will we use to determine whether a chemical is safer than 6PPD?
- Can manufacturers make changes to tire design that remove the need for 6PPD or eliminate the pollution of 6PPD (and its transformation products) from tires?

To accelerate the pace of innovation for 6PPD alternatives, we're bringing interested parties together to share resources and ideas. In partnership with UMass Lowell, we held a forum in December 2022 for organizations to discuss collaborative needs and opportunities to find safer, effective alternatives to 6PPD. Participants shared insights and research around 6PPD and identified some critical next steps to solving this complex problem.

Looking Ahead: 6PPD Alternatives Assessment

In 2022, the Legislature allocated funding for Ecology to prepare a 6PPD alternatives assessment (AA). An AA identifies, compares, and selects safer alternatives to unsafe chemicals like 6PPD.

The research we're conducting is a critical step in preparing for the 6PPD AA. Before conducting the AA, Ecology will establish specific data requirements and standards (known as hazard criteria) to assess chemical safety.

When we evaluate potential alternatives in the AA, we can compare a chemical's toxicity, performance, availability, and cost to that of 6PPD. We will use this information to identify alternatives for 6PPD that: 1) meet tire performance requirements; and 2) are safer to humans, coho salmon, and other aquatic life.

Related Information

- [Ecology's 6PPD webpage](#)²
- [Technical Memo: Assessment of Potential Hazards of 6PPD and Alternatives](#)³
- [Collaborative Innovation Forum: Functional Substitutes to 6PPD in Tires \(Meeting Report\)](#)⁴



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² ecology.wa.gov/6PPD

³ www.ezview.wa.gov/Portals/_1962/Documents/6ppd/6PPD%20Alternatives%20Technical%20Memo.pdf

⁴ www.sustainablechemistrycatalyst.org/s/6PPD-in-Tires-Innovation-Forum-Meeting-Report.pdf