Written Responses to Pre-Submitted Questions for Washington State Interagency 6PPD Webinar

Thank you for submitting a question in advance of our June 2023 6PPD interagency webinar. This document provides written responses to all questions submitted through the comment form.

Submitted by Deborah Johnson

Q: Question in advance of webinar: Ecology's emphasis is on "fish water," but our interest is drinking water. What little I can find online suggests 6PPD is more of a surface water issue, but mobility in soil & potential for groundwater contamination is limited. Is that accurate? Can you suggest some resources focused on 6PPD/drinking water concerns? Thank you.

A: This is something we are concerned about too and we plan to develop a complete analysis and plan in our state action plan. When we hear from our stakeholders where your concerns lay, it helps us know what to dig into for the action plan. Drinking water in Washington comes from either groundwater or surface water. Concerning groundwater, 6PPD sticks to soil and is not expected to move into underground water sources. That said, this problem is new enough that there aren't any testing programs for 6PPD or its transformation products such as 6PPDQ in drinking waters in Washington state. Ecology is in the process of developing an action plan that will assess the need for groundwater monitoring.

Concerning surface water, in Washington most of our surface waters used for drinking come from highly protected upstream watersheds. But there are systems that access the Columbia River and other lowland surface waters that could potentially be affected by road runoff. There is no current requirement for monitoring, and so we don't know if concentrations of 6PPD and 6PPD quinone are high enough to cause health problems in people.

I can point you to a few resources we have found useful:

- Johannessen & Metcalfe (2022) sampled for 6PPD-q in wastewater treatment plants and drinking water treatment plants in Ontario, Canada. 6PPD-q was not detected at the drinking water treatment plants.
- Zhang et al. (2023) discusses the physical characteristics of 6PPD that indicate it is unlikely to transfer to groundwater.
- OECD (2012) is another great resource for information on the physical chemistry of 6PPD and human health toxicity.

Submitted by Andrew Kenefick

Q: Why doesn't Ecology follow a game plan similar to what was done for the phase-out of copper brake pads (RCW 70.285 RCW)? Force the tire industry to develop substitutes by setting a phase-out period for 6PPD in tires. The onus ought to be on the tire industry to find a substitute, rather than Ecology. They are the experts on tire chemistry, performance, and manufacturing, not Ecology. By taking on the research, Ecology has shifted the burden of a common-technology-forcing approach. Washington is not the big dog here. If California were to phase out 6PPD, I bet the tire industry would find an acceptable substitute quickly.

A: A phase out of 6PPD similar to the copper break pads is one idea that has been floated by stakeholders. Ecology does not have the authority to impose a ban or phase out of chemicals in consumer products unless we have determined that safer alternatives are feasible and available. That's why our work to date has focused on identifying safer alternatives.

We regulate chemicals in consumer products through our Safer Products for Washington program. In June 2023, we proposed listing 6PPD as a priority chemical under this program. This could kick of a five-year process that could regulate 6PPD in tires, either through a reporting requirement or a restriction, if safer alternatives are feasible and available. You can stay informed about this process on SPWA's stakeholder page.

Submitted by Rich Baldauf

Q: Since tire abrasion results in very small particles being generated, most tire wear is likely transported by wind and vehicle induced turbulence tens to hundreds of meters downwind of the road, with very little likely settling on or next to the road. Will the transport of tire wear particles through the air be considered when evaluating stormwater mitigation options, especially the ability to treat stormwater at the roadside vs at the watershed scale? Will techniques to try and capture tire wear particles in the air near the road be considered as part of best management practices?

A: Tires themselves, tire debris, and abrasion material all contain 6PPD and are very likely to be found on every road in Washington. Due to this, they are considered ubiquitous pollutants. However, the amount of 6PPD-quinone present in stormwater depends on many factors. Airborne 6PPD-quinone would be the smallest size fraction. There are many other urban pollutants that have an air pathway like PCBs, but the air pathway doesn't have a direct relationship with stormwater until it lands somewhere as dry or wet deposition. The drainage area they end up in may be a road, roof, other impervious surface, forest, wetland, or stream. Therefore, many stormwater BMPs are presumed to be able to help address this pathway, like street sweeping and maintaining infrastructure through cleaning roadside ditches, catch basins, and storm drains.

Understanding how 6PPD-quinone moves through and interacts with the environment, also referred to as "fate and transport," is an active area of research worldwide, and was an important data gap identified in the report Stormwater Treatment of Tire Contaminants: Best Management Practices Effectiveness. Much of Ecology's current research investigates how effective runoff treatment BMPs are at treating and reducing pollutants carried in stormwater.

Submitted by Kat Hallberg

Q: In Part 1 - 6PPD and 6PPD-quinone: Identification of a Problem and the Cause, a statement is made that "the chemical culprit is discovered among 2000 chemicals", the presenter stated that there were actually 2,260 chemical in stormwater, what about the other 2000 chemicals? 6PPD isn't the only baddie in the bunch. Where can we get a listing of them all, or at least the worst ones.

> **A**: Our presenter was referencing two important research studies that helped pave the way to identifying 6PPD-quinone. The first of these studies is "Using High-Resolution Mass Spectrometry to Identify Organic Contaminants Linked to Urban Stormwater Mortality Syndrome in Coho Salmon" (Peter et al. 2018). This study documented how analytical advancements allowed researchers to detect thousands of unique chemicals in stormwater. The second study is "A ubiquitous tire rubber-derived chemical induces acute mortality in coho salmon" (Tian et al. 2020). This team of researchers was able to identify 2,260 unique chemicals in stormwater using high-resolution mass spectrometry, and of those chemicals, they identified 6PPD-quinone as a product of 6PPD. To learn more about the chemical cocktail described in these studies, please view the studies directly.
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> Human activities release many chemicals into the environment, which is documented by many studies across disciplines like forestry, agriculture, industrial discharges, and urban municipal waste. The exact composition of runoff depends on the location, as the chemicals washed off into stormwater are a result of human activities occurring nearby. There are also many naturally occurring chemicals in rainwater and runoff, like carbon, phosphorus, and toxics like mercury. Studies like Peter et al. 2018 and Tian et al. 2020 are important because detecting a chemical allows researchers and decision-makers to start assessing risk.

Submitted by Joana Líbano

Q: Do you have any indication as to whether the carcinogenic content comes from the aniline/MNB, or from other elements that make up the 6PPD?

Thank you.

> **A:** So a couple of things here. First, the feeding studies in rats fed high doses of 6PPD do not support a determination of carcinogenicity. Based on their review of those studies, the authoritative bodies OECD (Organization for Economic Co-operation and Development) and ECHA (the European Chemicals Agency) concluded that it is unlikely that 6PPD causes cancer. The hazard assessment from GreenScreen also classified 6PPD as a low hazard for carcinogenicity.
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> Additionally, 6PPD doesn't seem to have the genetic toxicity that could produce cancer. OECD and ECHA concluded that 6PPD is not likely to cause genetic damage that leads to cancer. GreenScreen also classified 6PPD as a low hazard for mutagenicity.
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> Now, to some of the detail of your question. Aniline is a toxic chemical that can be produced as an aquatic transformation product of 6PPD. We don't know if it's produced in people after exposure to 6PPD, though. Overall, the biological metabolites produced from 6PPD have not been evaluated in toxicity assays, but we will be evaluating all the data and keeping a close eye out for new research as we work to develop the statewide action plan.

Submitted by Nancy Beck

Q: For the 2nd added criteria seeking acute toxicity information for transformation products, can you describe what type of acute toxicity testing would be required? Would this include acute aquatic toxicity?

> **A:** Only acute aquatic toxicity would be required. Whereas Safer Products for Washington hazard criteria require data on acute aquatic toxicity or chronic aquatic toxicity, the 6PPD alternatives assessment will require data on acute aquatic toxicity to coho salmon (and two other trophic levels) for both the parent compound and ozonated parent compound. We will revise the language in our hazard criteria to better clarify this requirement.

Submitted by Joe Scordino

Q: Will you present a list of accredited labs in Washington that are 'certified' to analyze stormwater and creek samples for 6PPD? Also, could you provide an estimate of lab costs per sample to analyze for 6PPD?

> **A**: No labs are currently accredited for 6PPD-quinone. Some labs have submitted requests for accreditation and are being evaluated by the department. Further information regarding lab accreditations can be viewed on our website using the lab search tool.

Submitted by Brad Wright

Q: What specific BMPs, regulations, or educational/outreach material have been developed to target heavy use industries, such as airports, raceways, car tire resurfacing and replacement, crumb rubber generating industries? While 6-PPD replacements might be a long term solution, these industries currently generate a lot of material that the Western Washington Stormwater Manual Volume IV doesn't adequately address.

> **A**: This question spans more than one program at Ecology and includes work outside of Ecology. We can address this question from a stormwater management perspective. Impervious surfaces are already a priority for stormwater management, especially those with high vehicle use roads and parking. Our guidance for stormwater management for these surfaces and activities is already included in the Stormwater Management Manuals (SWMMs). Many heavy use industries are also being regulated under the Industrial Stormwater General Permit (ISGP). This guidance will help cities, counties, and industries manage tire debris in stormwater.
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> Our 2015 analysis of 2007-2013 PH I monitoring results found that there was evidence of pollutant build-up during the dry season and recommends the following:
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> > "Stormwater management programs can sweep and conduct other housekeeping best management practices (BMPs) in industrial and commercial areas during the dry season to reduce high stormwater loads of metals, diesel hydrocarbons, and total nutrients during the first-season storms."
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> Other recent effectiveness monitoring studies have shown that street sweeping reduces conventional pollutants transported by stormwater (phosphorus, nitrogen, bacteria, fine sediment, trash, plastics, and other plastic/sediment bound chemicals). Street sweeping is presumed to be

effective at capturing organic matter or plastics that 6PPD-quinone has sorbed onto and tire wear particles that contain the parent material of 6PPD. We will continue to update our guidance in response to new research and emerging information.

Submitted by Bill Stauffacher

Q: Thank you taking comments. I have three questions:

1. **How has the tire industry engaged with Ecology and others on this issue?**

   A: Ecology has shared phone calls and meetings with several industry members around the feasibility of possible alternatives, including performance requirements of antiozonants. We cannot speak to how the tire industry has engaged with others on this issue.

2. **I am aware of an alternatives analysis on 6PPD in tires that is soon to kick off in California. How is Ecology collaborating with regulators in California on this to leverage the information in this AA?**

   A: We are in active communication with the California Department of Toxic Substances Control (DTSC) and their Safer Consumer Products program. As part of their program, industry is responsible for conducting the alternatives assessment – not the state. As of now, it looks like industry will be required to submit their alternatives assessment to DTSC in March 2024. We will use the information in those alternatives assessments to inform our AA.

3. **In conducting an AA of 6PPD in tires in Washington, how does Ecology plan to ensure tire safety and that the tires we drive on every day are safe from a performance standpoint?**

   A: We understand that tires are an essential safety component of automobiles, and we don't want to do anything to jeopardize the safety of passengers. To be used in tires, an alternative chemical would still need to uphold all Federal Motor Vehicle Safety Standards prior to use by industry.

Submitted by Julie Panko

Q1: Are you aware of any research evaluating human health impacts and when will that be published?

A: Thank you for your question. People who have skin allergy to other tire additives may be allergic to 6PPD, as shown in a study by Herve-Bazin et al (1977). Herve-Bazin et al (1977) conducted patch tests on the skin of tire workers who were allergic to a similar tire additive called IPPD, and found the workers to be allergic to 6PPD also (called DMPPD in this study). Animal studies support the conclusion that 6PPD causes skin allergy, with or without allergy to similar chemicals (Yamano et al., 2009). We have are not aware of any studies examining the allergic potential of 6PPDQ in humans.

We have not seen any evidence that 6PPD or 6PPDQ can cause respiratory allergy (for example, the type of allergy that makes you sneeze).

Both 6PPD and 6PPDQ have been found in human urine, as reported by a study in China (Du et al., 2022). Human exposure to these chemicals may happen in Washington state, but no similar studies have been done.

Studies in lab rodents have shown that 6PPD can cause difficult births in rats (OSPAR Commission, 2006), and 6PPD and the quinone can both cause liver changes in mice (Fang et al., 2023). However, we don't know if this occurs in humans yet.

Research:

1. Du, B., Liang, B., Li, Y., Shen, M., Liu, L.-Y., & Zeng, L. (2022). First Report on the Occurrence of N-(1,3-Dimethylbutyl)-N′-phenyl-p-phenylenediamine (6PPD) and 6PPD-Quinone as Pervasive Pollutants in Human Urine from South China. Environmental Science & Technology Letters, 9(12), 1056–1062. https://doi.org/10.1021/acs.estlett.2c00821
2. Fang, L., Fang, C., Di, S., Yu, Y., Wang, C., Wang, X., & Jin, Y. (2023). Oral exposure to tire rubber-derived contaminant 6PPD and 6PPD-quinone induce hepatotoxicity in mice. The Science of the total environment, 869, 161836. https://doi.org/10.1016/j.scitotenv.2023.161836
3. Herve-Bazin, B., Gradiski, D., Duprat, P., Marionac, B., Foussereau, J., Cavelier, C., & Btebr, P. (1977). Occupational eczema from N-isopropyl-N′-phenylparaphenylenediamine (IPPD) and N-dimethyl-1,3 butyl-N′-phenylparaphenylenediamine (DMPPD) in tyres. Contact Dermatitis, 3(1), 1–15. https://doi.org/10.1111/j.1600-0536.1977.tb03580.x
4. OSPAR Commission. (2006). Hazardous Substances Series 4-(dimethylbutylamino)diphenylamine (6PPD) 2005 (2006 Update). Available at: https://www.ospar.org/documents?v=7029.
5. Yamano, T., & Shimizu, M. (2009). Skin sensitization potency and cross-reactivity of p-phenylenediamine and its derivatives evaluated by non-radioactive murine local lymph node assay and guinea-pig maximization test. Contact Dermatitis, 60(4), 193–198. https://doi.org/10.1111/j.1600-0536.2008.01500.x

Q2: Is Ecology considering road pavement types in terms of mitigation options to reduce tire wear?

A: We are following ongoing research and maintaining communication with other state agencies, including WSDOT, as we consider ways to reduce the threat of 6PPD and 6PPD-quinone. If data show that certain types of pavements significantly prevent the transport of tire wear particles and/or 6PPD-quinone, we could explore the option further.

Submitted by Allison Cook

Q: Meeting was full when I tried to join! Bummer! Need to up your capacity please!

A: Thanks for your interest in the 6PPD interagency webinar! We're sorry the meeting was full when you tried to attend and we plan to increase our Zoom capacity for future webinars. In the meantime, we invite you to review the materials we prepared in advance of the live event to learn more about Washington State's 6PPD work. You can also review our 6PPD interagency webinar

follow-up document, which includes links to resources we shared and written responses to many of the questions we received during the webinar. Feel free to contact us directly at 6PPD@ecy.wa.gov with any questions or comments.