DEPARTMENT OF ECOLOGY
State of Washington

Searching for Safer Alternatives to 6PPD

Craig Manahan

Managing Stormwater in Washington

March 2026

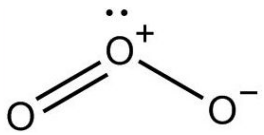
6PPD and Ozone

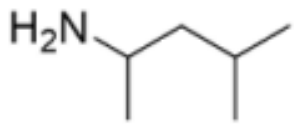
(N-(1,3-dimethylbutyl)—N'phenyl-p-phenylenediamine)

phenyl-p-phenylenediamine

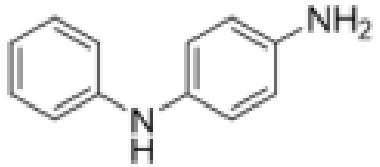
Ozone

O_3

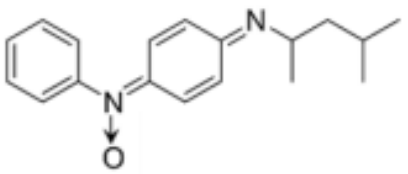




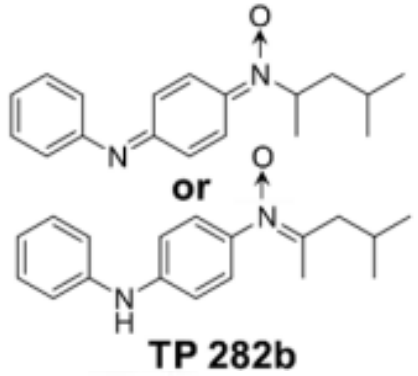
1,3-DMBA



4-ADPA



TP 282a



TP 282b

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6PPD-quinone

Potential 6PPD Regulation

- US EPA
- California DTSC
- EU ECHA
- WA State
  - Alternatives Assessment
  - Safer Products for Washington
  - Potential Legislation

US Environmental Protection Agency

- Advanced Notice of Proposed Rulemaking (ANPRM) under the Toxic Substances Control Act (TSCA)
- ANPRM (November 2024): The EPA issued an Advanced Notice of Proposed Rulemaking to investigate risks, solicit information on alternatives, and evaluate regulatory options under TSCA Section 6.
- TSCA Section 8(d) Rulemaking: Finalized in late 2024, this requires manufacturers and importers of 6PPD to submit unpublished health and safety studies to the EPA.

CA Department of Toxic Substances Control

- Motor Vehicle Tires Containing 6PPD are a Priority Product under California DTSC (Department of Toxic Substances Control) Safer Consumer Products (SCP) regulatory process.
- Manufacturers must submit alternative analysis (AA), with final AAs due in Fall 2026
- DTSC can mandate regulatory responses, such as restriction of 6PPD, information disclosure, or green chemistry investments.

European Chemicals Agency

- The Netherlands and Austria have issued calls for comments and evidence on PPDs and PDs under the European Chemicals Agency
- They intend to submit an Annex XV Restriction Dossier
- Annex XV is a formal proposal to restrict hazardous substances
- The dossier will be reviewed by several committees then decided upon by the European Commission
- If approved, the restriction is added to the Annex XVII of REACH, which lists restricted substances

Alternatives Assessment

- Legislature funded this work in 2022.
- Purpose of the assessment:
  - Identify, compare, and select safer alternatives to 6PPD in tires.
  - Evaluate each option's toxicity, performance, availability, and cost.

"If the department finds safer alternatives exist, include recommended regulatory, policy, or legislative actions to advance safer alternatives."

Safer Products for Washington

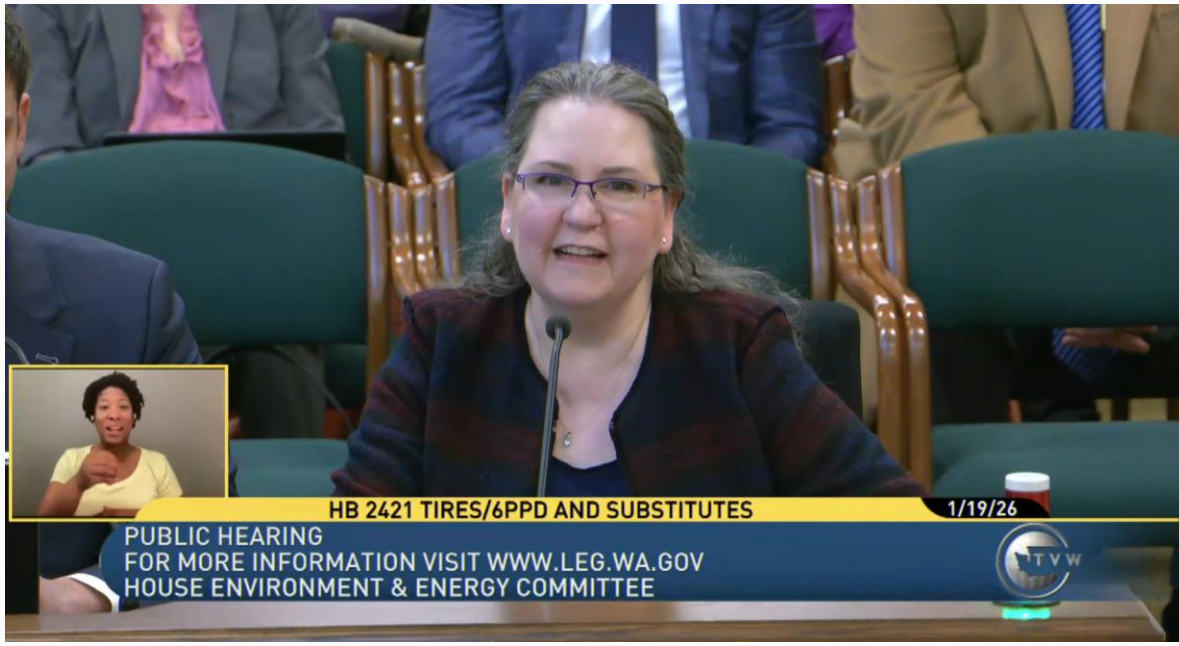
- 6PPD
  - Tires
  - Artificial turf
- Priority products report: May 2025
- Regulatory recommendations: **June 2027**
- If a safer, feasible, and available alternative is identified, rulemaking to restrict 6PPD
- If not, reporting requirement

Photo credit: Rubberecycle Mulch
Changes made: cropped to square

Potential WA Legislation

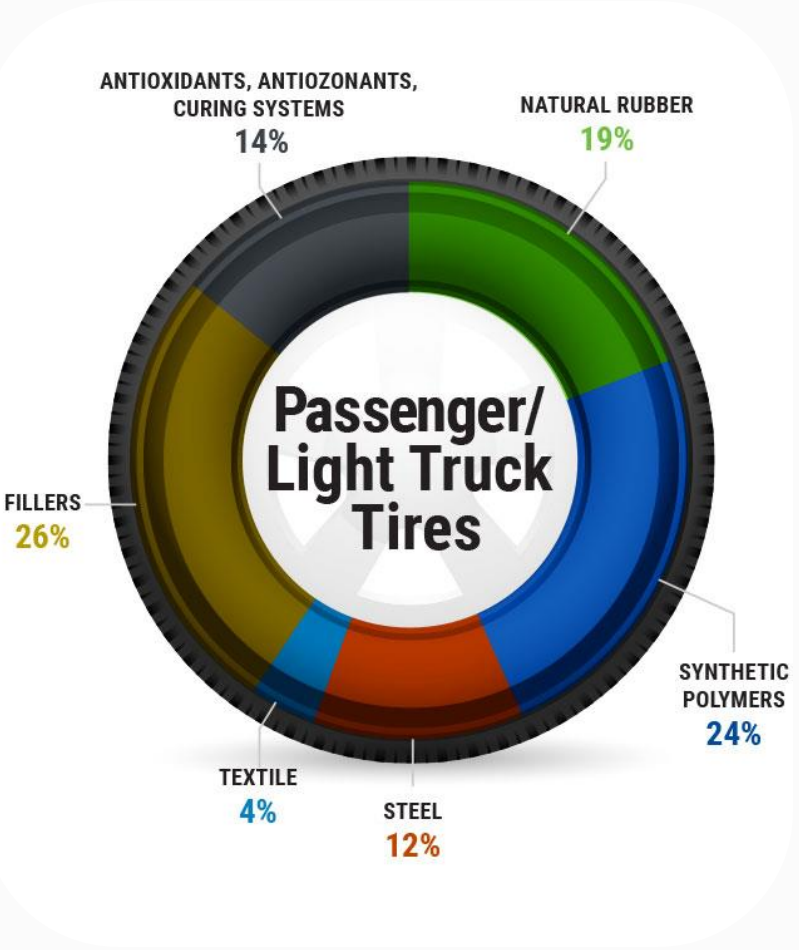
HB 2421

- Restrict 6PPD and regrettable substitutes beginning Jan. 1, 2035
- Ecology would adopt rules to develop a list of regrettable substitutes.



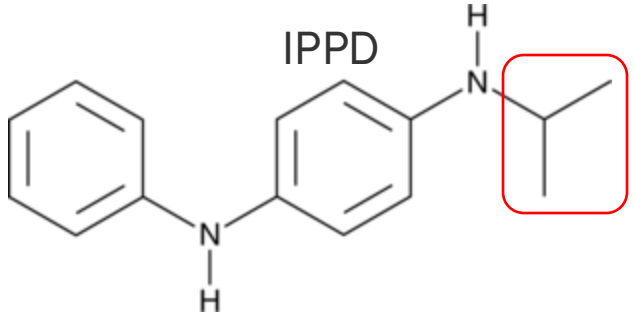
Are There Alternatives to 6PPD?

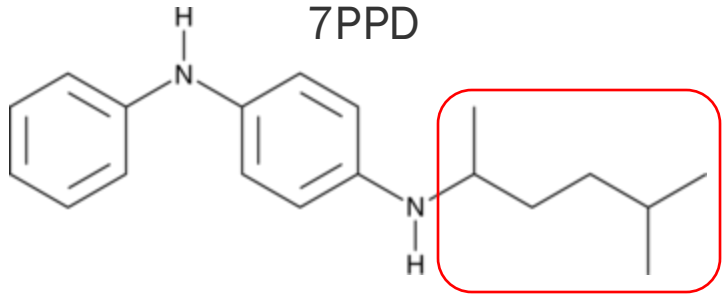
- 6PPD is really good at its job
  - Development of alternatives has only recently started
- Cheap
  - 50 lb tire * 1% = 0.5 lbs
  - $4.5/lb for 6PPD
  - $2.75/ tire in 6PPD



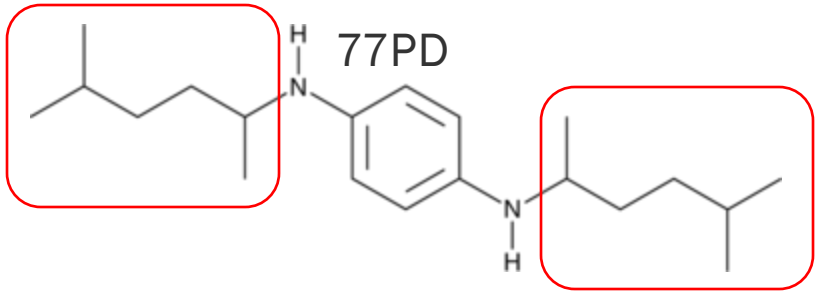
Are There Alternatives to 6PPD?

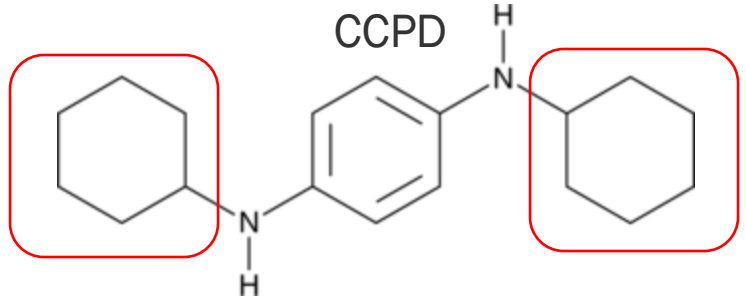
PPDs





PDs

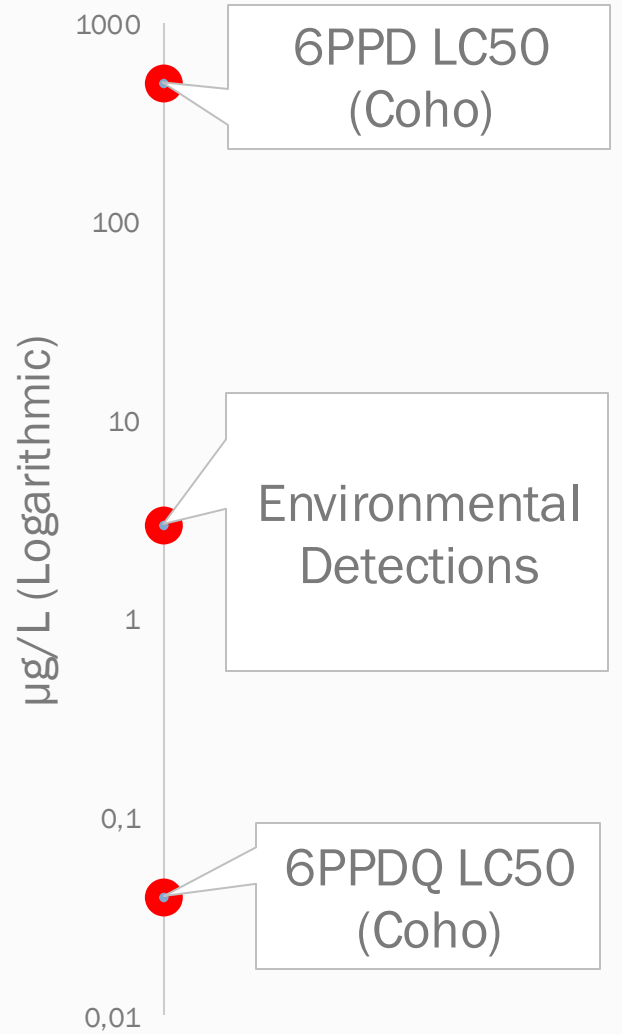




- Non PPDs/PDs
  - Aromatic Amines
  - Graphene/functionalized graphene
  - Hindered phenols
  - Biobased antioxidants

How Safe Does an Alternative Need to Be?

- Coho Toxicity
- Toxicity to other aquatic species
- Human health is a concern
  - 6PPD is a reproductive toxicant
- Transformation products are a concern
- Ecology has published hazard criteria for our alternatives assessment



Are There *Safer* Alternatives to 6PPD?

- Flexsys
  - Aromatic amine

- Sennics/Sinochem
  - SA6000

- Perpetuus
  - Amine functionalized graphene

- LANXESS
  - CCPD

*These are chemical companies – NOT tire companies

Is it Feasible and Available?

- Safer products for Washington Criteria require a product be **feasible** and **available** for restriction.
- Typically, this means a tire would have to have a safer alternative and be on the market for a comparable price to 6PPD containing tires.
- Tire manufacturers say it will be several years at the soonest before they can do sufficient testing.

Future Steps

More Testing and Manufacturer Outreach

- New alternatives
- Rubber leachate toxicity

Publish our AA findings in late 2026 report

SP-WA report published in June 2027

Thanks!

For more information:

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Why do we need 6PPD?

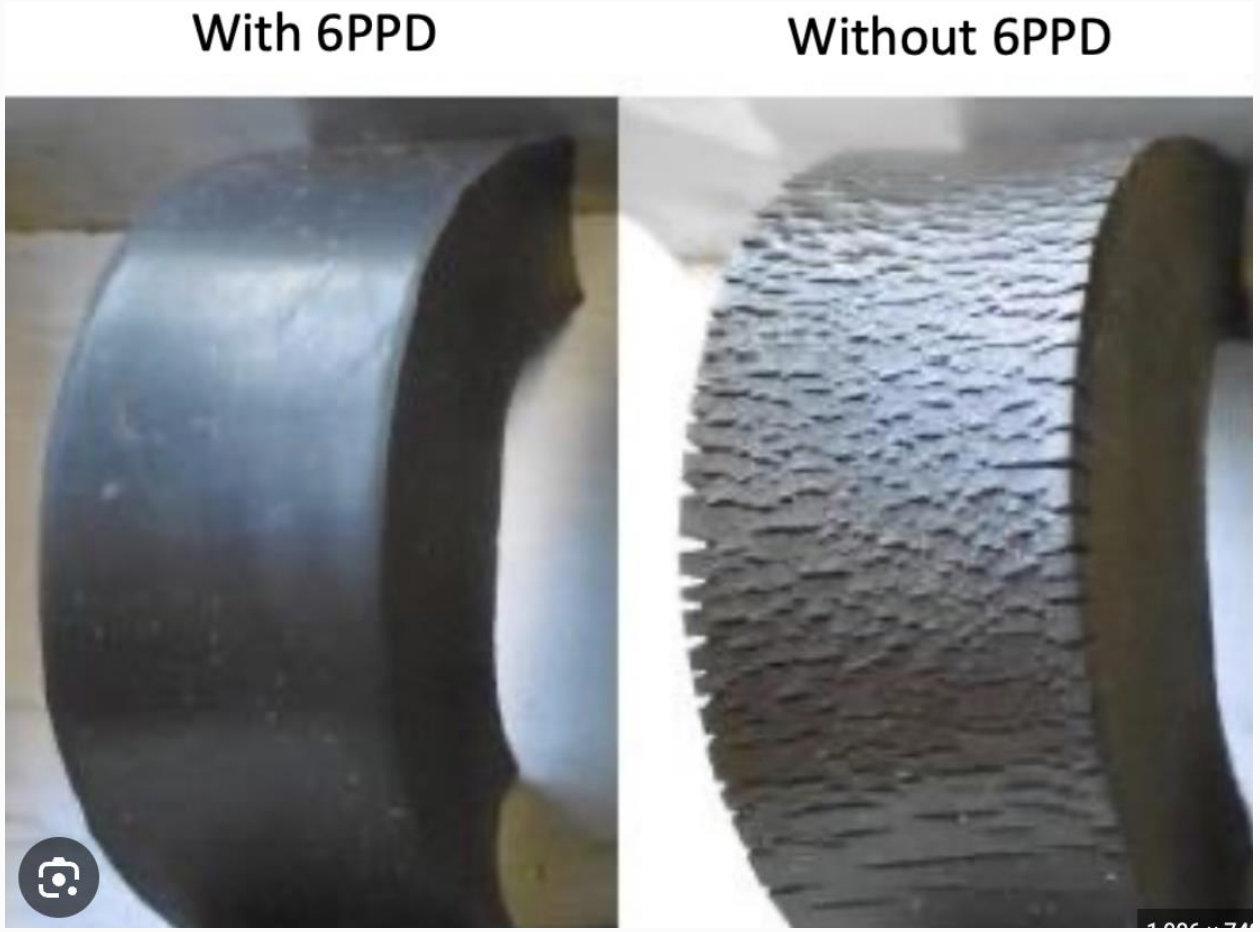
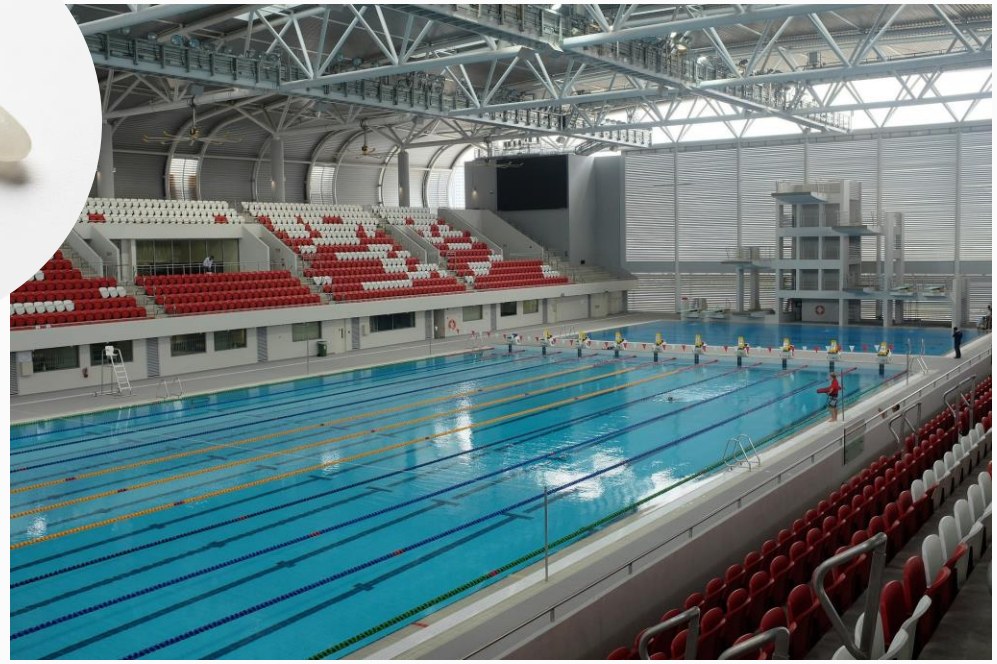


Photo by the U.S. Tire Manufacturers Association.

6PPD-quinone

- LC50 to coho of 40 ng/L (0.040 µg/L)
- 0.1 g in an Olympic size swimming pool (2.5 million liters)
- 3-4 grains of rice