



Antioxidants and Antiozonants role in manufacturing safe tires

July 29, 2021

Speakers

Sarah Amick – Vice President EHS&S and Senior Counsel, USTMA

Howard Colvin – Independent technical consultant to USTMA

Julie Panko – Principal Scientist, ToxStrategies (on behalf of USTMA)

USTMA Members - <https://sustainability.ustires.org/>

BRIDGESTONE

Continental 
The Future in Motion


COOPERTIRES

Giti 

GOODYEAR 
MORE DRIVEN

 **Hankook**
driving emotion

KUMHO TIRE 
Better, All-Ways


MICHELIN
A BETTER WAY FORWARD

nokian[®]
TYRES

PIRELLI

 **SUMITOMO**
RUBBER INDUSTRIES

TOYO TIRES[®]
driven to perform[®]

 **YOKOHAMA**

What we will cover

- Overview of 6PPD and 6PPD-Quinone – two distinct materials
- Relevant data gaps raised by Tian et al.
- USTMA's response to the Tian et al.
- Overview of the function of a tire, tire manufacturing and tire materials
- Overview of the functions 6PPD provides in manufacturing safe tires
- USTMA member commitment to supporting an alternatives analysis under the Safe Consumer Products Regulations

6PPD and 6PPD-Quinone – two distinct materials

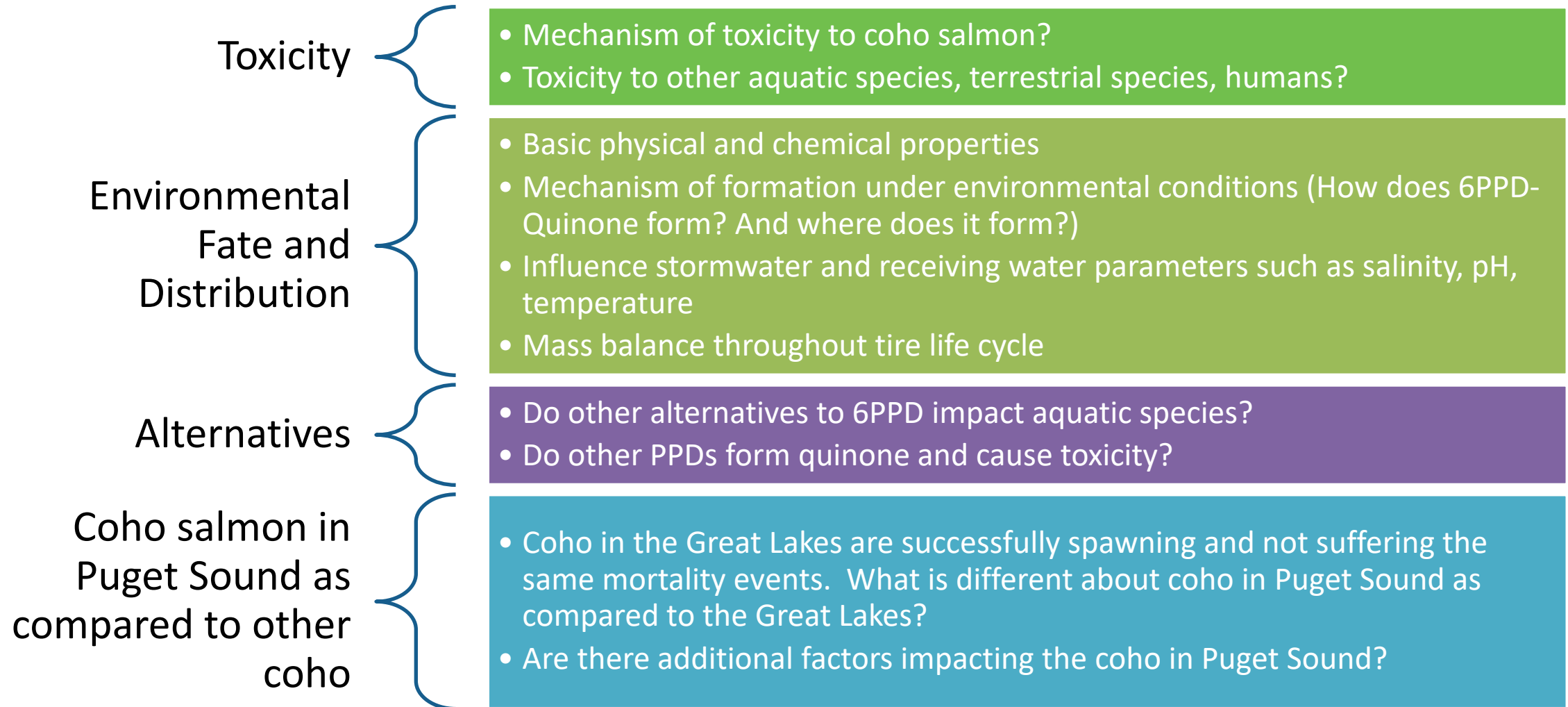
6PPD

- Antioxidant and antiozonant - protects tires during both static and dynamic conditions
- Minimizes thermal degradation

6PPD-Quinone

- Transformation material of 6PPD, identified for the first time by Tian et al. in December 2020

6PPD-Quinone Relevant Data Gaps



Tire manufacturing industry response to Tian et al. 2020



1. Continued engagement with researchers and regulators

- For example - University of Washington, Washington Stormwater Center, Department of Ecology, DTSC, Alaska DEC, EPA, NOAA, NIST, SFEI



2. Identification of relevant data gaps

- World Business Council for Sustainable Development (WBCSD), Tire Industry Project (TIP) is engaged to fill relevant data gaps

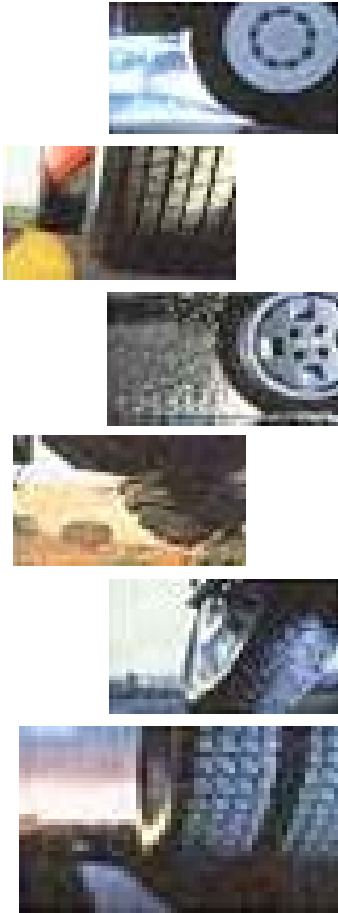


3. Alternatives analysis

- Proactive outreach to DTSC to review 6PPD in tires under the CA Safer Consumer Products Regulations (SCPR)
- Member company research to evaluate alternatives
- Coordination with chemical suppliers

WHAT MUST TIRES DO?

The functions of the tire



- Support weight of the vehicle
- Provide precise/effortless everyday steering
- Provide stable & effective emergency steering
- Grip to accelerate
- Grip to brake
- Perform in wet conditions
- Perform in winter conditions
- Provide a quiet ride
- Absorb vibrations and impacts
- Provide long wear life
- Resist heat, overload, speed, low inflation
- Improve vehicle fuel economy (low rolling resistance tires)
- Comply with NHTSA Federal Motor Vehicle Safety Standards

Tires are Highly Engineered Products



In General:

- *10-15 Rubber compounds*
 - Each formulated for a unique function
 - Air Retention, tread wear, wire adhesion, etc...
- *45-60 Unique materials per tire*


Safety is our Priority

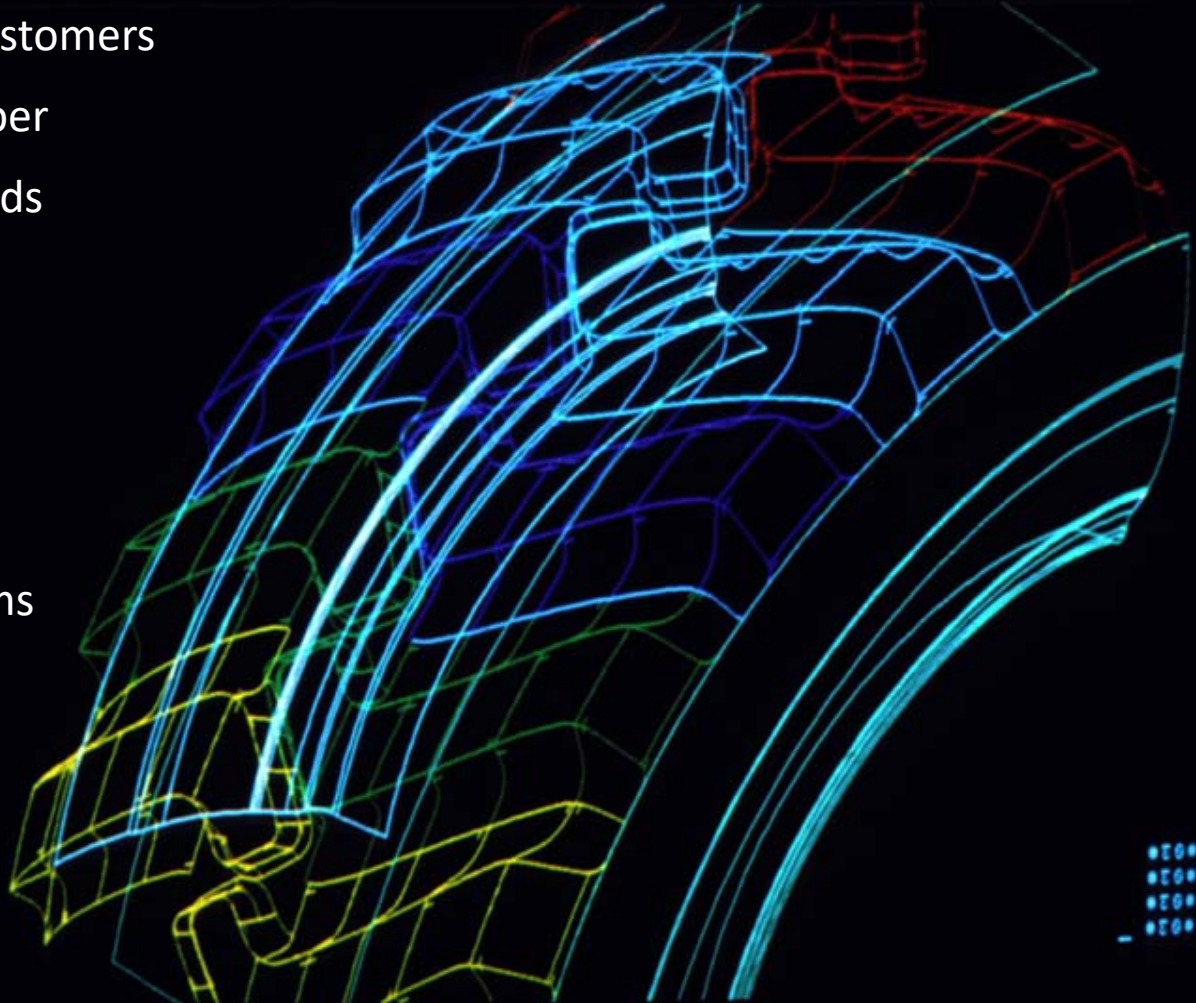
Tires are highly regulated products to ensure consumer safety

The National Highway Traffic Safety Administration (NHTSA) regulates new tires. The Safety Act, 49 U.S.C. §§ 30103-30105 et seq.

Changes in tire materials may change a tire's ability to meet NHTSA safety standards

Raw Materials Used in Tires

- 
- Synthetic Elastomers
 - Natural Rubber
 - Processing Aids
 - Fillers
 - **Protection**
 - Textiles
 - Steel
 - Curing systems



Example of a Tread Rubber Compound

Material	Function	~ Percentage (%)
SBR, BR, Natural Rubber	Elastomer	50
Carbon Black / Silica	Filler	22
Naphthenic Oil	Processing Aid	21
Stearic Acid	Component of Curing System	0.7
Zinc	Component of Curing System	0.7
6PPD	Protection Material	1
Wax	Protection Material	0.7
Silane	Coupling Agent	1.8
Sulfur	Component of Curing System	0.7
DPG	Component of Curing System	0.5
CBS	Component of Curing System	0.6
Total		~ 100

ROLE OF 6PPD IN MANUFACTURING SAFE AND DURABLE TIRES

Protection Materials

- **Antioxidants and antiozonants prevent degradation and cracking of the rubber compounds caused by exposure to oxygen, ozone, and temperature fluctuation during both dynamic and static conditions**
 - **Antioxidants** help to keep rubber from the breaking down due to the effect of temperature and oxygen exposure
 - **Antiozonants** are used to impede the effects of exposure to ozone on the surface of the tire

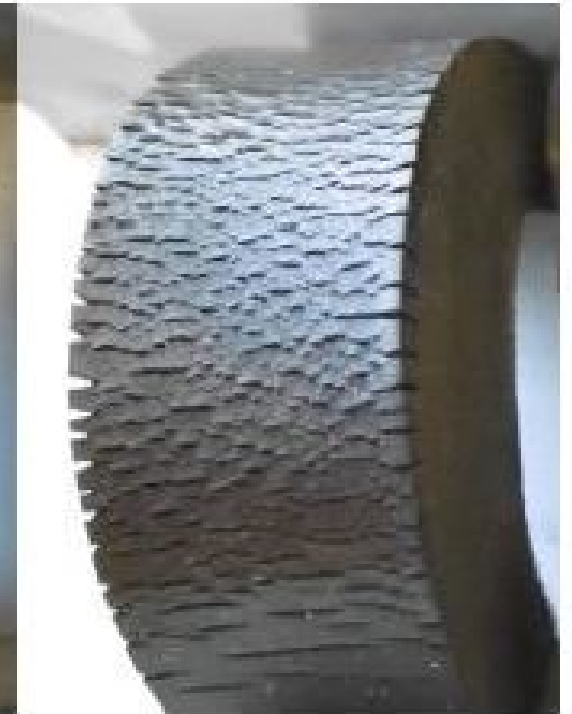
Protection Materials

- 6PPD is used by USTMA Members because it is the **most effective** antioxidant and antiozonant, that protects the rubber compound during dynamic and static conditions, to prevent degradation and cracking
- Without the use of high-performing protection materials like 6PPD, tires will crack and can degrade rapidly, leading to possible catastrophic failure

With 6PPD



Without 6PPD

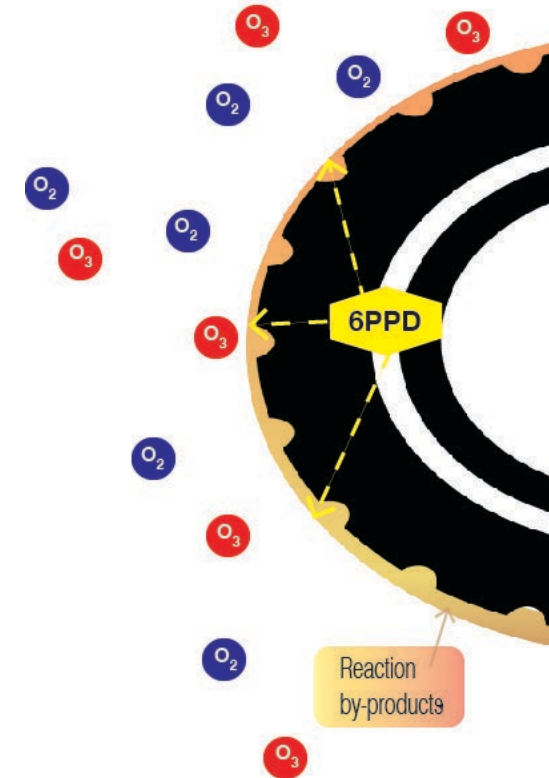


Qualities/functions required of Dynamic Protection Materials

- ✓ Continuously present at the surface
 - ✓ Good solubility and diffusivity in rubber compounds
- ✓ Reactive with ozone but not too reactive to prevent premature depletion
- ✓ No adverse effects on the rubber processing
- ✓ Available in rubber compound over its entire life cycle to ensure protection of the rubber
- ✓ Low toxicity of the material and its transformation products

Reaction Transformation Products

- The 6PPD reaction with ozone and oxygen forms transformation products
 - Mechanism of formation of 6PPD-quinone still to be clarified
- The rubber and tire industry have investigated the reaction mechanisms over time to understand by product formation
- Prior to Tian et al., 2020, 6PPD quinone was unknown



Our commitment to supporting the alternatives analysis process



Is there a safer alternative that can be used in place of 6PPD to manufacture tires?



USTMA response – proactive outreach to DTSC to review 6PPD in tires under the Safer Consumer Products Regulations (SCPR)



USTMA is committed to working with DTSC to complete the alternatives analysis for 6PPD in tires under the SCPR

THANK YOU

Sarah Amick
samick@ustires.org