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Q&A: STAGE 1 ALTERNATIVES ANALYSIS FOR 6PPD IN TIRES

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Why is 6PPD used in tires?

6PPD serves an essential safety function in tires as an antioxidant and antiozonant, protecting the components of the tire from attack by ozone, oxygen and other factors, which is why all motor vehicle tires on the road today contain 6PPD. Without 6PPD, a tire's integrity would be severely and quickly compromised, jeopardizing driver and passenger safety. Any alternative identified in this process must continue to ensure compliance with Federal Motor Vehicle Safety Standards ("FMVSS") and other consumer, vehicle and tire manufacturer requirements.

**BACK
TO
TOP**

What is the California Alternatives Analysis ("AA") process?

The advance the design, development, and use of products that are chemically safer for people and the environment through the Alternatives Analysis (“AA”) process. This process requires manufacturers of Priority Products available for sale in California to conduct a comprehensive, science-based analysis to determine whether there are any alternatives to a designated Chemical of Concern in their product or whether there are other technically feasible ways to design and manufacture the product. The analysis can also be conducted by another entity acting on behalf of the manufacturer, such as a consortium, trade association, public-private partnership, or non-profit organization.

California Safer Consumer Products Regulations (“SCPR”)

(<https://dtsc.ca.gov/scp/alternatives-analysis/>)

In the case of motor vehicle tires containing 6PPD, the SCPR provides a rigorous, transparent, science-based regulatory framework to analyze whether potential 6PPD alternatives exist. The framework not only considers products during their use by consumers but also impacts across the entire lifecycle (i.e., from obtaining required raw materials through the products’ end-of-life). Any potential alternative to 6PPD identified through the SCPR process must provide equivalent tire safety and performance to 6PPD, while improving environmental metrics. The SCPR framework accounts for this, including the need for products to continue complying with Federal Motor Vehicle Safety Standards (“FMVSS”) and other consumer, vehicle and tire manufacturer requirements. A key goal of the SCPR process is to avoid regrettable substitutions, defined as changing the product in a way that shifts the risks to another type of hazard or a different part of the product lifecycle. For more information about California’s regulations, please visit

dtsc.ca.gov.

(<https://dtsc.ca.gov/scp/alternatives-analysis-frequently-asked-questions-faqs/>)

Why is the USTMA 6PPD AA Consortium undertaking an AA for 6PPD in tires?

In late 2020, a novel transformation product of 6PPD, called 6PPD-quinone (“6PPDQ”), was first reported to be toxic to certain species of salmon in laboratory studies. Since that time, USTMA and its members have been working closely with federal and state regulators, materials suppliers, academic and government research teams, industry associations and other partners to advance research into 6PPDQ and evaluate potential alternatives to 6PPD.

**BACK
TO
TOP**

In December 2020, USTMA requested that the California Department of Toxic Substances Control (“DTSC”) include 6PPD in tires on the 2021-2023 Priority Products Work Plan. USTMA's goal is to use the DTSC alternatives analysis process to help guide the search for 6PPD alternatives. With full support from USTMA, DTSC listed motor vehicle tires containing 6PPD as Priority Products in California effective October 1, 2023. To meet the requirements under the SCPR, USTMA convened a consortium of 32 tire manufacturers to conduct an AA for 6PPD in tires. The Preliminary (Stage 1) AA Report was released by USTMA and submitted by Consortium members on March 29, 2024 and a revised report was submitted on July 22, 2024.

Which companies are members of the USTMA 6PPD AA Consortium?

The U.S. Tire Manufacturers Association (“USTMA”), which represents several of the world’s largest global tire companies, has mobilized a Consortium of 32 tire manufacturers to conduct an AA for 6PPD in tires under California’s SCPR. The members of this Consortium are:

*() indicates name(s) used for Priority Product Notification (“PPN”) if different

American Kenda Rubber Industrial Co., LTD (American Kenda Rubber Ind Co.)

Apollo Tires (US) Inc. (Apollo Tyres Limited)

Bridgestone Americas, Inc.

CEAT Ltd.

China Manufacturers Alliance, LLC

Continental Tire the Americas, LLC

GITI Tire (USA), Ltd. (Giti Tire)

Hankook Tire America Corp.

Jiangsu General Science Technology Co., Ltd.

JK Tyre & Industries Limited

Kumho Tire U.S.A., Inc. (Kumho Tire)

Linglong Americas, Inc.

Maxxis International USA (Maxxis Technology Center) (Cheng Shin USA Tech Center)

Michelin North America, Inc. (+ PT. Multistrada Arah Sarana Tbk)

**BACK
TO
TOP**

Nexen Tire America, Inc. (Nexen Tire Corporation)
Nokian Tyres Inc. (Nokian Tyres US Operations LLC)
North American Commercial Tire Resources Inc. (Guizhou Tyre Co., Ltd.)
Otani Radial Tire Co, Ltd and Otani Co, Ltd
Pirelli Tire LLC
Prinx Chengshan Holdings, Ltd
Prometeon Tyre Group Commercial Solutions, LLC
Qingdao Sentury Tire Co., Ltd.
Sailun North Americas (Sailun Group Co., Ltd)
Shandong Haohua Tire Co., Ltd
Shandong Jinyu Tire Co., Ltd
Sumitomo Rubber Industries, Inc.
The Goodyear Tire & Rubber Company
Tianjin Wanda Tire Group Co., Ltd (+ Hebei Wanda Tyre Co., Ltd.)
Triangle Tyre Co., Ltd
Toyo Tire Holdings of Americas Inc.
Yokohama Tire Corporation (+ Yokohama TWS North America, Inc.)
ZC Rubber America Inc.

What chemicals were evaluated as part of the Stage 1 AA Report?

In total, over 60 initial candidate alternatives were identified for screening and scoring for their suitability as possible alternatives to 6PPD in tires. In the Stage 1 AA Report the Consortium considered different types of alternatives to 6PPD as an antidegradant in tires, including: (1) other phenylene diamines (“PPDs”) that are the most logical and possibly easiest to implement alternatives to 6PPD, and (2) non-PPD possible alternatives that likely pose greater challenges in incorporating into tire chemistry. The full list of candidate alternatives considered can be found in Appendix F of the report.

**BACK
TO
TOP**

What criteria and screening methodology were used to evaluate the possible alternatives?

Candidate alternatives, identified via a broad and comprehensive literature review, were first screened for feasibility using a new screening method developed by the Consortium. Alternatives passing this initial screen (called “possible alternatives”) were then evaluated in the Stage 1 AA. This analysis took into account a vast body of scientific literature on chemical performance, hazard, and exposure potential (including an evaluation of potential transformation products) to determine whether the chemical should be further evaluated in a Stage 2 AA.

The chemicals selected for further evaluation in Stage 2 had sufficient data demonstrating suitable potential in the areas of performance and environmental impact. As required by the DTSC process, during Stage 2, the Consortium will confirm the “short list” of possible alternatives (in light of new data that may emerge), assess the potential impacts of these options and initiate a more detailed review of the chemicals’ potential hazards and exposure-related chemical properties.

What were the conclusions of the report?

More than 60 candidate alternatives for 6PPD were evaluated, screened and scored for likely feasibility as part of this Stage 1 AA. This extensive review identifies seven possible alternatives that warrant further evaluation in the Stage 2 AA:

Chemical Name

Acronym

CAS

N-(1,4-Dimethylpentyl)-N'-phenyl-p-phenylenediamine

7PPD

3081-01-4

N-Isopropyl-N'-phenyl-p-phenylenediamine

IPPD

101-72-4

N,N'-Bis(1,4-dimethylpentyl)-p-phenylenediamine

77PD

3081-14-9

N,N'-Dicyclohexyl-p-phenylenediamine

CCPD

4175-38-6

Specialized graphene

1

NA

1034343-98-0

**BACK
TO
TOP**

Octyl gallate

2

NA

1034-01-1

Nano calcium carbonate surface modified by gallic acid

NA

No CAS

The materials referred to as graphene in the USTMA 6PPD Consortium Preliminary AA Report are graphene-based materials (sometimes referred to as a graphene nano-platelet) with a surface area not greater than 180 m²/g, and a carbon content greater than 99% and an oxygen content less than 1%. The lateral particle size of these materials is between 100 nm and 5 μm.

1

Octyl gallate was investigated instead of propyl, butyl or pentyl gallates. Propyl gallate has been tested as an antiozonant for non-rubber applications. Propyl gallate, however, is expected to be less suitable for rubber than other gallate esters with longer carbon chains. Propyl gallate melts at 150°C, which is the temperature at which rubber is mixed. Natural rubber compounds are sometimes mixed at a lower temperature. Unless propyl gallate completely melts and is dispersed in the compound, it will not have an opportunity to function as an antiozonant. Octyl gallate is a much better choice because it melts at approximately 100° C and is sure to melt during mixing. Butyl gallate melts at 144°C so it may be acceptable, but octyl gallate has been used as a food additive, is more readily available and has more hazard information.

2

A full analysis of these conclusions and potential alternatives can be found in Table 5.15 and Section 6 of the AA report.

Why do some possible alternatives advanced to Stage 2 have hazard scores similar to 6PPD?

**BACK
TO
TOP**

6PPD has been widely studied and used in tires as a highly effective antidegradant since the 1960's. The recent concern regarding 6PPD in tires relates to a newly identified transformation product, 6PPDQ, and its potential impacts to certain salmonids. Therefore, the screening method developed and applied by the Consortium includes evaluating transformation products, in addition to the parent chemical, for potential impacts to certain salmonids. For each of the possible alternatives recommended for Stage 2 analysis, the Consortium considered data suggesting that the chemical and its transformation products have reduced adverse impacts to salmonids or that this could be easily explored using in vitro methods.

How likely are any of these alternatives to ultimately replace 6PPD?

At the end of the Stage 2 AA, we are optimistic that we will have identified one or more possible alternatives that hold promise to replace or materially reduce 6PPD in motor vehicle tires, subject to future performance testing to ensure comparable tire safety and performance. Additional toxicity testing may need to be performed to satisfy regulatory requirements and to fill important data gaps.

How soon could a potential alternative be implemented?

The safety, performance and sustainability of our products remains our uncompromising priority and there is important work to be done to ensure any potential alternatives meet that high standard. The chemicals present in tires today all perform specific and integrated functions, and tire composition cannot responsibly be modified without great care, including extensive and rigorous testing. Any alternative identified in this process must continue to ensure compliance with Federal Motor Vehicle Safety Standards ("FMVSS") and other consumer, vehicle and tire manufacturer requirements. Before any actual alternative can be implemented, extensive testing will be required to ensure tire safety and performance.

Based on the experience of Consortium members, the tire research and development, design, and performance testing process for a tire using existing, commercially produced materials known to perform as necessary in tires, can take a minimum of 4 to 6.5 years. In the tire design process, each step may be repeated multiple times until an acceptable design is achieved, which can significantly extend the design process. Any challenges encountered while conducting a step in the tire design process may require development to go back to an earlier stage.

**BACK
TO
TOP**

In the case of replacing 6PPD, once a suitable new candidate antidegradant is identified, an additional 4 years (minimum) of limited-scale field testing would be required to ensure performance as a tire ages. After satisfactory results are obtained from field testing, additional time would be needed for deployment of the new antidegradant in tires for the market. We anticipate coordination with regulators, including California DTSC, during this process, moving the process forward as promptly as possible within the bounds of responsible tire design and development.

What can be done about 6PPD/6PPDQ in the environment while tire manufacturers develop alternative(s) to 6PPD in tires?

While efforts to find a potential alternative to 6PPD (while still complying with safety standards) will take time, there are things that can be done to reduce 6PPD/6PPDQ in the environment. Those measures include street sweeping in urban areas, choosing pavement surfaces (such as rubber modified asphalt and permeable pavement) that reduce tire abrasion and mitigate stormwater impacts, installing bioretention technologies to treat stormwater, and maintaining proper tire inflation to reduce tire abrasion. USTMA is currently engaging with select stakeholders to determine how best we may partner together in pilot demonstration projects designed to advance the practical knowledge around promising solutions and will have more to report on those efforts soon.

What does it mean that the USTMA 6PPD AA Consortium Stage 1 AA received a Notice of Deficiency?

A notice of deficiency is a standard step demonstrating the rigor and iterative nature of the Alternatives Analysis process and serves as the mechanism for DTSC to provide helpful suggestions and seek clarification about certain parts of the Stage 1 Report.

When the Preliminary AA Report is submitted under the SCPR, DTSC begins a 60-day review period. DTSC may issue one of the following: a notice of compliance, a notice of deficiency, a notice of disapproval, or a notice of ongoing review. The notice of deficiency is the mechanism available to DTSC to ask questions and seek clarifications.

USTMA 6PPD AA Consortium members submitted a revised Stage 1 AA report to meet the July 22, 2024 deadline. In addressing DTSC's feedback, this revised Stage 1 AA report reflects several key updates.

**BACK
TO
TOP**

What updates were made in this revised Stage 1 AA as a result of the Notice of Deficiency?

The revised Stage 1 AA report reflects several key updates. Most notably, the revised report includes the identification of two additional materials to move forward to Stage 2 (octyl gallate and Irganox 1520), bringing the total to seven materials warranting further evaluation as potential alternatives to 6PPD.

Has the consortium addressed all of the recommendations and critiques made by DTSC in its Notice of Deficiency?

After thorough review and significant analysis, the consortium believes the revised Stage 1 AA report addresses DTSC's feedback provided in its Notice of Deficiency in May 2024. USTMA is grateful for the agency's constructive collaboration throughout this process, and DTSC's acknowledgement that "the Consortium prepared a thorough Preliminary AA Report (Report) that closely follows the AA process laid out in the Safer Consumer Product Regulations."

This revised Stage 1 AA demonstrates the rigor and iterative nature of the Alternatives Analysis process and we look forward to receiving a notice of compliance for the revised Stage 1 AA Report following DTSC's review, which will enable USTMA's 6PPD Consortium to formally launch development of a Stage 2 AA Report.

What new potential alternatives have been added to the list of considerations for Stage 2 AA?

The revised Stage 1 AA report identifies two additional materials to move forward to Stage 2 for additional screening: Octyl gallate and Irganox 1520.

Octyl gallate can be synthesized from natural sources and/or fossil fuel-based sources. It has a lower hazard score and similar relative exposure potential compared to 6PPD. While no tests addressing ozone performance in tire or tire compounding have been located, a similar chemical, propyl gallate, has been shown to be an antiozonant in biological systems.

Irganox 1520 is a phenolic antioxidant. It has a substantially lower hazard score compared to 6PPD. It is less water soluble, has lower vapor pressure and is more carbon- and fat-soluble compared to 6PPD. It has limited but promising performance data with respect to ozone protection.

**BACK
TO
TOP**

What happens next in the California SCPR process?

Now that the USTMA 6PPD AA Consortium has submitted its revised AA, DTSC has 30 days to review the report and issue a notice of compliance, a notice of disapproval, or a notice of ongoing review. Our goal is to receive a notice of compliance for the revised Stage 1 AA Report, which will enable the Consortium to formally launch development of the Stage 2 AA Report.

What will happen during the Stage 2 AA process?

The Stage 1 AA Report identified seven possible alternatives to replace 6PPD in motor vehicle tires, so it is appropriate for the Consortium to conduct a Stage 2 AA. As required by the DTSC process, during Stage 2, the Consortium will confirm the “short list” of possible alternatives (in light of new data that may emerge), assess the potential impacts of these options and initiate a more detailed review of the chemicals’ potential hazards and exposure-related chemical properties.

The procedure for completing Stage 2 is outlined in the SCPR and begins with California DTSC’s approval of the Stage 1 AA Report. The SCPR provide for at least a 12-month timeframe for conducting the Stage 2 AA and require that the Stage 2 AA report be submitted one year after DTSC approval of the Stage 1 report, subject to any potential approved extension request.

The depth and breadth of this groundbreaking work mark significant progress towards the identification of potential alternatives, and further demonstrates our industry’s commitment as a leading force in the search for alternatives to 6PPD in motor vehicle tires. We intend to pursue the Stage 2 AA process with the same rigor, commitment, and enthusiasm as we have approached Stage 1.

Is this list of potential alternatives now final or will the consortium be continuing to evaluate new candidates throughout the Stage 2 AA?

**BACK
TO
TOP**

The chemicals selected for further evaluation in Stage 2, including the two new materials in the revised Stage 1 AA, had sufficient data demonstrating suitable potential in the areas of performance and environmental impact. As part of the Stage 2 AA process, the consortium will revisit all previously screened candidate materials that were eliminated as a result of toxicological data gaps, to determine if reliable toxicological data are available. In particular, specialized carbon nanotube mixture, 8PPD, rambutan peel extract, and amine functionalized lignin are all complex mixtures with promising performance (chiefly in patents) but no available toxicity data. If such data are found or become available, these additional materials could also be considered in Stage 2.

Why has the consortium requested an extension to the Alternatives Analysis schedule for Stage 2?

As part of the revised Stage 1 AA, the consortium has requested a 1-year extension for the completion of the Stage 2 report. This extension would allow for additional preliminary performance testing of candidate alternatives in rubber and potential toxicity testing. This timeline has been built into the proposed schedule included in the revised report.

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About USTMA

The U.S. Tire Manufacturers Association is the national trade association for tire manufacturers that produce tires in the U.S. Our 12 member companies operate 58 tire-related manufacturing facilities in 17 states. U.S. tire manufacturing has an annual economic footprint of \$170.6 billion and is responsible for more than 291,000 U.S. jobs in manufacturing, distribution and retailing. The industry supports more than 510,000 additional U.S. jobs in supplier and induced activities, totaling more than 801,000 jobs nationwide. USTMA advances a sustainable tire manufacturing industry through thought leadership and a commitment to science based public policy advocacy. Our member company tires make mobility possible. USTMA members are committed to continuous improvement of the performance of our products, worker and consumer safety and environmental stewardship. For more information, visit and follow us on Twitter

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**BACK
TO
TOP**

About the USTMA 6PPD Alternatives Analysis (“AA”) Consortium

The USTMA 6PPD Consortium is comprised of the world’s leading tire companies. It includes USTMA’s 12 full members and 4 statistical affiliates, plus 16 additional tire companies. The Consortium was formed by USTMA to assess possible alternatives to 6PPD in motor vehicle tires. The Consortium powers an active, transparent and collaborative approach to the AA process to produce the most effective and exhaustive review possible of whether a safer alternative to 6PPD in tires currently exists that maintains critical tire performance and vehicle safety needs.

Attachments:

(<https://ustires.org/thttps://www.ustires.org/tire-manufacturers-consortium-6ppd-alternatives-analysis-report-receives-notice-compliance>)

Tire Manufacturers Consortium 6ppd Alternatives Analysis Report Receives Notice Of Compliance From California DTSC, Clearing Way For Stage 2

USTMA 6PPD Consortium Revised Preliminary AA Report July 2024

(<https://acrobat.adobe.com/id/urn:aaid:sc:VA6C2:0a2693e9-a7c8-4049-9697-63cabb1b6223>)

(<https://www.ustires.org/largest-global-tire-industry-consortium-releases-preliminary-6ppd-alternatives-analysis-report>)

Largest Global Tire Industry Consortium Releases Preliminary 6PPD Alternatives Analysis Report

(https://www.ustires.org/sites/default/files/2024-03/USTMA%20Consortium%206PPD%20AA%20Preliminary%20Report_3-25-24.pdf)

Preliminary (Stage 1) Alternatives Analysis Report: Motor Vehicle Tires Containing N-(1,3-dimethylbutyl)-N'-phenyl-p-phenylenediamine (6PPD)

**BACK
TO
TOP**

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Aug 26, 2024

TIRE MANUFACTURERS CONSORTIUM 6PPD ALTERNATIVES ANALYSIS REPORT RECEIVES NOTICE OF COMPLIANCE FROM CALIFORNIA DTSC, CLEARING WAY FOR STAGE 2

(<https://ustires.org/tire-manufacturers-consortium-6ppd-alternatives-analysis-report-receives-notice-compliance>)

WASHINGTON, August 26, 2024 – The U.S.

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**BACK
TO
TOP**



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**BACK
TO
TOP**