Australian Government
Department of Health, Disability and Ageing
Australian Industrial Chemicals Introduction Scheme

Methylene-bridged bisphenols

Evaluation statement (EVA00198)

26 June 2026

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AICIS evaluation statement (EVA00198)

Subject of the evaluation

Methylene-bridged bisphenols

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Phenol, 2,2'-methylenebis[4-methyl-6-nonyl-	7786-17-6

Reason for the evaluation

Evaluation Selection Analysis (ESA) indicated a potential environmental risk.

Parameters of evaluation

This evaluation considers the environmental risks associated with the industrial uses of a group of 5 synthetic phenolic antioxidants. The group consists of 2,2'-methylenebis[6-(1,1-dimethylethyl)-4-methylphenol] (DBMC) and 4 of its analogues that are listed on the Australian Inventory of Industrial Chemicals (the Inventory). The chemicals differ by the substituent on the 4- or 6- position of the phenol ring.

Chemicals in this group have been assessed for their risks to the environment according to the following parameters:

- Industrial uses listed in the '**Summary of introduction, use and end use**' section
- Expected emission into sewage treatment plants (STPs), surface waters, and soil due to industrial and commercial use.

These chemicals have been assessed as a group because they have similar use patterns and are structurally similar.

In this evaluation the chemicals will be referred to as:

- DBMC (CAS RN 119-47-1)
- 6-methylcyclohexyl substituted analogue (CAS RN 77-62-3)
- 4-ethyl substituted analogue (CAS RN 88-24-4)
- 6-cyclohexyl substituted analogue (CAS RN 4066-02-8)

- 6-nonyl substituted analogue (CAS RN 7786-17-6)

Summary of evaluation

Summary of introduction, use and end use

The chemicals in this group are used as antioxidants and/or UV or heat stabilisers in a variety of commercial and household products worldwide. They are used in the following products according to reported Australian and international use data:

- adhesive and sealant products
- explosive products
- fuel, oil, fuel oil additives and related products
- lubricant and grease products
- paint and coating products
- plastic and polymer products
- ink, toner and colourant products
- personal care products (cosmetics)
- photographic products
- fabric, textile and leather products not covered by other end uses.

The DBMC is used in high volumes globally. Internationally, the annual use volumes exceed:

- 1,000 tonnes for DBMC
- 100 tonnes for the 6-nonyl substituted analogue
- 10 tonnes for the 6-methylcyclohexyl substituted analogue
- 1 tonne for the 4-ethyl and 6-cyclohexyl substituted analogues.

Environment

Summary of environmental hazard characteristics

Based on the information presented in this evaluation and according to the environmental hazard thresholds stated in the Australian Environmental Criteria for Persistent, Bioaccumulative and/or Toxic Chemicals (DCCEEW n.d.), the chemicals in this group are:

- Persistent (P)
- Not Bioaccumulative (Not B)
- Not Toxic (Not T).

Environmental hazard classification

The chemicals in this evaluation do not satisfy the criteria for classification according to the Globally Harmonised System of Classification and Labelling of Chemicals (GHS) for environmental hazards (UNECE 2017). This evaluation does not consider classification of physical and health hazards.

Summary of environmental risk

Chemicals in this group are used as antioxidants and stabilisers in a range of products and articles. They may be released to soils, STPs, and surface waters including following

leaching from articles. When the chemicals are released to the water compartment, a large portion of the chemicals are expected to partition to sediment.

The chemicals are persistent in the environment but are not bioaccumulative and not toxic. The concentrations of the chemicals found in the environment are typically below concentrations expected to cause effects in organisms.

Based on measured international environmental monitoring data, the chemicals in this group are expected to be present in the Australian environment at concentrations below the level of concern. Calculated Risk Quotient (RQ) values for surface water, seawater, sediment and soil are below 1. Therefore, current use of these chemicals is not expected to pose a significant risk to the environment.

Conclusions

The Executive Director proposes to be satisfied that the identified risks to the environment from the introduction and use of the industrial chemical can be managed.

Note:

1. Obligations to report additional information about hazards under section 100 of the *Industrial Chemicals Act 2019* apply.
2. A person introducing these chemicals should be aware of their obligations under environmental, workplace health and safety and poisons legislation as adopted by the relevant state or territory.

Supporting information

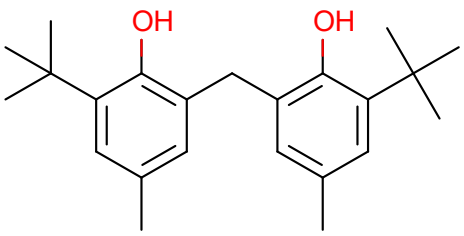
Grouping rationale

This evaluation considers the environmental risks associated with the industrial uses of 5 synthetic phenolic antioxidant chemicals used mainly in plastics, rubber and other polymers.

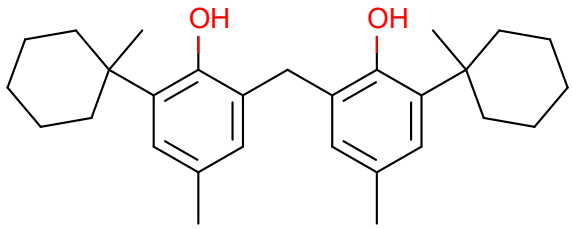
The chemicals in this group are symmetrical bisphenols. The 2 phenol rings are joined at the 2-position by a methylene bridge. All chemicals feature disubstituted phenol rings, with a sterically hindered saturated aliphatic group at the 6-position and either a methyl or ethyl group at the 4-position.

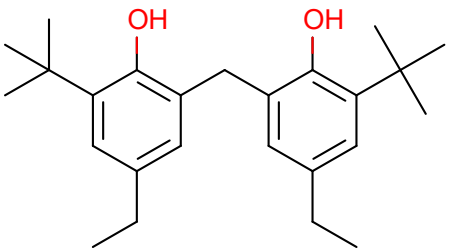
As the 5 substances have similar use patterns and structures, the fate and hazard characteristics are expected to be similar.

Chemical identity

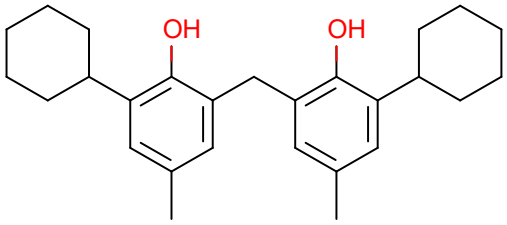
CAS number	119-47-1
CAS name	Phenol, 2,2'-methylenebis[6-(1,1-dimethylethyl)-4-methyl-
Molecular formula	$C_{23}H_{32}O_2$
Associated names	2,2'-Methylenebis[4-methyl-6-tert-butylphenol] 2,2′-Methylenebis[6-(1,1-dimethylethyl)-4-methylphenol] p-Cresol, 2,2′-methylenebis[6-tert-butyl-
Molecular weight (g/mol)	340.50
SMILES (canonical)	OC=1C(=CC(=CC1C(C)(C)C)C)CC2=CC(=CC(=C2O)C(C)(C)C)C
Structural formula	

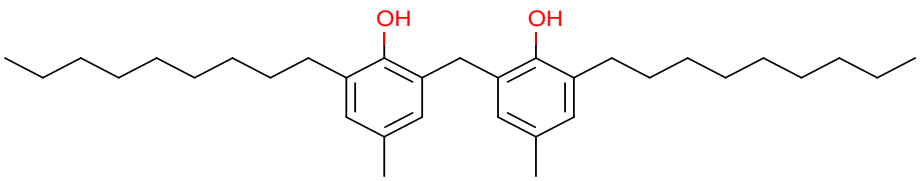
CAS number	77-62-3
CAS name	Phenol, 2,2'-methylenebis[4-methyl-6-(1-methylcyclohexyl)-
Molecular formula	$C_{29}H_{40}O_2$

Associated names	p-Cresol, 2,2′-methylenebis[6-(1-methylcyclohexyl)- 2,2′-Methylenebis[4-methyl-6-(1-methylcyclohexyl)phenol]
Molecular weight (g/mol)	420.63
SMILES (canonical)	OC=1C(=CC(=CC1C2(C)CCCCC2)C)CC3=CC(=CC(=C3O)C4(C)CCCCC4)C
Structural formula	

CAS number	88-24-4
CAS name	Phenol, 2,2'-methylenebis[6-(1,1-dimethylethyl)-4-ethyl-
Molecular formula	$C_{25}H_{36}O_2$
Associated names	2,2'-Methylenebis[4-ethyl-6-tert-butylphenol 2,2′-Methylenebis[6-(1,1-dimethylethyl)-4-ethylphenol] Phenol, 2,2′-methylenebis[6-tert-butyl-4-ethyl-
Molecular weight (g/mol)	368.55
SMILES (canonical)	OC=1C(=CC(=CC1C(C)(C)C)CC)CC2=CC(=CC(=C2O)C(C)(C)C)CC
Structural formula	

CAS number	4066-02-8
CAS name	Phenol, 2,2′-methylenebis[6-cyclohexyl-4-methyl-
Molecular formula	$C_{27}H_{36}O_2$
Associated names	Bis(2-hydroxy-3-cyclohexyl-5-methylphenyl)methane

	2,2′-Methylenebis[6-cyclohexyl-4-methylphenol]
	p-Cresol, 2,2′-methylenebis[6-cyclohexyl-
Molecular weight (g/mol)	392.57
SMILES (canonical)	OC=1C(=CC(=CC1C2CCCCC2)C)CC3=CC(=CC(=C3O)C4CCCCC4)C
Structural formula	

CAS number	7786-17-6
CAS name	Phenol, 2,2'-methylenebis[4-methyl-6-nonyl-
Molecular formula	$C_{33}H_{52}O_2$
Associated names	2,2′-Methylenebis[4-methyl-6-nonylphenol]
	p-Cresol, 2,2′-methylenebis[6-nonyl-
Molecular weight (g/mol)	480.77
SMILES (canonical)	OC=1C(=CC(=CC1CCCCCCCCC)C)CC2=CC(=CC(=C2O)CCCCCCCCC)C
Structural formula	

Relevant physical and chemical properties

Measured physical and chemical property data were retrieved from the registration dossiers for chemicals in this group under the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH) legislation in the European Union (EU) (ECHA CHEM n.d.-a; ECHA CHEM n.d.-b) and the available scientific literature (NCBI n.d.-e; OECD 2003). Estimated values were obtained through calculations using EPISuite (US EPA 2017). Information for representative members of the chemicals in this evaluation are shown below.

Chemical	DBMC	6-methylcyclohexyl substituted analogue	6-nonyl substituted analogue
Physical form	solid	solid	solid
Melting point	130–131°C (exp.)	126°C (exp.)	252°C (calc.)
Boiling point	220°C (decomposition, exp.)	365°C (decomposition, exp.)	584°C (calc.)
Vapour pressure	2.77 x 10^{-7} Pa (calc.)	5.8 x 10^{-7} Pa (exp.)	< 0.001 Pa (calc.)
Water solubility	7 µg/L (exp.)	≤ 3 µg/L (exp.)	< 0.001 µg/L (calc.)
Henry's law constant	0.013 Pa·m^3/mol (calc.)	0.081 Pa·m^3/mol (calc.)	< 0.001 Pa·m^3/mol (calc.)
Ionisable in the environment?	No	No	No
pK_a	-	-	-
log K_{OW}	6.25 (exp.)	9.9 (35°C, exp.)	13 (calc.)

The chemical DBMC is a very slightly volatile organic chemical with a very slight solubility in water based on measured physicochemical properties. The high measured K_{OW} indicates that it is lipophilic.

Limited experimental physical and chemical property data are available for 3 of the analogues of DBMC. Available data together with calculated values obtained for these chemicals show they have similar physicochemical properties as DBMC, with a decrease in solubility, and an increase in log K_{OW} values compared to DBMC.

Introduction and use

Australia

Australian use information is only available for DBMC. No specific Australian use, import, or manufacturing information has been identified for the remaining 4 chemicals in this evaluation.

Australian use of DBMC in fragrances is estimated to be 10 kg/year. This volume is based on use data provided by the International Fragrance Association (IFRA) for the Asia-Pacific region for the year 2023.

The NICNAS human health evaluation of DBMC identified Australian uses such as (NICNAS 2016):

- in adhesives and sealants
- as a rubber antioxidant
- in a binder precursor in polymers

- as an antioxidant in explosives.

Recent information provided to AICIS as part of this evaluation confirms the use of DBMC at concentrations up to 1% in adhesive and sealant products.

Other Australian uses identified through material safety data sheets (MSDS) include uses of DBMC in:

- plastic products, including latex and polyurethane waterproofing membranes, at concentrations up to 10%
- in adhesives and adhesive tapes, at concentrations up to 5%.

International

Available information indicates that the chemicals in this group are used worldwide mainly as antioxidants, heat and UV stabilisers in adhesives, and a range of polymers, such as plastic and rubber.

Chemicals in this group belong to a type of antioxidant that scavenges radicals and stops further radical formation (Bartsch et al. 2018; Kröhnke et al. 2015; Öncel et al. 2019). This interrupts the chain reactions that damage products.

The annual production volume for DBMC was estimated to be around 3,300–3,500 tonnes in 2003, with major producers located in Germany, Japan, the United Kingdom, France and the United States (US) (OECD 2003). In Europe, the chemical is registered for use at 1,000–10,000 tonnes/year (ECHA CHEM n.d.-a), whereas reported use volumes are 454–1,134 tonnes/year for the US (US EPA 2024) and up to 2,000 tonnes in 2023 for Japan (NITE n.d.).

The 4 analogues of DBMC have lower reported use volumes. In Europe, registration volumes are 10–100 tonnes/year for the 6-methylcyclohexyl substituted analogue, 1–10 tonnes/year for the 4-ethyl substituted analogue and 100–1,000 tonnes/year for the 6-nonyl substituted analogue (ECHA CHEM n.d.-b; ECHA CHEM n.d.-c; ECHA CHEM n.d.-e). Whereas manufacture of the 6-cyclohexyl substituted analogue has ceased (ECHA CHEM n.d.-d). In the US, reported use volumes are 23–113 tonnes/year for the 4-ethyl substituted analogue (US EPA 2024). Reported annual use volumes are up to 1,000 tonnes/year for the 4-ethyl substituted analogue in Japan (NITE n.d.). All analogue chemicals are used as antioxidants or stabilisers in various industrial applications.

Recent information provided to AICIS as part of this evaluation confirms the use of DBMC at concentrations up to 2.5% w/w. Chemicals in this group may be used in the manufacture of a wide range of polymers such as (Mayzo n.d.; Perflavory n.d.; ECHA CHEM n.d.-b; ECHA CHEM n.d.-c; US EPA 2020; Western Reserve Chemicals n.d.):

- synthetic elastomers
- thermoplastic elastomers
- polyurethane foams
- engineering resins.

Chemicals in this group may be used in products such as (DeLima Associates n.d.; EC n.d.-a; EWG n.d.; Mayzo n.d.; Perflavory n.d.; ECHA CHEM n.d.-a; ECHA CHEM n.d.-b; ECHA CHEM n.d.-c; US EPA 2020; US EPA 2022; US EPA 2024):

- adhesives and sealants
- lubricants and greases, fats, oils and waxes
- hydraulic and metal working fluids
- fuels
- paint and coatings
- personal care products (cosmetics)
- photographic film and chemicals
- car engine maintenance fluids.

One or more of these chemicals were found in consumer products such as car seats at concentrations up to 4.7 ng/g (Wu and Venier 2023), in textiles at up to 51.9 ng/g (Ji et al. 2024), in shoe soles at up to 2,820 ng/g (Yan et al. 2024), flooring mats at concentrations up to 0.22% (ILFI n.d.) and in mulching films at concentrations of up to 210 ng/g (Xu Yiwen et al. 2024). DBMC and the 6-methylcyclohexyl substituted analogue may also be included in automotive tyres (ECHA CHEM n.d.-a; OECD 2003), in PVC pipes (Mercea et al. 2021), and in greenhouse covers (Menger et al. 2024). DBMC was detected in printing ink wastewater (Zhang F et al. 2021).

The chemical DBMC is included in the INCI database as a cosmetic ingredient functioning as an antioxidant (Personal Care Products Council n.d.). Use of the substance in cosmetics has been prohibited in the European Economic Area (EEA) since 17 December 2022 (COSlaw n.d.-b; EC n.d.-b). The chemical may nevertheless be present in cosmetics available in other parts of the world. DBMC is on the IFRA Transparency List (IFRA n.d.) and a listed ingredient in 13 products available on the US and Canadian market (DeLima Associates n.d.; EWG n.d.). DBMC and the 4-ethyl substituted analogue were found in lipstick available for sale in China, Korea, Canada and the US at average concentrations of 2 ng/g and 26 ng/g product, respectively (Tang S et al. 2021).

Existing Australian regulatory controls

Environment

The industrial use of the chemicals in this group is not subject to any specific national environmental regulations.

International regulatory status

United Nations

Chemicals in this group are not currently identified as Persistent Organic Pollutants (POPs) (UNEP 2001), ozone depleting substances (UNEP 1987), or hazardous substances for the purpose of international trade (UNEP & FAO 1998).

OECD

The chemical DBMC is listed as an OECD High Production Volume (HPV) chemical (OECD n.d.-a). The substance has been sponsored for assessment by Japan and a Screening Information Data Sheet (SIDS) Initial Assessment Report (SIAR) has been published (OECD 2003).

European Union

The chemical DBMC has been identified as a Substance of Very High Concern (SVHC) under the REACH legislation. The date of inclusion in the Candidate List is 17 January 2022 (ECHA n.d.-b). No environmentally relevant conclusions were included.

The use of DBMC in cosmetics is prohibited since the substance was added to Commission Regulation (EU) 2022/1531 (Omnibus Act V) and Annex II to the EU Cosmetics Regulation (COSlaw n.d.-b; EC n.d.-b). As of 17 December 2022, non-compliant cosmetic products must be recalled from the EU market (COSlaw n.d.-a; COSlaw n.d.-b).

The chemicals in this group are included in the European Positive list of the drinking water directive (ECHA n.d.-a).

United States of America

Some of the chemicals are regulated by the U.S. Food and Drug Administration (FDA) for uses in food contact materials under 21 Code of Federal Regulations (CFR):

- DBMC and the 4-ethyl substituted analogue and 6-nonyl substituted analogue may be used as a component of adhesives (FDA n.d.-a).
- The 6-methylhexyl substituted analogue is authorised for use in closure-sealing gaskets at up to 1% w/w (FDA n.d.-b).
- DBMC may be used as a stabiliser in polyoxymethylene (POM) copolymers at up to 1% weight by weight (w/w) (FDA n.d.-c).
- DBMC may be use as a stabiliser in POM homopolymers at up to 0.5% w/w (FDA n.d.-d).
- DBMC and the 4-ethyl and 6-nonyl substituted analogues may be used up to 5% of the weight of rubber products (FDA n.d.-e).
- DBMC and the 6-methylhexyl, 4-ethyl and 6-nonyl substituted analogues may be used only at certain concentrations as antioxidants and/or stabilisers in polymers (FDA n.d.-f).

Other

The Swiss Ordinance of the Federal Department of Home Affairs (FDHA) on articles and materials Annex 6 IV Part A lists a mixture of DBMC and the 6-methylhexyl substituted analogue as a permitted substance for the manufacture of packaging inks (FOPH n.d.). Printed articles and materials shall not release the substances in quantities exceeding the total specific migration limit (SML) of 1.5 mg/kg.

China allows specific amounts of additives to be used in food contact materials, expressed as mass fractions (%) (NHFPC 2016). Certain polymeric materials may contain a maximum of 0.1–5% of DBMC, whereas the limit in polyamides is defined as ‘used appropriately according to the production demand’. This definition has also been applied to all regulated polymers containing the 6-methylcyclohexyl substituted analogue. The 4-ethyl and 6-cyclohexyl substituted analogues may be added to certain polymers at up to 0.5–0.6% and 0.5%, respectively.

Environmental exposure

Industrial uses of chemicals in this group are expected to result in diffuse emissions to the environment including soil, sediments, and surface waters, including via STPs.

The chemicals are synthetic compounds used as antioxidants, and UV and heat stabilisers in a wide range of products including polymers, adhesives, lubricants, hydraulic fluids and personal care products. They are included as additives that are not chemically bonded to the materials to which they are added. Emissions of the chemicals are expected through migration of substance out of articles as well as from abrasion and wear of these articles during their normal use. Emissions through migration of substance are similarly also expected from other uses, such as in adhesives and personal care products. These emissions may occur to water and soil. Leaching of the chemical may occur to any immediate environment from articles such as PVC pipes, mulching films, clothes, shoe soles, tyres and printing inks (Jang et al. 2024; Ji et al. 2024; Liu Y et al. 2025; Mercea et al. 2021; Yan et al. 2024; Zhang F et al. 2021).

When used in textiles and clothing, chemicals in this group may be transferred to wastewater and become a source of contamination in STP influent (Ji et al. 2024). Depending on degradation and partitioning processes of chemicals in STPs, some fraction of the quantity of chemicals in wastewater entering STPs can be emitted to rivers or oceans in treated effluent, or to soil by application of biosolids to agricultural land (Struijs 1996).

Environmental fate

Leaching from products

Antioxidant additives, such as chemicals in this group, are not bound to the polymer matrix and may leach out of products over time. Leaching occurs as chemical moves from the surface of a product into environmental compartments. The migration behaviour of some of the chemicals in this group has been investigated in literature studies.

The chemical DBMC was found in neutral to weakly alkaline landfill leachate in China (Zhang Q-Q et al. 2013) indicating the ability for this chemical to leach from waste in landfill conditions.

Diffusion of DBMC was lower than the diffusion of other common antioxidants in a study investigating antioxidants in PVC (Mercea et al. 2021).

In a leaching experiment involving rubber and plastic shoe sole samples, low migration of DBMC was observed from PVC, polybutadiene rubber (BR) and a thermoplastic elastomer. Although leaching was more pronounced from ethylene-vinyl acetate (EVA), polyurethane (PU), thermoplastic polyurethane (TPU) and thermoplastic rubber (TPR) samples (Yan et al. 2024).

The lower molecular weight degradants of the chemicals in this evaluation may have faster migration rates from polymers than the parent compounds (Bartsch et al. 2018).

Partitioning

The chemicals in this evaluation are expected to mainly partition to sediment and soil when released into the environment.

The chemicals in this group are neutral organic chemicals that are very slightly soluble in water and very slightly volatile. The Henry's Law constants of these chemicals are in the range of 9 x 10^{-8}–52.6 Pa m^3/mol, suggesting they will be very slightly to moderately volatile from water and moist soil. The chemicals in this group have high lipophilicity, with log K_{OW} values of 6.3–13.1 and measured and calculated carbon soil adsorption coefficients (log K_{OC}) of 6.3–9.2 L/kg, indicating they will be immobile and will preferentially adsorb to phases in the environment with high organic carbon content (including sediment and soil).

Following release to surface waters, calculations with a standard multimedia partitioning (fugacity) model with sole release to the water compartment (Level III output) predict that the chemicals will generally partition to sediment (91.1–97.5%), with small amounts remaining in water (2.5–8.9%), and negligible partitioning to air and soil (< 0.1%) (US EPA 2017).

The chemicals in this group may be emitted to the soil compartment through application of biosolids from STP processes. Calculation with a standard multimedia partitioning (fugacity) model with sole release to the soil compartment (Level III approach) predict that these chemicals will remain in soil (99.9–100%), with negligible amounts partitioning to the other compartments (≤ 0.1%) (US EPA 2017).

Degradation

Based on available evidence, chemicals in this group are persistent in the water and soil.

Chemicals in this evaluation fail ready biodegradation tests. A test according to OECD TG 301 C monitoring O_2 consumption resulted in no degradation (0%) of DBMC within 28 days (ECHA CHEM n.d.-a). A test according to OECD TG 301 B monitoring CO_2 evolution resulted in 10–12% degradation of the 6-methylhexyl substituted analogue within 28 days (ECHA CHEM n.d.-b). A test in accordance with a Japanese National Standard Method monitoring O_2 consumption resulted in 8% degradation of the 4-ethyl substituted analogue within 14 days (ECHA CHEM n.d.-c).

These results are supported by a failed ready biodegradation result for a related substance. The related substance 4,4'-butylidenebis[2-(1,1-dimethylethyl)-5-methylphenol] (CAS RN 85-60-9) had a measured biodegradation rate of 2–12% after 28 days in an OECD TG 301 B study monitoring CO_2 evolution (ECHA CHEM n.d.-f).

Simulation studies in water and water/sediment systems are only available for a related substance. Degradation of 4,4′-methylenebis[2,6-dimethylphenol] (CAS RN 5384-21-4) was studied in 2 simulation tests using lake water (OECD TG 309 study) and lake water/sediment systems (OECD TG 308 study), and a radiolabelled substrate (ECHA CHEM n.d.-g). In water, primary degradation half-lives of 14–17 days were seen, whereas ultimate biodegradation reached 4–19% after 63 days and was found to be concentration dependent. In the water/sediment simulation systems, primary degradation half-lives of < 1–5 days were obtained, and ultimate biodegradation was 12–18% after 103 days. The structure of this substance is similar to the chemicals in this group but has considerably less bulk around the phenol alcohol. The chemicals in this evaluation are expected to undergo less ultimate degradation than observed in these studies.

These experimental results are supported by EPISUITE and catalogic calculations that indicate ultimate degradation half-lives in water likely exceed 60 days for all chemicals in the group (LMC 2015; US EPA 2017).

Hydrolysis is not expected to be an important pathway for the chemicals in the group, as the substances do not have hydrolysable functional groups.

No specific biodegradation data for soil are available for the chemicals in this group, but related information indicates persistence in soil. A study with the related substance 4,4′-methylenebis[2,6-dimethylphenol] (CAS RN 5384-21-4) according to OECD TG 307 resulted in primary biodegradation half-lives of < 1–1.6 days and an ultimate biodegradation rate of 8–16% after 61 days (ECHA CHEM n.d.-g). This corresponds to ultimate half-lives in soil of 243–507 days. As with the simulation studies above, the chemicals in this evaluation are bulkier than this substance and are expected to undergo less ultimate degradation than observed in this study.

The chemicals are expected to degrade in the atmosphere through reaction with photogenerated hydroxyl radicals. Calculations performed assuming a typical hydroxyl radical concentration of 1.5×10^6 molecules/cm^3 and 12 hours of sunlight per day resulted in a half-lives of 1.9–3.1 hours (US EPA 2017). A significant fraction of the chemicals that exist in the air compartment is expected to be in the particulate phase.

Bioaccumulation

The chemicals in this evaluation are not expected to bioaccumulate based on the currently available evidence. Measured BCFs for DBMC and the 4-ethyl substituted analogue are below categorisation thresholds. DBMC also has a short transformation half-life in fish. Calculations suggest that the remaining chemicals in this evaluation are also unlikely to bioaccumulate.

Identified experimental BCF values in carp (*Cyprinus carpio*) include 320–840 L/kg for DBMC and 740–980 L/kg for the 4-ethyl substituted analogue (ECHA CHEM n.d.-a; n.d.-c). The tests were conducted at concentrations below the solubility limit of DBMC, and the concentration was maintained throughout the experiments through the addition of a co-solvent system made up of PEG-40 hydrogenated castor oil (HCO-40) and 2-methoxyethanol. Both studies were conducted under flow-through conditions and the BCF was measured at steady state.

The biotransformation half-life of DBMC in fish is short. The measured transformation half-life for DBMC has been reported to be 1.1 days (Papa et al. 2014). Calculated BCF values that consider biotransformation are below the domestic threshold for DBMC (US EPA 2017).

Various chemicals, including DBMC, were investigated and screened in historical biota samples from the Swedish Environmental Specimen Bank (Rebryk and Haglund 2022). The presence of DBMC was flagged by matching measured peaks to a database and not to a reference substance. The relative concentrations of chemicals in 7 Baltic Sea species were measured and used to calculate trophic magnification factors (TMFs). The authors proposed a TMF of 4.7 for DBMC. However, chemicals, such as trimethyl isocyanurate, with estimated low log K_{OW} values and low potential for bioaccumulation (US EPA 2017), were also identified and calculated to have similarly concerning TMF values. As such, the reliability of the study is considered to be low.

Another study investigated the concentrations of various chemicals in 28 species from a tropical estuary (Liu Y et al. 2025). The presence of DBMC and the 4-ethyl substituted analogue was flagged by matching measured peaks to a database and not to a reference substance. No significant trend was observed between trophic level and concentrations of DBMC or the 4-ethyl substituted analogue.

An experimental biomagnification factor (BMF) of 0.016 (dimensionless) was obtained for the related chemical 4,4'-butylidenebis[2-(1,1-dimethylethyl)-5-methylphenol] (CAS RN 85-60-9) using the relationship between fish feed and rainbow trout (*Oncorhynchus mykiss*), following OECD TG 305 (ECHA CHEM n.d.-f).

Calculated BCF and BAF values that consider biotransformation are 2–1,561 L/kg ww for the 4 analogues of DBMC (US EPA 2017), which suggests that the analogue chemicals may not bioaccumulate.

Environmental transport

There is little evidence that the chemicals in this group undergo long range transport. However, a study tentatively identified DBMC in a copepod and an amphipod during analysis of a total of 34 organisms that occur in the arctic (Sørensen et al. 2023). The presence of DBMC was flagged by matching measured peaks to a database and not to a reference substance.

Predicted environmental concentration (PEC)

The PECs for the chemicals in this group have been selected based on international monitoring of the chemicals in surface water, seawater, sediment and sludge. Many of these data are from areas with significant industrial activities and are considered to be a worse case compared to Australian conditions.

For the chemicals in this evaluation PECs have been determined based on monitoring information for DBMC. DBMC was found to have the highest environmental concentrations. Although the remaining chemicals in this group are relatively data poor, they were not detected in aquatic environments and have lower reported use volumes compared to DBMC.

For the water compartment PECs are based on worst case DBMC concentrations in China and Germany: 0.051 µg/L for freshwater, 0.021 µg/L for sea water and 0.044 µg/L for STP effluent.

A PEC of 334 µg/kg was calculated for sediments based on worst case DBMC concentrations from the Arabian Gulf in an area that encompasses many petrochemical and plastic industry sites.

A PEC of 1.6 µg/kg was obtained for soil, and this figure is based on a worst-case DBMC concentration encountered in a single study from China.

DBMC was detected in 3 seawater samples collected at the Kiel Fjord in Germany at concentrations up to 20.51 ng/L (Lintner et al. 2025), and in 34 river water samples from China at up to 51.4 ng/L with a mean of 13.7 ng/L, while none of the 4-ethyl substituted analogue was found (Tang Z et al. 2025). A different study did not detect DBMC or the 6-cyclohexyl substituted analogue in any of 4 river water samples from Beijing (Liu R et al. 2015a). Analysis of surface water downstream from industrial parks in the Yangtze River Delta in China revealed DBMC concentrations of 1.09–18.2 ng/L with an average of 3.93 ng/L (Xu Yaqian et al. 2024).

In an analysis of wastewater in China, DBMC concentrations of 0.14 ng/L were measured in STP effluent (Liu R et al. 2015b). Other studies from China found DBMC in 4 STP effluent samples from Beijing in a range of 0.4–0.9 ng/L (Liu R et al. 2015a) and in 15 effluent samples from industrial wastewater treatment plants along the Yangtze River at a range of

4.4–44.2 ng/L with a mean of 19.4 ng/L (Tang Z et al. 2025). These 2 studies also looked for the 6-cyclohexyl and 4-ethyl substituted analogues but did not detect them.

DBMC was detected in 50% of sediment samples from the Kiel Fjord in Germany at concentrations up to 90.94 µg/kg dry weight (dw) (Lintner et al. 2025). DBMC was found to be a major component in sediment of the Arabian Gulf, with concentrations up to 334 µg/kg dw (Rushdi et al. 2022). In China, sediment from rivers, canals and lakes in the Yangtze River Delta revealed DBMC concentrations of 0.116–13.8 µg/kg dw with an average of 0.731 µg/kg dw (Xu Yaqian et al. 2024), while the 6-methylcyclohexyl substituted analogue was found in freshwater lake sediment at concentrations up to 0.19 µg/kg dw (Su et al. 2024).

In China, soil samples from the Yangtze River Delta contained DBMC at concentrations of 0.0686–1.62 µg/kg dw with an average of 0.184 µg/kg dw (Xu Yaqian et al. 2024).

Some of the chemicals in this group were detected in STP sludge samples from 33 cities around China (Liu R et al. 2015b). DBMC was found in 54% of samples with concentrations ranging from below the limit of quantification (< MQL) to 91.3 µg/kg dw and a median of 0.75 µg/kg dw, while the 4-ethyl substituted analogue was present in 9% of samples at concentrations of < MQL–2 µg/kg dw. The 6-cyclohexyl substituted analogue did not appear at concentrations above the limit of quantification. A different study found DBMC in 4 sludge samples from Beijing at a range of 1.2–2.1 µg/kg dw, while the 6-cyclohexyl substituted analogue was not detected in any of the samples (Liu R et al. 2015a). More recently, an examination of sewage sludge from 30 provinces across mainland China identified DBMC in all samples at concentrations of 0.3–3,137 µg/kg dw, with an average concentration of 421 µg/kg dw and a mean value of 249 µg/kg dw (Xiang et al. 2024).

In air, maximum concentrations of 0.39 pg/m^3 DBMC and 0.36 pg/m^3 of the 4-ethyl substituted analogue were recorded in samples taken in Chicago, USA (Wu et al. 2020). Samples of air particulate matter from Wuhan, China contained DBMC at a concentration of up to 856.78 pg/m^3 with a mean of 237.38 pg/m^3 and the 4-ethyl substituted analogue at a concentration of up to 9.61 pg/m^3 and a mean of 1.1 pg/m^3 (Wang et al. 2024).

Chemicals in this group were detected in household dust at maximal concentrations of 76 µg/kg for DBMC and 19 µg/kg for the 4-ethyl substituted analogue in Canada and the USA (Wu et al. 2020), 6.6 µg/kg for DBMC and 9.53 µg/kg for the 4-ethyl substituted analogue in China (Tan et al. 2024).

The chemical DBMC was found at concentrations of 152–531 µg/L in neutral to weakly alkaline landfill leachate in China (Zhang Q-Q et al. 2013). After membrane-based treatment processes, 251–343 µg/L DBMC remained in the effluent, which indicates that this compound is not efficiently removed by these types of treatment processes.

During an analysis of 34 organisms from the arctic, DBMC was tentatively identified in a copepod and an amphipod (Sørensen et al. 2023). A study of 28 species collected from the Nandu River Estuary in China found DBMC present in 20 species at concentrations up to 221 µg/kg ww with an average of 30.2 µg/kg ww, and the 4-ethyl substituted analogue present in 10 species at concentrations up to 95.6 µg/kg ww with an average of 17 µg/kg ww (Liu Y et al. 2025).

Environmental effects

Due to the very slight water solubility of DBMC, the dispersant mixture N-N-dimethylformamide (DMF)/HCO-40, 3/1 (w/w) (DMF/CO) has been used in many of the acute and chronic toxicity studies. In some cases, the toxicity endpoint is above the solubility limit, which introduces uncertainty to toxicity values.

Effects on aquatic life

Chemicals in this evaluation have limited potential to cause toxic effects in aquatic organisms. No effects were observed up to the water solubility limits for any chemicals.

Standard ecotoxicity tests conducted according to internationally recognised test guidelines are available for some of the chemicals in this group. Ecotoxicity data were identified in the following sources:

- international risk assessments (OECD 2003)
- literature studies and reviews (Chai et al. 2023)
- REACH registration dossiers (ECHA CHEM n.d.-a; ECHA CHEM n.d.-b; ECHA CHEM n.d.-c; ECHA CHEM n.d.-e)
- online databases (NITE n.d.).

Chemicals in this evaluation are very poor soluble substances. Many of the identified studies were performed using loading rate methodologies or with the assistance of solubilising agents.

Information was available for all chemicals in the evaluation, except for the 6-cyclohexyl substituted analogue. This chemical is expected to have similar toxicity characteristics as the other chemicals in this group.

Most identified aquatic toxicity data indicates that the chemicals cause no adverse effects in aquatic organisms up to the limits of solubility. Only results where some adverse effects were observed are listed in the following tables.

Acute toxicity

The following measured median lethal concentration (LC50) value for DBMC is above the water solubility limit for the chemical:

Taxon	Endpoint	Method
Fish	DBMC: 96 h LC50 = 1.02 mg/L (diluted with DMSO)	*Danio rerio* (zebrafish) embryo semi-static, nominal concentrations OECD TG 236

Significantly reduced hatching rates were observed in zebrafish (*Danio rerio*) embryos exposed to DBMC for 72 hours at or above concentrations of 681 µg/L (Chai et al. 2023). Significantly decreased heart rates were also observed after 96 hours in these exposure groups.

Chronic toxicity

The following measured no observed effect concentrations (NOEC) for DBMC and the 6-methylcyclohexyl substituted analogue shown in the table below are above their respective water solubility limits:

Taxon	Endpoint	Method
Invertebrates	DBMC: 21 d NOEC = 0.34 mg/L (DMF/CO)	*Daphnia magna* (water flea) reproduction semi-static, nominal concentrations OECD TG 211
Algae	DBMC: 72 h NOEC = 1.3 mg/L (DMF/CO)	*Raphidocelis subcapitata* (microalga) growth rate static, nominal concentrations (measured is > 80% of nominal) OECD TG 201
Algae	6-methylcyclohexyl substituted analogue: 72 h NOEC = 1,000 mg/L (WAF)	*Desmodesmus subspicatus* (green alga) growth rate static, nominal concentrations OECD TG 201

Effects on terrestrial Life

A 56 day reproduction NOEC for DBMC of above or equal to 1,000 mg/kg dw was obtained for the earthworm *Eisenia fetida* using nominal concentrations and following OECD TG 222 (ECHA CHEM n.d.-a). No statistically significant effect was observed.

A study according to OECD TG 208 measured a 17 day seedling emergence NOEC for DBMC of above or equal to 1,000 mg/kg dw for 6 common food plant species, using nominal concentrations (ECHA CHEM n.d.-a). No statistically significant effect was observed.

Effects on sediment dwelling life

An ecotoxicity study using DBMC and according to OECD TG 218 determined a 28 day emergence and development rate EC50 of above or equal to 1,000 mg/kg dw and a 28 day emergence rate NOEC of 650 mg/kg dw for the midget *Chironomus yoshimatsui* (NITE n.d.). The study was conducted under static conditions and nominal concentrations were used.

Predicted no-effect concentration (PNEC)

A surface water PNEC for DBMC of 6.8 µg/L was derived from the measured invertebrate chronic ecotoxicity endpoint (21 d NOEC = 0.34 mg/L) using an assessment factor of 50. This assessment factor was selected, as reliable chronic ecotoxicity data are available over 2 trophic levels.

A sediment PNEC for DBMC of 6.5 mg/kg dw was derived from the measured invertebrate chronic ecotoxicity endpoint (28 d NOEC = 650 mg/kg dw) using an assessment factor of 100. This assessment factor was selected, as one reliable long term ecotoxicity endpoint is available for one species.

A soil PNEC for DBMC of 20 mg/kg dw was derived from the measured annelid chronic ecotoxicity endpoint (56 d NOEC ≥ 1,000 mg/kg dw) using an assessment factor of 50. This assessment factor was selected, as 2 reliable long term ecotoxicity endpoints are available for 2 types of organisms (an annelid and plants). This value is conservative as no effects were observed in the 2 available studies.

No relevant toxic effects were seen for any of the 4 analogue chemicals. As such, the PNECs for DBMC are expected to signify worst-case protective values for all chemicals in this evaluation.

Categorisation of environmental hazard

The categorisation of the environmental hazards of the assessed chemicals according to Australian Environmental Criteria for Persistent, Bioaccumulative and/or Toxic Chemicals is presented below (DCCEEW n.d.):

Persistence

Persistent (P). Based on measured and estimated degradation rates, the chemicals in this group are categorised as Persistent.

Bioaccumulation

Not Bioaccumulative (Not B). Based on low measured and calculated bioconcentration factors (BCFs) in fish, and evidence of biotransformation, the chemicals in this group are categorised as Not Bioaccumulative.

Toxicity

Not Toxic (Not T). Based on available acute ecotoxicity values above 1 mg/L and evidence of low chronic toxicity, the chemicals in this group are categorised as Not Toxic.

GHS classification of environmental hazard

The chemicals in this evaluation do not satisfy the criteria for classification according to the Globally Harmonised System of Classification and Labelling of Chemicals (GHS) for aquatic hazards (UNECE 2017). This is based on the available acute and chronic ecotoxicity information, as well as water solubility information and read-across principles.

Hazardous to the aquatic environment (acute / short term)

Based on experimental acute toxicity information indicating no acute toxicity endpoints at concentrations at or below their limit of solubility, the following chemicals are not classified for short term aquatic toxicity:

- DBMC (CAS RN 119-47-1)

- 6-methylcyclohexyl substituted analogue (CAS RN 77-62-3)
- 4-ethyl substituted analogue (CAS RN 88-24-4)
- 6-nonyl substituted analogue (CAS RN 7786-17-6)

No experimental ecotoxicity information is available for the 6-cyclohexyl substituted analogue (CAS RN 4066-02-8). This chemical is structurally similar to the other chemicals in the evaluation and is expected to have similar ecotoxicity (based on a read-across approach). Therefore, this chemical is not classified for short term aquatic toxicity.

Hazardous to the aquatic environment (chronic / long-term)

The chemicals in this evaluation are poorly soluble substances.

Experimental chronic toxicity information is available for DBMC (CAS RN 119-47-1). Toxic effects were observed above the limit of solubility for the chemical. However, no chronic effects below the limit of solubility of DBMC have been identified. Therefore, the available chronic NOEC endpoints are not relevant for classification and DBMC is not classified for long term aquatic toxicity.

Limited experimental chronic toxicity information is available for the other chemicals in this evaluation. These chemicals are structurally similar to DBMC and are expected to have similar ecotoxicity (based on a read-across approach). Therefore, the following chemicals are not classified for long term aquatic toxicity:

- 6-methylcyclohexyl substituted analogue (CAS RN 77-62-3)
- 4-ethyl substituted analogue (CAS RN 88-24-4)
- 6-nonyl substituted analogue (CAS RN 7786-17-6)
- 6-cyclohexyl substituted analogue (CAS RN 4066-02-8)

Environmental risk characterisation

Based on the PEC and PNEC values determined above, the following Risk Quotients (RQ = PEC ÷ PNEC) have been calculated for the release of the chemicals to the water, sediment and soil compartments:

Compartment	PEC	PNEC	RQ
Surface water	0.051 µg/L	6.8 µg/L	0.008
STP effluent	0.044 µg/L	6.8 µg/L	0.006
Seawater	0.021 µg/L	6.8 µg/L	0.003
Sediment	334 µg/kg dw	6,500 µg/kg dw	0.05
Soil	1.6 µg/kg	20,000 µg/kg dw	0.00008

Given that the calculated RQ values are less than 1, these chemicals are not expected to pose a significant risk to any environmental compartment. Estimated environmental concentrations are below levels likely to cause harmful effects to organisms in typical environmental conditions.

Uncertainty

This evaluation was conducted based on a set of information that may be incomplete or limited in scope. Some relatively common data limitations can be addressed through use of conservative assumptions (OECD 2019) or quantitative adjustments such as assessment factors (OECD 1995). Others must be addressed qualitatively, or on a case-by-case basis (OECD 2019).

The most consequential areas of uncertainty for this evaluation are:

- No Australian monitoring information was available for the chemicals in this evaluation. The outcomes of this evaluation may change if new monitoring information become available to indicate that environmental concentrations of these chemicals in Australia are higher than currently assessed.
- There is limited ecotoxicity information available for the chemicals in this group. The outcomes of the evaluation may change if additional information becomes available to suggest that the ecotoxicity has been underestimated.

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