Dyes that could release selected carcinogenic amines (listed on AICS): Human health tier II assessment

27 November 2014

Chemicals in this assessment

Chemical Name in the Inventory	CAS Number
2-Naphthalenol, 1-[[2-methyl-4-[(2-methylphenyl)azo]phenyl]azo]-	85-83-6
2-Naphthalenol, 1-[[4-(phenylazo)phenyl]azo]-	85-86-9
Benzenediazonium, 2-methyl-4-[(2-methylphenyl)azo]-, sulfate (1:1)	101-89-3
2-Naphthalenamine, 1-[(2-methylphenyl)azo]-	131-79-3
2-Naphthalenol, 1-[(2-methoxyphenyl)azo]-	1229-55-6
2-Naphthalenol, 1-[(2-methylphenyl)azo]-	2646-17-5
1-Naphthalenesulfonic acid, 4-[[1-hydroxy-6-[[[[5-hydroxy-6-[(2-methoxyphenyl)azo]-7-sulfo-2-naphthalenyl]amino]carbonyl]amino]-3-sulfo-2-naphthalenyl]azo]-, trisodium salt	3687-80-7
2-Naphthalenol, 1-[[2,5-dimethyl-4-[(2-methylphenyl)azo]phenyl]azo]-	4477-79-6

Chemical Name in the Inventory	CAS Number
1,3-Benzenediamine, 4,4'-[(4-methyl-1,3-phenylene)bis(azo)]bis[6-methyl-	4482-25-1
3H-Pyrazol-3-one, 2,4-dihydro-4-[(2-methoxyphenyl)azo]-5-methyl-2-phenyl-	4645-07-2
1-Naphthalenol, 4-[(2-methylphenyl)azo]-	5098-94-2
1,3-Naphthalenedisulfonic acid, 7-hydroxy-8-[[4-(phenylazo)phenyl]azo]-, disodium salt	5413-75-2
1,3-Benzenediamine, 4,4'-[(4-methyl-1,3-phenylene)bis(azo)]bis[6-methyl-, dihydrochloride	5421-66-9
C.I. Acid Black 132	12219-02-2
1-Naphthalenesulfonic acid, 4-hydroxy-3-[(2-methoxyphenyl)azo]-, monosodium salt	5858-39-9
1,3-Naphthalenedisulfonic acid, 7-hydroxy-8-[[4-(phenylazo)phenyl]azo]-, compound with N-cyclohexylcyclohexanamine	6226-87-5
Phenol, 4-[[4-(phenylazo)phenyl]azo]-	6250-23-3
1,3-Naphthalenedisulfonic acid, 7-hydroxy-8-[[4-(phenylazo)phenyl]azo]-	25317-39-9
Phenol, 2-methyl-4-[[4-(phenylazo)phenyl]azo]-	6300-37-4
1,3-Benzenediamine, 4-[(2-methylphenyl)azo]-, monohydrochloride	6364-35-8
2-Naphthalenamine, N-ethyl-1-[[4-(phenylazo)phenyl]azo]-	6368-72-5
1,3-Benzenediamine, 4-methyl-6-[(2-methylphenyl)azo]-, monohydrochloride	6416-59-7
2-Naphthalenesulfonic acid, 4-hydroxy-7-[[[[5-hydroxy-6-[(2-methoxyphenyl)azo]-7-sulfo-2-naphthalenyl]amino]carbonyl]amino]-3-[(2-methyl-4-sulfophenyl)azo]-, trisodium salt	6420-44-6
2,7-Naphthalenedisulfonic acid, 5-(acetylamino)-4-hydroxy-3-[(2-methylphenyl)azo]-, disodium salt	6441-93-6

Chemical Name in the Inventory	CAS Number
2,7-Naphthalenedisulfonic acid, 4-hydroxy-3-[(2-methoxyphenyl)azo]-5-[[(4-methylphenyl)sulfonyl]amino]-, disodium salt	6505-96-0
1,3-Benzenediamine, 4-methyl-6-[(2-methylphenyl)azo]-	7467-29-0
C.I. Acid Red 158	8004-55-5
C.I. Basic Brown 4	8005-78-5
C.I. Basic Red 42	12221-66-8
Benzenediazonium, 4-chloro-2-methyl-	27165-08-8
Chromate(2-), [3-hydroxy-4-[(2-hydroxy-1-naphthalenyl)azo]-1-naphthalenesulfonato(3-)][1-[[2-hydroxy-5-[(2-methoxyphenyl)azo]phenyl]azo]-2-naphthalenolato(2-)]-, disodium	27425-58-7
Acetamide, N-[5-[[2-(acetyloxy)ethyl](2-cyanoethyl)amino]-2-[[4-(phenylazo)phenyl]azo]phenyl]-	39230-20-1
Benzenediazonium, 4-chloro-2-methyl-, 1,5-naphthalenedisulfonate (1:1)	51503-28-7
1,3-Benzenediamine, 4,4'-[(4-methyl-1,3-phenylene)bis(azo)]bis[6-methyl-, acetate	55772-47-9
2-Naphthalenamine, N-(2-ethylhexyl)-1-[[2-methyl-4-[(2-methylphenyl)azo]phenyl]azo]-	56358-09-9
2-Naphthalenamine, 1-[[2-methyl-4-[(2-methylphenyl)azo]phenyl]azo]-N-tridecyl-	57712-94-4
2-Naphthalenesulfonamide, 6-hydroxy-N-(2-hydroxyethyl)-N-methyl-5-[[4-(phenylazo)phenyl]azo]-	58104-55-5
2,3-Naphthalenediol, 1,4-bis((2-methoxyphenyl)azo)-	61600-41-7
Tannins, compounds with 4,4'-[(4-methyl-1,3-phenylene)bis(azo)]bis[6-methyl-1,3-benzenediamine]	68425-18-3

Chemical Name in the Inventory	CAS Number
2-Naphthalenaminium, 7-hydroxy-8-[(2-methoxyphenyl)azo]-N,N,N-trimethyl-, chloride	68391-30-0
1,3-Naphthalenedisulfonic acid, 7-hydroxy-8-[[4-(phenylazo)phenyl]azo]-, compound with 2-ethyl-N-(2-ethylhexyl)-1-hexanamine (1:2)	68555-82-8
2(1H)-Quinolinone, 4-hydroxy-1-methyl-3-[[4-(phenylazo)phenyl]azo]-	73287-67-9
1,3-Benzenediamine, 2(or 4)-methyl-, coupled with diazotized 2(or 4)-methyl-1,3-benzenediamine, hydrochlorides	83968-21-2
2-Naphthalenesulfonic acid, 4-hydroxy-7-[[[[5-hydroxy-6-[(2-methoxyphenyl)azo]-7-sulfo-2-naphthalenyl]amino]carbonyl]amino]-3-[(6-sulfo-2-naphthalenyl)azo]-, sodium salt, compound with 2,2'-(methylimino)bis[ethanol]	83763-86-4
2-Naphthalenesulfonamide, N-[2-(acetyloxy)ethyl]-6-hydroxy-N-methyl-5-[2-[4-(2-phenyldiazenyl)phenyl]diazenyl]-	70210-08-1
1,3-Naphthalenedisulfonic acid, 7-hydroxy-8-[[4-(phenylazo)phenyl]azo]-, potassium sodium salt	70321-81-2
2-Naphthalenol, 1-[[4-(phenylazo)phenyl]azo]-, ar',ar''-methyl derivatives	70879-65-1
2-Naphthalenesulfonic acid, 7-[[4,6-bis[[3-(diethylamino)propyl]amino]-1,3,5-triazin-2-yl]amino]-4-hydroxy-3-[[4-(phenylazo)phenyl]azo]-, monoacetate (salt)	71032-95-6
C.I. Solvent Red 164	71819-51-7
1,3'-Bipyridinium, 1',2'-dihydro-6'-hydroxy-4'-methyl-2'-oxo-5'-[[4-(phenylazo)phenyl]azo]-, salt with hydroxybutanedioic acid (1:1)	72765-55-0
1,3'-Bipyridinium, 1',2'-dihydro-6'-hydroxy-3,4'-dimethyl-2'-oxo-5'-[[4-(phenylazo)phenyl]azo]-, chloride	75199-20-1
Benzenesulfonic acid, 5-ethoxy-2-[[4-(phenylazo)phenyl]azo]-, sodium salt	83221-42-5

Chemical Name in the Inventory	CAS Number
2-Naphthalenesulfonic acid, 7,7'-(carbonyldiimino)bis[4-hydroxy-3-[(2-methoxyphenyl)azo]-, sodium salt	83221-76-5
1-Naphthalenesulfonic acid, 4-[[1-hydroxy-6-[[[[5-hydroxy-6-[(2-methoxyphenyl)azo]-7-sulfo-2-naphthalenyl]amino]carbonyl]amino]-3-sulfo-2-naphthalenyl]azo]-, sodium salt	83221-78-7
2-Naphthalenesulfonic acid, 7,7'-(carbonyldiimino)bis[4-hydroxy-3-[(2-methylphenyl)azo]-, sodium salt	83232-30-8
2-Naphthalenesulfonic acid, 4-hydroxy-7-[[[[5-hydroxy-6-[(2-methylphenyl)azo]-7-sulfo-2-naphthalenyl]amino]carbonyl]amino]-3-[(2-methyl-4-sulfophenyl)azo]-, sodium salt	83232-32-0
C.I. Disperse Yellow 218	83929-90-2
1,3-Naphthalenedisulfonic acid, 7-hydroxy-8-[[4-(phenylazo)phenyl]azo]-, compound with 10-nonadecanamine (1:2)	84100-97-0
1,3-Benzenediamine, 2(or 4)-methyl-, coupled with diazotized 2(or 4)-methyl-1,3-benzenediamine	84281-76-5
1,3-Benzenediamine, 2(or 4)-methyl-, coupled with diazotized 2(or 4)-methyl-1,3-benzenediamine, acetate	84281-77-6
1,3-Benzenediamine, 2-methyl-4-[(2-methylphenyl)azo]-, monohydrochloride	84434-40-2
1,3-Benzenediamine, 4-methyl-6-[(2-methylphenyl)azo]-, monoacetate	84434-44-6
1,3-Benzenediamine, 2-methyl-4-[(2-methylphenyl)azo]-	84434-45-7
1,3-Benzenediamine, 4,4'-[[2(or 4)-methyl-1,3-phenylene]azo]bis[2(or 6)-methyl-, diacetate	84560-08-7
2-Naphthalenesulfonic acid, 7-[[4,6-bis[4-(2-aminoethyl)-1-piperazinyl]-1,3,5-triazin-2-yl]amino]-4-hydroxy-3-[[4-(phenylazo)phenyl]azo]-, formate (salt, hydrochloride methanesulfonate (salt)	85305-11-9

Chemical Name in the Inventory	CAS Number
2-Naphthalenesulfonic acid, 7-[[4,6-bis[4-(2-aminoethyl)-1-piperazinyl]-1,3,5-triazin-2-yl]amino]-4-hydroxy-3-[[4-(phenylazo)phenyl]azo]-, hydrochloride	85305-12-0
3-Pyridinecarbonitrile, 1,2-dihydro-6-hydroxy-4-methyl-1-[3-(1-methylethoxy)propyl]-2-oxo-5-[[4-(phenylazo)phenyl]azo]-	85136-74-9
2-Naphthalenol, 1-[[2-methyl-4-[(2-methylphenyl)azo]phenyl]azo]-, ar-styrenated	85203-90-3
1,3-Benzenediamine, 2(or 4)-methyl-, coupled with diazotized 2(or 4)-methyl-1,3-benzenediamine, acetates hydrochlorides	91696-40-1
2-Naphthalenesulfonic acid, 7-[[4,6-bis[(2-aminopropyl)amino]-1,3,5-triazin-2-yl]amino]-4-hydroxy-3-[(2-methoxyphenyl)azo]-, monoformate (salt)	108225-03-2
Propanoic acid, 2-hydroxy-, compound with 7-[[4,6-bis[[3-(diethylamino)propyl]amino]-1,3,5-triazin-2-yl]amino]-4-hydroxy-3-[[4-(phenylazo)phenyl]azo]-2-naphthalenesulfonic acid acetate (salt)	118658-98-3
1,3'-Bipyridinium, 5',5'''-[methylenebis(4,1-phenyleneazo)]bis[1'-[3-(dimethylamino)propyl]-1',2'-dihydro-6'-hydroxy-4'-methyl-2'-oxo-, dichloride, dihydrochloride	118658-99-4

Preface

This assessment was carried out by staff of the National Industrial Chemicals Notification and Assessment Scheme (NICNAS) using the Inventory Multi-tiered Assessment and Prioritisation (IMAP) framework.

The IMAP framework addresses the human health and environmental impacts of previously unassessed industrial chemicals listed on the Australian Inventory of Chemical Substances (the Inventory).

The framework was developed with significant input from stakeholders and provides a more rapid, flexible and transparent approach for the assessment of chemicals listed on the Inventory.

Stage One of the implementation of this framework, which lasted four years from 1 July 2012, examined 3000 chemicals meeting characteristics identified by stakeholders as needing priority assessment. This included chemicals for which NICNAS already held exposure information, chemicals identified as a concern or for which regulatory action had been taken overseas, and chemicals detected in international studies analysing chemicals present in babies' umbilical cord blood.

Stage Two of IMAP began in July 2016. We are continuing to assess chemicals on the Inventory, including chemicals identified as a concern for which action has been taken overseas and chemicals that can be rapidly identified and assessed by using Stage One information. We are also continuing to publish information for chemicals on the Inventory that pose a low risk to human health or the environment or both. This work provides efficiencies and enables us to identify higher risk chemicals requiring assessment.

The IMAP framework is a science and risk-based model designed to align the assessment effort with the human health and environmental impacts of chemicals. It has three tiers of assessment, with the assessment effort increasing with each tier. The Tier I assessment is a high throughput approach using tabulated electronic data. The Tier II assessment is an evaluation of risk on a substance-by-substance or chemical category-by-category basis. Tier III assessments are conducted to address specific concerns that could not be resolved during the Tier II assessment.

These assessments are carried out by staff employed by the Australian Government Department of Health and the Australian Government Department of the Environment and Energy. The human health and environment risk assessments are conducted and published separately, using information available at the time, and may be undertaken at different tiers.

This chemical or group of chemicals are being assessed at Tier II because the Tier I assessment indicated that it needed further investigation.

For more detail on this program please visit:**www.nicnas.gov.au**

Disclaimer

ACRONYMS & ABBREVIATIONS

Grouping Rationale

The critical health concern for the chemicals in this group is the potential for carcinogenic effects following exposure to certain aromatic amines present as both impurities and breakdown products.

All chemicals in this group are azo compounds that share a similar molecular structure (R—N=N—R). The chemicals in this group could contain one or more azo linkages, in which the attached functional groups differ for each chemical.

The significance of azo-reduction in the mutagenicity and carcinogenicity of azo dyes is well established. The chemicals in this group have the potential to undergo reductive cleavage to form one or more of the following carcinogenic and/or genotoxic aromatic amines, which have been previously assessed by NICNAS:

- *o*-anisidine (CAS No. 90-04-0) (NICNASa);
- *o*-toluidine (CAS No. 95-53-4) (NICNASb);
- *p*-aminoazobenzene (CAS No. 60-09-3) (NICNASc);
- *o*-aminoazotoluene (CAS No. 97-56-3) (NICNASd);
- 2,4-toluenediamine (CAS No. 95-80-7) NICNASe);
- 5-nitro-*o*-toluidine (CAS No. 99-55-8) (NICNASf);
- *p*-chloroaniline (CAS No. 106-47-8) (NICNASg); and
- 4-chloro-*o*-toluidine (CAS No. 95-69-2) (NICNASh).

In the European Union (EU), these aromatic amines are classified as carcinogens and are included in Regulation on Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH) list of 22 aromatic amines in Annex XVII Appendix 8 (European Commission, 2006) (see **International restrictions** section).

Due to the range of functional groups present in the chemicals being assessed, they are not considered to be toxicologically similar for local toxicity effects, which includes sensitisation. The acute toxicity of azo dyes also varies, with median lethal dose LD50 values (oral) reported between 250 and 2000 mg/kg bw (Bafana et. al, 2011).

Whilst data for acute toxicity and local effects for individual chemicals are included in this report for information purposes, data should not be considered as applicable to all the chemicals in the group. For the majority of the chemicals in this group, no data are available for acute toxicity or local effects, and read across from other group members is not possible. However, compared with the concerns about carcinogenicity, these effects would be a secondary concern.

Import, Manufacture and Use

Australian

Based on the previous mandatory and/or voluntary calls for information, the following chemicals have reported Australian industrial uses:

- in textile dyeing in mills;
- in wood stains and polishes;
- as a colourant in detergents and crepe paper; and
- as identification in metal castings.

Direct Red 26 (CAS No. 3687-80-7); Acid Red 73 (CAS No. 5413-75-2); Acid Black 132 (CAS No. 12219-02-2); Disperse Yellow 23 (CAS No. 6250-23-3); Disperse Yellow 7 (CAS No. 6300-37-4); Direct Red 24 (CAS No. 6420-44-6); Acid Red 264 (CAS No. 6505-96-0); CAS No. 8005-78-5; Basic Red 42 (CAS No. 12221-66-8); Disperse Red 151 (CAS No. 70210-08-1); and CAS No. 27165-08-8.

The total volume introduced into Australia, reported under previous mandatory and/or voluntary calls for information, was 0.3 tonne for each of these chemicals.

The chemicals Acid Red 35 (CAS No. 6441-93-6) and Basic Red 76 (CAS No. 68391-30-0) are on the 'List of chemicals used as dyes in permanent and semi-permanent hair dyes in Australia' (NICNAS, 2007).

International

The following international uses have been identified through EU REACH dossiers; Galleria Chemica; Substances and Preparations in the Nordic countries (SPIN) database; the European Commission Cosmetic Ingredients and Substances (CosIng) database; United States (US) Personal Care Product Council International Nomenclature of Cosmetic Ingredients (INCI) dictionary; eChemPortal; the Organisation for Economic Co-operation and Development High Production Volume chemical program (OECD HPV), the US Environmental Protection Agency's Aggregated Computational Toxicology Resource (ACToR), US Household Products Database (US HPD), HazMap, National Research Council US (NRC US), the US National Library of Medicine's Hazardous Substances Data Bank (HSDB); and various international assessments (IARC 1975; Government of Canada, 2013a; Government of Canada, 2013b).

The majority of the chemicals are used as colouring agents or dyes in a number of applications including varnishes, oils, fats, waxes, plastics, aluminium foil, celluloid, plexiglass, polyester and polyvinyl chloride (PVC). A number of these chemicals are also used as dyes in leather, textiles, ink, wood and papermaking industries.

Other uses of the chemicals in this group include:

- in lubricants and fuel additives (Solvent Red 24 (CAS No. 85-83-6); CAS No. 56358-09-9; CAS No. 70879-65-1; CAS No. 71819-51-7; Solvent Red 19 (CAS No. 6368-72-5); and CAS No. 57712-94-4);
- in cleaning/washing agents (Solvent Red 24);

- in adhesives, binding agents (Solvent Red 24); and
- as a dye in coloured smoke for military munitions (Solvent Red 1 (CAS No. 1229-55-6)) (NRC US, 1999).

In general, the chemicals are not listed in available product ingredient databases, indicating that they are not likely to be widely available for domestic use. The chemical identified as CAS No. 4477-79-6 has reported domestic use in one brand of home maintenance primer products (identified as an old product) up to a concentration of 1 % (US HPD).

The following chemicals are listed in the US Personal Care Product Council INCI dictionary with the identified functions of:

- colourant (Solvent Red 24; Solvent Red 23 (CAS No. 85-86-9); CAS No. 131-79-3; Solvent Red 1; Orange Oil SS (CAS No. 2646-17-5); Acid Red 73); and
- hair colourant (CAS No. 4482-25-1; Acid Red 35; CAS No. 8005-78-5 and Basic Red 76).

With the exception of Solvent Red 23, there is currently no documented use of these chemicals in cosmetic products in the United States (Personal Care Products Council 2011). Orange Oil SS has reported cosmetic use in shampoo and soap bars (old products) (US HPD).

Restrictions

Australian

No known restrictions have been identified.

International

Cosmetic

Based on the information obtained from Galleria Chemica, the chemicals Solvent Red 24 (CAS Nos. 85-83-6) and Solvent Red 23 are listed in the Health Canada List of prohibited and restricted cosmetic ingredients (the cosmetic ingredient "Hotlist").

The chemicals Solvent Red 24; Solvent Red 23; Solvent Red 1; CAS No. 4482-25-1; CAS No. 5413-75-2; CAS No. 5421-66-9; CAS No. 8005-78-5; CAS No. 85136-74-9; CAS No. 68425-18-3; CAS No. 118658-98-3; CAS No. 118658-99-4 are listed in the:

- Association of South East Asian Nations (ASEAN) Cosmetic Directive Annex II Part 1: List of substances which must not form part of the composition of cosmetic products;
- EU Cosmetics Regulation 1223/2009 Annex II—List of substances prohibited in cosmetic products; and
- New Zealand Cosmetic Products Group Standard—Schedule 4: Components cosmetic products must not contain.

The chemicals Solvent Red 24; CAS No. 85136-74-9; CAS No. 108225-03-2; and CAS No. 118658-99-4 are prohibited for all uses, whereas the other chemicals are prohibited when used as a substance in hair dye products.

The chemical Solvent Red 23 (identified as CI 26100) is listed in the:

- ASEAN Cosmetic Directive Annex IV Part 1—List of colouring agents allowed for use in cosmetic products;
- EU Cosmetics Regulation 1223/2009 Annex II—List of colourants allowed in cosmetic products; and
- New Zealand Cosmetic Products Group Standard—Schedule 6—Colouring agents cosmetic products may contain with restriction.

In the above directives, the chemical is specified as 'not to be used in products applied to mucus membranes'; purity criteria also apply.

Basic Red 76 is listed in the EU Cosmetics Regulation 1223/2009 Annex III—List of substances which cosmetic products must not contain except subject to the restrictions laid down. The chemical is allowed in non-oxidative hair dye products at a maximum concentration of 2 %.

The chemicals Solvent Red 24; Solvent Red 23; and CAS No. 131-79-3 are listed in the Philippines Restricted Ingredients For Use In Cosmetics—List of substances which must not form part of the composition of cosmetic products.

Other

The chemicals are restricted by Annex XVII to REACH Regulation as follows:

'1. Azodyes which, by reductive cleavage of one or more azo groups, may release one or more of the aromatic amines listed in Appendix 8, in detectable concentrations,

i.e. above 30 ppm in the finished articles or in the dyed parts thereof, according to the testing methods listed in Appendix 10, shall not be used in textile and leather articles which may come into direct and prolonged contact with the human skin or oral cavity, such as:

- clothing, bedding, towels, hairpieces, wigs, hats, nappies and other sanitary items, sleeping bags;
- footwear, gloves, wristwatch straps, handbags, purses/wallets, briefcases, chair covers, purses worn round the neck;
- textile or leather toys and toys which include textile or leather garments; and
- yarn and fabrics intended for use by the final consumer.

2. Furthermore, the textile and leather articles referred to in paragraph 1 above shall not be placed on the market unless they conform to the requirements set out in that paragraph.'

The chemicals *o*-anisidine; *o*-toluidine; *p*-aminoazobenzene; 2,4-toluenediamine; *o*-aminoazotoluene; 5-nitro-*o*-toluidine; *p*-chloroaniline; and 4-chloro-*o*-toluidine are listed in Appendix 8 of EU REACH Annex XVII.

The chemicals identified by CAS No. 85136-74-9; CAS No. 108225-03-2; and CAS No. 118658-99-4 are restricted under Annex XVII to the REACH Regulations. 'The chemical cannot be used in substances and preparations placed on the market for sale to the general public in individual concentrations ≥0.1 %' (European Parliament and Council 1999; European Parliament and Council 2006; European Parliament and Council 2008).

Existing Worker Health and Safety Controls

Hazard Classification

The chemicals identified as CAS No. 85136-74-9; CAS No. 108225-03-2; and CAS No. 118658-99-4 (identified by its chemical name only) are classified as hazardous, with the following risk phrases for human health in the Hazardous Substances Information System (HSIS) (Safe Work Australia):

- Carc. Cat 2; R45 (carcinogenicity) for chemicals CAS No. 85136-74-9; CAS No. 118658-99-4; and CAS No. 108225-03-2; and
- Xi; R41 (eye damage) for CAS No. 108225-03-2.

The chemical, CAS No. 118658-98-3, is classified as hazardous, with the following risk phrases for human health in the HSIS (Safe Work Australia):

- Xn; R48/22 (repeated dose toxicity); and
- Xi; R43 (sensitisation).

The remaining chemicals in this group are not listed on the HSIS (Safe Work Australia).

Exposure Standards

Australian

No specific exposure standards are available.

International

No specific exposure standards are available.

Health Hazard Information

The critical concern for this group of chemicals and the focus of this assessment relates to potential carcinogenic effects following exposure. Toxicological data are available for several of the chemicals being assessed: Solvent Red 24; Solvent Red 23; Solvent Red 1; Solvent Red 19; Orange Oil SS; Basic Red 76; Acid Red 73; Acid Red 35; Disperse Yellow 7; CAS No. 56358-09-9; and CAS No. 70879-65-1, which are considered representative of the potential for toxicity due to azo cleavage for all chemicals in this group. The data from the structurally-related chemicals and aromatic amines (azo cleavage products), the *p*-aminoazobenzene; *o*-anisidine; *o*-toluidine; 4-toluenediamine; *o*-aminoazotoluene; 5-nitro-*o*-toluidine; 4-chloro-*o*-toluidine; and *p*-chloroaniline are also included in this assessment.

Toxicokinetics

The toxicokinetics of this chemical group is expected to be influenced by varying molecular weight and polarity (Bafana et al., 2011; Government of Canada, 2014). The chemicals in this group belong to one the following types of dyes: disperse, direct, reactive, solvent, basic and acidic dyes. Whilst the reported levels of solubility and bioavailability of the dyes appears to vary, available read across and empirical data suggest a potential for azo reduction (SCCNFP, 2002; SCCP, 2005; SCCS, 2011; Government of Canada, 2011; Government of Canada, 2013a; Government of Canada, 2013b; Government of Canada, 2014).

Azo bond reduction and cleavage occurs by an enzyme-mediated metabolism in the liver, skin and intestines. In the liver, metabolism is facilitated by cytosolic and microsomal enzymes (Platzek et al., 1999), including NADH cytochrome P450 reductase, NAD(P)H quinone oxidoreductase, and cytochrome P450s (OEHHA, 2012). Bacterial strains in human faeces have been shown to cleave azo dyes, suggesting the important role of the intestinal microflora in azo reduction (Platzek et al., 1999).

Although azo reduction occurs favourably in anaerobic conditions, several in vitro and in vivo studies indicated that this process could also occur aerobically when azo dyes are applied to the skin (SCCP, 2005). In vitro, the skin microflora of mouse, guinea pig and human caused reductive cleavage of the azo dyes, followed by percutaneous absorption (SCCNFP, 2002). In addition, non-biological processes, such thermal and photochemical degradation, have also been reported to break azo linkages (Engel et al., 2009).

Solvent Red 23 (in vivo and in vitro) and Solvent Red 24 (in vitro) have demonstrated azo reduction. For both chemicals, intestinal microflora in vitro reduced the azo linkage; skin bacteria under aerobic conditions in vitro also reduced Solvent Red 24 (Government of Canada, 2011; Government of Canada, 2013a). For Acid Red 73, skin bacteria in vitro formed 4-aminoazobenzene (SCCP, 2005).

For the chemicals in this group, reductive cleavage of the azo linkage would result in the formation of one (or in some cases two) of the following carcinogenic aromatic amines: *p*-aminoazobenzene; *o*-anisidine; *o*-toluidine; 2,4-toluenediamine; *o*-aminoazotoluene; 5-nitro-*o*-toluidine; 4-chloro-*o*-toluidine; and *p*-chloroaniline (SCCNFP, 2002).

These aromatic amines are expected to have greater absorption than the dye from where they are derived (Platzek et al., 1999). For this reason, azo reduction by skin and intestinal microflora, followed by the carcinogenic amine absorption is of particular concern. Metabolically, these aromatic amines undergo ring oxidation, N-glucuronidation, N-acetylation, and N-oxidation (SCCNFP, 2002). The toxicity of these chemicals is largely influenced by the N-oxidation, a process primarily mediated by cytochrome P450 enzymes, such as CYP1A2 and CYP3A4, although other enzymes could also play a role. The resulting

metabolic products are demonstrated to be highly reactive and are capable of DNA binding (NICNASa; NICNASb; NICNASc; NICNASd; NICNASe; NICNASf; NICNASg; NICNASh).

The majority of the aromatic amines have been reported to induce a significant increase in the activity of ethoxyresorufin-*O*-deethylase (a measure of aryl hydrocarbon receptor (AhR) agonism) NICNASa; NICNASb; NICNASc; NICNASd). AhR agonism and cytochrome P450 induction enhances amine metabolism.

Acute Toxicity

Oral

Findings from acute oral toxicity studies in animals indicated that Basic Red 76; Solvent Red 23; CAS No. 56358-09-9; and CAS No. 70879-65-1 have low acute toxicity. The median lethal dose (LD50) in rats is greater than 2000 mg/kg bw (SCCP, 2005; SCCS, 2011; REACH).

There was no evidence in these studies of methaemoglobinaemia associated with several of the aromatic amines that could be formed from reductive cleavage of the azo linkage (NICNASa; NICNASb; NICNASc; NICNASd; NICNASe; NICNASf; NICNASg; NICNASh).

Dermal

The data for acute dermal toxicity of the chemicals are limited. In an OECD Test Guideline (TG) 423 compliant study, the chemical CAS No. 56357-09-9 had low acute toxicity. The reported LD50 was >2000 mg/kg bw (REACH).

Inhalation

No data are available for the chemicals.

Corrosion / Irritation

Skin Irritation

The available in vitro and in vivo data for Basic Red 76; Solvent Red 23; and CAS No. 56358-09-9 indicate that these chemicals are, at most, slight irritants to skin (SCCP, 2005; SCCS, 2011; REACH).

Eye Irritation

The chemical, CAS No. 108225-03-2 is classified as hazardous with the risk phrase 'Risk of serious damage to eyes' (Xi; R41) in the HSIS (Safe Work Australia). No data are available to evaluate this classification.

Data available (in vivo and in vitro) for Basic Red 76 and CAS No. 56358-09-9 indicate that these chemicals are, at most, slight irritants to eyes (SCCS, 2011; REACH).

Sensitisation

Skin Sensitisation

The chemical CAS No. 118658-98-3 is classified as hazardous with the risk phrase 'May cause sensitisation by skin contact' (R43) in HSIS (Safe Work Australia). No data are available to evaluate this classification.

The sensitising potential of Solvent Red 1 was investigated using a local lymph node assay (LLNA) and a modified ear swelling test (MEST) in female Balb/c mice (Sailstadt et al., 1994). For the LLNA, 25 µL of solution containing 1.93 mg/ml of the chemical was applied to both ears of the animals for three days. For the MEST, 100 µL of solution with 4.9 mg/mL was applied on the shaved back of the animals (two days exposure period) and were challenged on day five of the experiment with acetone (as a vehicle) on one ear and the chemical on the other. The results indicated significant increases in lymph node proliferation and ear thickness on the ear exposed to the chemical, suggesting chemically-induced contact sensitisation (Sailstadt et al., 1994). Although comparison with the classification criteria was not possible (no stimulation index information), the MEST is considered a reliable screening test to detect moderate to strong sensitisers. Therefore, classification is considered to be warranted (refer **Recommendation** section).

A positive reaction was also reported in a mouse LLNA (Balb/c) for CAS No. 56358-09-9. Doses of 5, 50 or 500 mg/mL were applied onto the back of each ear once daily for three consecutive days. The stimulation index (SI) for the two highest doses was reported to be 3.27 and 8.35 (REACH). Classification is considered to be warranted (refer **Recommendation** section).

Solvent Red 23 induced slight sensitisation in guinea pigs; however, the animals were also exposed to the aromatic amine *p*-phenylenediamine or 4-aminoazobenzene (SCCP, 2005; Government of Canada, 2011).

Basic Red 76 did not produce skin sensitisation in a CBA/CaOlaHsd mice LLNA (OECD TG 429) up to a concentration of 10 % (w/v) in ethanol:water (7:3 v/v) (SCCS, 2011).

Observation in humans

Solvent Red 24 has been reported to cause allergic contact dermatitis in patients following a patch test (EFSA, 2005).

Repeated Dose Toxicity

Oral

The chemical, CAS No. 118658-98-3, is classified as hazardous with the risk phrase 'Harmful: Danger of serious damage to health by prolonged exposure if swallowed' (Xn; R48/22) in HSIS (Safe Work Australia). No data are available to evaluate this classification.

The blood, liver, spleen and kidneys are the target organs for the aromatic amines potentially formed following reductive cleavage of the azo bond (NICNASa; NICNASb; NICNASc; NICNASd; NICNASe; NICNASf; NICNASg; NICNASh).

Whilst the limited data available from guideline-compliant studies indicate that similar effects could occur following repeated exposure to two chemicals in this group, the doses at which these effects have been observed are not sufficient to warrant classification.

In a combined repeated-dose toxicity study and reproduction/developmental toxicity screening test (OECD TG 422), Wistar rats that were exposed to CAS No. 56358-09-9 showed a number of pathological changes that primarily affected the reproductive system, blood and the liver. In this study, rats were exposed daily to 160, 400 and 1000 mg/kg bw/day of the chemical via gavage for 42 days. In addition to effects on reproduction (see **Reproductive and developmental toxicity** section), the chemical also induced changes in haematological parameters (all doses), changes in organ weights, and vacuolation of liver cells (hepatocytes) in males. At doses of 160 and 400 mg/kg bw/day, the changes the chemical caused in the prostate gland were focal mononuclear infiltration and/or oedema of the interstitium (REACH). Red colouration was also noted in several tissues including body fat, the gastrointestinal tract, lymph nodes, liver and ovaries (female rat). Most of these changes were prominent in animals at the highest two doses (REACH).

Basic Red 76 produced a number of toxic effects in a subchronic oral study (OECD TG 408) in Wistar rats (SCCS, 2011). In this study, the rats were gavaged with 0, 60, 250, or 1000 mg/kg bw/day of Basic Red 76 for 91 days. A no observed adverse effect

level (NOAEL) of 60 mg/kg bw/day was established. The results indicated the following blood-related disorders at the two highest doses:

- increased methaemoglobin formation;
- destroyed red blood cells;
- increased iron and bilirubin accumulation in the liver and spleen;
- increased number of reticulocytes and severity of extramedullary haematopoiesis in the spleen; and
- splenic congestion and increased spleen weight.

In addition to the blood-related changes, the animals in the 1000 mg/kg bw/day group displayed hypertrophic changes of follicular cells in the thyroid and adenohypophyseal cells of the pituitary (SCCS, 2011).

Dermal

No data are available.

Inhalation

No data are available.

Genotoxicity

Based on the limited data available, it is not possible to draw a definite conclusion regarding the genotoxicity of the chemicals in this group. Although available data are neither sufficient nor adequately comprehensive for classification, a genotoxic mode of action cannot be ruled out.

The chemicals Solvent Red 24 (*o*-anisidine-based); Orange Oil SS (*o*-toluidine-based); CAS No. 56358-09-9 (*o*-toluidine-based); and Solvent Red 19 (*p*-aminoazobenzene-based), caused positive results in bacterial mutation assays (various *Salmonella typhimurium* strains) in the presence of metabolic activation (IARC, 1975; Government of Canada, 2013a; REACH).

Whilst Solvent Red 23 (*p*-aminoazobenzene-based) and Basic Red 76 (*o*-anisidine-based) gave negative results in bacterial mutation assays, it was not established if the Prival protocol (which is considred appropriate for this class of compounds) was used. However, a study in Solvent Red 1 (*o*-anisidine-based) using this protocol yielded a negative result (SCCNFP, 2002; Government of Canada, 2013a).

Although consistent results have not been observed, positive results were reported in several in vitro assays in some of the chemicals (IARC, 1975; SCCNFP, 2002; SCCP 2005; Government of Canada, 2011; SCCS, 2011; Government of Canada, 2013a), including:

- cell transformation in Syrian hamster embryo (SHE) cells (Solvent Red 24);
- gene mutations and micronuclei in mouse lymphoma cells in the presence of metabolic activation at cytotoxic levels (Solvent Red 1);
- chromosomal breaks in Chinese hamster ovary (CHO) cells in the absence of metabolic activation (Solvent Red 23);
- mutation in a mouse lymphoma assay in the presence of metabolic activation (Solvent Red 19); and
- an increase in cells with micronuclei in V79 cells with or without metabolic activation (Basic Red 76).

Limited in vivo data are available for the chemicals in this group. Orange Oil SS induced chromosomal damage in the bone marrow (rats) and peripheral blood (rats and mice) (IARC, 1975; Government of Canada, 2013a). Basic Red 76 failed to

produce an increase in the number of micronuclei in bone marrow cells of mice following intraperitoneal (i.p.) injection (SCCS, 2011). Solvent Red 1 did not induce micronuclei formation following i.p. injection (Government of Canada, 2013a).

The aromatic amines, which are potential cleavage products of the chemicals in this group, are reported to have mutagenic/genotoxic properties in a number of in vitro and in vivo assays (NICNASa; NICNASb; NICNASc; NICNASd; NICNASe; NICNASf; NICNASg; NICNASh).

Carcinogenicity

The chemicals identified by CAS No. 85136-74-9; CAS No. 108225-03-2; and CAS No. 118658-99-4 are classified as hazardous —Category 2 carcinogenic substances—with the risk phrase 'May cause cancer ' (T; R45) in the HSIS (Safe Work Australia). No experimental data are available to evaluate or to support an amendment to this classification.

Limited data are available on the chemicals in this group. The carcinogenic potential of Solvent Red 23 (*p*-aminoazobenzene-based); Solvent Red 19 (*p*-aminoazobenzene-based); Disperse Yellow 7 (CAS No. 6300-37-4) (*p*-aminoazobenzene-based); Solvent Red 24 (*o*-anisidine-based); and Orange Oil SS (*o*-toluidine-based) have been examined in long-term oral and dermal studies in mice and rats.

The strongest evidence for carcinogenicity was reported for Orange Oil SS. The chemical was found to be carcinogenic in mice, with intestinal and local tumours identified following oral and subcutaneous administration, respectively. The chemical also produced tumours in the mouse urinary bladders following bladder implantation. Studies in rats were inadequate for evaluation. Whilst both positive and negative results have been observed for other chemicals in this group, studies generally were considered inadequate for evaluation (IARC, 1975; Government of Canada, 2011; Government of Canada, 2013a).

The aromatic amine *o*-toluidine that could be formed following azo bond reductive cleavage in some of the chemicals in this group, is recommended for classification as a category 1 carcinogenic substance based on the evidence for carcinogenicity in humans (NICNASb).

Seven of these aromatic amines (*p*-aminoazobenzene; *o*-anisidine; *o*-toluidine; 2-4-toluenediamine; *o*-aminoazotoluene; 4-chloro-*o*-toluidine; and *p*-chloroaniline) are classified as hazardous (Category 2 carcinogenic substance) with the risk phrase 'May cause cancer' (T; R45) in the HSIS (Safework Australia). 5-Nitro-*o*-toluidine is classified as hazardous (Category 3 carcinogenic substance) with the risk phrase 'Limited evidence of carcinogenic effect' (Xn; R40) (Safe work Australia).

The available experimental data (animal studies) for these aromatic amines have identified a number of chemically-induced multi-organ tumours. These include benign and malignant tumours in the urinary bladder, spleen, subcutaneous tissues, kidneys, adrenal gland, liver, mammary glands, skin, blood and blood vessels, thyroid, lungs, gallbladder and renal pelvis (NICNASa; NICNASb; NICNASc; NICNASd; NICNASe; NICNASf; NICNASg; NICNASh).

Findings from several cohort studies involving factory workers have provided strong evidence for an increased risk of urinary bladder cancer associated with long-term occupational exposure to *o*-toluidine (NICNASb).

The mechanism of action underlying the carcinogenicity of these aromatic amines is still not fully understood. However, metabolic activation to produce nitrenium ion metabolites, which cause DNA adduct formation and induction of DNA damaging effects, has been suggested. A genotoxic mode of action cannot be dismissed (NICNASa; NICNASb; NICNASc; NICNASd; NICNASe; NICNASf; NICNASg; NICNASh).

Overall, based on the potential for the chemicals to be metabolised to form classified carcinogens, classification is considered appropriate (refer **Recommendation** section).

Reproductive and Developmental Toxicity

Limited data are available. In a combined repeated-dose toxicity study and reproduction/developmental toxicity screening test in Wistar rats (OECD TG 422), CAS No. 56358-09-9 was reported to cause reduced numbers of pups per litter, corpora lutea, implantations and indices of fertility and gestation (REACH). These effects were observed at 160 mg/kg bw/day. The chemical did not cause reproductive effects in male rats.

Basic Red 76, at doses of 250 and 1000 mg/kg bw, was reported to produce alterations in maternal and foetal body weights (SCCS, 2011). However, these changes were not considered severe. Solvent Red 23 did not induce either reproductive or maternal toxicity when tested in pregnant mice at gestational days 8–12 (EFSA, 2005; Government of Canada, 2011).

The aromatic amines, 2,4-toluenediamine and 5-nitro-*o*-toluidine, that could be formed following azo bond reductive cleavage of some of the chemicals in this group, have caused adverse effects on the male reproductive system in animal studies (NICNASe; NICNASf). Data for dyes that could be reduced to these chemicals in vivo are not available.

Risk Characterisation

Critical Health Effects

The available data to characterise the critical health effects are limited. There are a number of uncertainties regarding the toxic effects of the chemicals in this group, including inadequate data for carcinogenicity, incomplete genotoxicity data and the expected variation in the bioavailability of the chemicals. However, the chemicals are all considered to have the potential to be metabolised to classified carcinogens through reductive cleavage of the azo linkage. In addition, azo dyes are generally known to be contaminated with their respective starting amine material (SCCNFP, 2002).

Based on the limited data available, it is not possible to draw a definite conclusion regarding the genotoxicity of the chemicals in this group. However, while available data are insufficient or inadequately comprehensive for classification, genotoxicity as a mode of action cannot be ruled out.

The chemicals Solvent Red 1; CAS No. 56358-09-9; and CAS No. 118658-98-3 are considered to be potential skin sensitisers. CAS No. 108225-03-2 is classified for eye irritation. The irritation and sensitisation potential of the other chemicals in this group have not been investigated.

Public Risk Characterisation

Cosmetic and domestic

Some of the chemicals in this group (Solvent Red 23; Solvent Red 24; CAS No. 131-79-3; Solvent Red 1; Orange Oil SS; CAS No. 4482-25-1; CAS No. Acid Red 73; CAS No. Acid Red 35; CAS No. 8005-78-5; and Basic Red 76) have been identified as having potential cosmetic use. In Australia, Acid Red 35 and Basic Red 76 have reported use in hair dyes. A recent international use of Solvent Red 23 and Orange Oil SS in hair dyes was also reported.

Some of the potential cleavage products or impurities of the chemicals in this group (aromatic amines) such as *o*-toluidine; *p*-aminoazobenzene; *o*-aminoazotoluene; and *p*-chloroaniline have been detected in a number of cosmetic products (NICNASb; NICNASc; NICNASd; NICNASg). The chemical *o*-toluidine was detected in permanent hair dyes and commercial henna samples (colours not specified) (NICNASb). Hence, the public could potentially be exposed to classified carcinogens as an impurity in, or through the release of, these aromatic amines derived from the chemicals in this group. In addition, *o*-aminoazotoluene in decorative colouring (alta) used by Asian women on their feet has been reported. 'Certain imported products with cultural significance in some communities may result in increased risk for these populations' (NICNASd).

Based on the available data, widespread domestic use is not expected; however, the introduction of these dyes for home use cannot be excluded.

Several of the the chemicals are banned or restricted internationally, particularly for use in hair dyes (see **Restrictions: International**). The SCCNFP (2002) concluded that 'azo dyes which may release one or more carcinogenic aromatic amines, poses a risk to the health of the consumer'. In 2004, the SCCNFP concluded that several of the dyes cannot be considered safe for hair dyeing purposes, unless they are regarded as such on the basis of an adequate safety dossier. These include:

- Solvent Red 1 (*o*-anisidine-based);
- Solvent 23 and Acid Red 73 (*p*-aminoazobenzene-based); and
- CAS No. 8005-78-5 and CAS No. 4482-25-1 (2,4-toluenediamine-based) (SCCNFP, 2004).

In 2011, the European Scientific committee on consumer safety (SCCS) concluded that 'Basic Red 76 containing up to 18% methyl sulphate does not pose a risk to the health of the consumer when used as a non-oxidative hair dye with a maximum on-head concentration of 2.0%.' (SCCS, 2011). However, this opinion did not directly consider the release of *o*-anisidine from reductive cleavage of the azo linkage. Whilst quantitive risk calculations conducted by the Government of Canada estimated a margin of exposure of 10000 for cancer effects for the use of Solvent Red 1 in hair conditioner (concentration ≤0.1%) (Government of Canada, 2013a), in the absence of Australian specific use data, it is not possible to extrapolate this finding for Australia.

Overall, there is sufficient uncertainty regarding the safety of these chemicals in cosmetic products; risk management controls should be considered.

Dyed textiles, leather and paper products

The public could also be exposed to classified carcinogenic aromatic amines as impurities, or through the release of these aromatic amines derived from the chemicals in this group through:

- prolonged exposure to articles of clothing and leathergoods containing the dyes;
- young children exposed by sucking the materials containing the dye; and
- exposure by dermal contact or incidental ingestion of printed cardboards, papers or foils.

In the EU, aromatic amines such as *p*-aminoazobenzene; 2,4-toluenediamine; *p*-chloroaniline; *o*-anisidine; and 4-chloro-*o*-toluidine were detected in textiles (Spijkenisse, 2004; Piccinini et al., 2008; NICNASa; NICNASc; NICNASe; NICNASg; NICNASh; RAPEX). The concentrations of these aromatic amines in samples have exceeded the European Union limit of 30 mg/kg. In Australia, *p*-aminoazobenzene was detected in imported pillow cases at a concentration of 250 mg/kg, which was significantly more than the European Union limit (ACCC, 2014a; NICNASc).

An international assessment of the risk of cancer due to textiles and leather goods coloured with certain azo dyes concluded that, while consumer exposure is likely to be 'very low', the associated cancer risks give cause for concern. Although this assessment was not publicly available, the European Scientific Committee on Toxicity, Ecotoxicity and Environment (CSTEE) considers that the report adequately reviews the situation regarding the risk of cancer for consumers as a result of using fabrics dyed with azo compounds, and that the conclusions are, in general, acceptable. The CSTEE also supported the recommendation that using azo dyes that have the potential to give rise to 22 aromatic amines (these include the eight aromatic amines that would be formed following reductive cleavage of the azo bond of the chemicals in this group), should be restricted to the lowest possible levels or completely eliminated.

The Australian Competition and Consumer Commission (ACCC) has published guidance on the safe concentrations of particular chemicals in consumer goods (ACCC, 2014b). The guidance prescribes concentrations of chemicals in clothing, textiles and leather articles in direct and prolonged contact with the human skin or oral cavity, below which a safety concern does not exist. It also includes a list of the 22 hazardous aromatic amines (including the eight aromatic amines that would be formed following reductive cleavage of the azo bond of the chemicals in this group).

In considering the NICNAS recommendation for previously assessed azo dyes, the ACCC conducted a market survey to determine if any dyes of concern had been used in manufacturing consumer goods supplied in Australia. The ACCC has negotiated several recalls of products based on the results of the surveys (ACCC, 2014a). The ACCC tested for the concentration of aromatic amines that could be released from the chemicals in this group. This testing is considered appropriate for the chemicals in this group. The ACCC is considering mechanisms to restrict the supply of textiles and leather articles that could come into direct and prolonged contact with the human skin that might plausibly result in human exposure to certain aromatic amines at unacceptable levels. Options being considered will also be relevant for the chemicals in this group.

No data are available about the presence or release of the aromatic amines from paper products. Whilst the dyes are expected to be impregnated in the paper products, there is uncertainty in the risks associated with incidental ingestion of products by children. Should information become available regarding the presence of the dyes and/or the aromatic amines in paper products in Australia, a Tier III assessment may be necessary to characterise the risk.

Occupational Risk Characterisation

During product formulation, oral, dermal, ocular and inhalation exposure of workers to the chemical may occur, particularly where manual or open processes are used. These may include transfer and blending activities, quality control analysis, and cleaning and maintaining equipment. Worker exposure to the chemical at lower concentrations may also occur while using formulated products containing the chemical. The level and route of exposure will vary depending on the method of application and work practices employed.

Given the critical systemic long-term health effects, the chemicals could pose an unreasonable risk to workers unless adequate control measures to minimise dermal, ocular and inhalation exposure are implemented. The chemicals should be appropriately classified and labelled to ensure that a person conducting a business or undertaking (PCBU) at a workplace (such as an employer) has adequate information to determine the appropriate controls.

The *Guidance on the interpretation of workplace exposure standards for airborne contaminants* advises that 'exposure to carcinogens should be eliminated or minimised so far as is reasonably practicable' (Safe Work Australia, 2013).

The data available support an amendment to the hazard classification for those chemicals that are not currently classified as carcinogens in the HSIS (Safe Work Australia) (refer to **Recommendation** section).

NICNAS Recommendation

Overall, there is sufficient uncertainty regarding the safety of these chemicals in consumer products that risk management controls through changes to the Poisons Standard should be considered. Risks for workplace health and safety should be managed through changes to classification and labelling. A Tier III assessment may be necessary to provide further information.

It is also recommended that the ACCC consider mechanisms to restrict the supply of textiles and leather articles which could come into direct and prolonged contact with the human skin that might plausibly result in human exposure to these chemicals at unacceptable levels. Additionally, ACCC should also consider investigating whether paper products that may contain these aromatic amines are widely available in Australia.

Depending on the outcome of any risk management decisions, a Tier III assessment may be necessary to assess health effects such as sensitisation, that are not fully considered in this report.

Regulatory Control

Public Health

Appropriate scheduling and labelling should be undertaken to mitigate risk when the chemicals are used in domestic and cosmetic products. Due to the carcinogenicity concern for the aromatic amines present as impurities, or released through the metabolism of the chemicals in this group, and in the absence of data establishing safety, these chemicals and/or the aromatic amine precursors should be considered for listing in Schedule 7 or Appendix C of the *Standard for the Uniform Scheduling of Medicines and Poisons* (SUSMP), consistent with the scheduling policy framework guidelines. Matters to be taken into consideration include:

- that whilst the data for the dyes themselves are limited, the chemicals are all considered to have the potential to be metabolised to classified carcinogens through reductive cleavage of the azo linkage;
- that restrictions on using some of these chemicals exist overseas, with some restrictions based on the absence of adequate data to demonstrate safety; and
- that trace levels of the aromatic amines used in the production of the dyes could be technologically inevitable.

Work Health and Safety

The chemicals are recommended for classification and labelling under the current approved criteria and adopted GHS as below. This assessment does not consider classification of physical and environmental hazards.

NB:

The carcinogenicity classification applies to those chemicals not currently classified. The chemicals identified by CAS No. 85136-74-9; CAS No. 108225-03-2; and CAS No. 118658-99-4 are already classified as hazardous—Category 2 carcinogenic substances—with the risk phrase 'May cause cancer ' (T; R45) in the HSIS (Safe Work Australia).

The irritation classification applies only to CAS No. 108225-03-2.

The sensitisation classification applies only to Solvent Red 1; CAS No. 56358-09-9; and CAS No. 118658-98-3.

The repeated dose classification applies only to CAS No. 118658-98-3.

Hazard	Approved Criteria (HSIS)[a]	GHS Classification (HCIS)[b]
Irritation / Corrosivity	Risk of serious eye damage (Xi; R41)*	Causes serious eye damage - Cat. 1 (H318)
Sensitisation	May cause sensitisation by skin contact (Xi; R43)	May cause an allergic skin reaction - Cat. 1 (H317)
Repeat Dose Toxicity	Harmful: Danger of serious damage to health by prolonged exposure if swallowed (Xn; R48/22)*	May cause damage to organs through prolonged or repeated exposure through the oral route - Cat. 2 (H373)
Carcinogenicity	Carc. Cat 3 - Limited evidence of a carcinogenic effect (Xn; R40)	Suspected of causing cancer - Cat. 2 (H351)

[a] Approved Criteria for Classifying Hazardous Substances [NOHSC:1008(2004)].

[b] Globally Harmonized System of Classification and Labelling of Chemicals (GHS) United Nations, 2009. Third Edition.

[*] Existing Hazard Classification. No change recommended to this classification

Advice for consumers

Products containing the chemicals should be used according to the instructions on the label.

Advice for industry

Control measures

Control measures to minimise the risk from oral, dermal, ocular and inhalation exposure to the chemicals should be implemented in accordance with the hierarchy of controls. Approaches to minimise risk include substitution, isolation and engineering controls. Measures required to eliminate, or minimise risk arising from storing, handling and using a hazardous chemical depend on the physical form and the manner in which the chemicals are used. Examples of control measures which could minimise the risk include, but are not limited to:

- using closed systems or isolating operations;
- using local exhaust ventilation to prevent the chemicals from entering the breathing zone of any worker;
- minimising manual processes and work tasks through automating processes;

- work procedures that minimise splashes and spills;
- regularly cleaning equipment and work areas; and
- using protective equipment that is designed, constructed, and operated to ensure that the worker does not come into contact with the chemicals.

Guidance on managing risks from hazardous chemicals are provided in the *Managing risks of hazardous chemicals in the workplace—Code of practice* available on the Safe Work Australia website.

Personal protective equipment should not solely be relied upon to control risk and should only be used when all other reasonably practicable control measures do not eliminate or sufficiently minimise risk. Guidance in selecting personal protective equipment can be obtained from Australian, Australian/New Zealand or other approved standards.

Obligations under workplace health and safety legislation

Information in this report should be taken into account to help meet obligations under workplace health and safety legislation as adopted by the relevant state or territory. This includes, but is not limited to:

- ensuring that hazardous chemicals are correctly classified and labelled;
- ensuring that (material) safety data sheets ((M)SDS) containing accurate information about the hazards (relating to both health hazards and physicochemical (physical) hazards) of the chemicals are prepared; and
- managing risks arising from storing, handling and using a hazardous chemical.

Your work health and safety regulator should be contacted for information on the work health and safety laws in your jurisdiction.

Information on how to prepare an (M)SDS and how to label containers of hazardous chemicals are provided in relevant codes of practice such as the *Preparation of safety data sheets for hazardous chemicals—Code of practice* and *Labelling of workplace hazardous chemicals—Code of practice*, respectively. These codes of practice are available from the Safe Work Australia website.

A review of the physical hazards of these chemicals has not been undertaken as part of this assessment.

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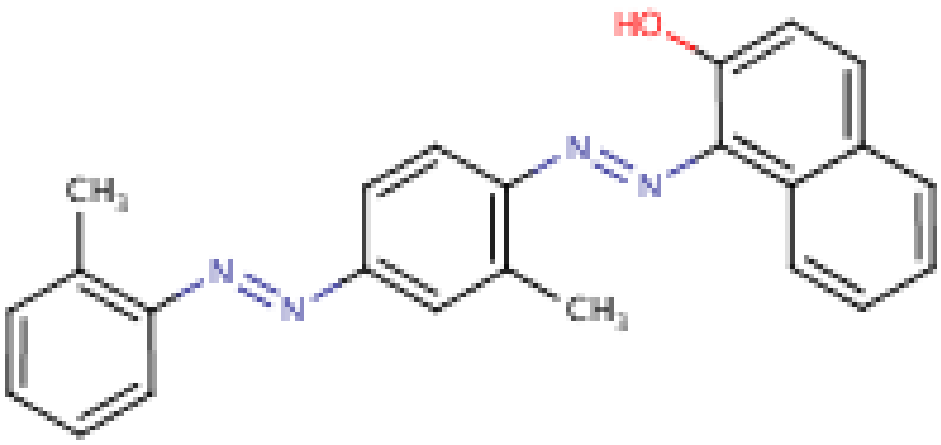
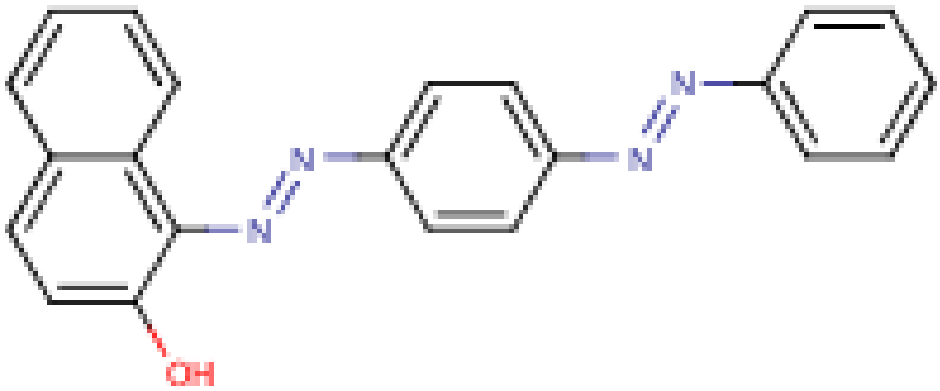
Last Update 27 November 2014

Chemical Identities

Chemical Name in the Inventory and Synonyms	**2-Naphthalenol, 1-[[2-methyl-4-[(2-methylphenyl)azo]phenyl]azo]-** C.I. Solvent Red 24 1-((2-methyl-4-((2-methylphenyl)azo)phenyl)azo)-2-naphthalenol Scarlet red CI 26105 Aka501
CAS Number	85-83-6
Structural Formula	
Molecular Formula	C24H20N4O
Molecular Weight	380.45

Chemical Name in the Inventory and Synonyms	**2-Naphthalenol, 1-[[4-(phenylazo)phenyl]azo]-** C.I. Solvent Red 23 1-((4-(phenylazo)phenyl)azo)-2-naphthalenol Red 17 CI 26100 Aka225
CAS Number	85-86-9
Structural Formula	
Molecular Formula	C22H16N4O
Molecular Weight	352.39

Chemical Name in the Inventory and Synonyms	**Benzenediazonium, 2-methyl-4-[(2-methylphenyl)azo]-, sulfate (1:1)** 4-(o-tolylazo)-o-toluenediazonium hydrogen sulfate benzenediazonium, 2-methyl-4-((2-methylphenyl)azo)-, sulfate (1:1) C.I. Azoic Diazo Component 4, sulfate salt
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	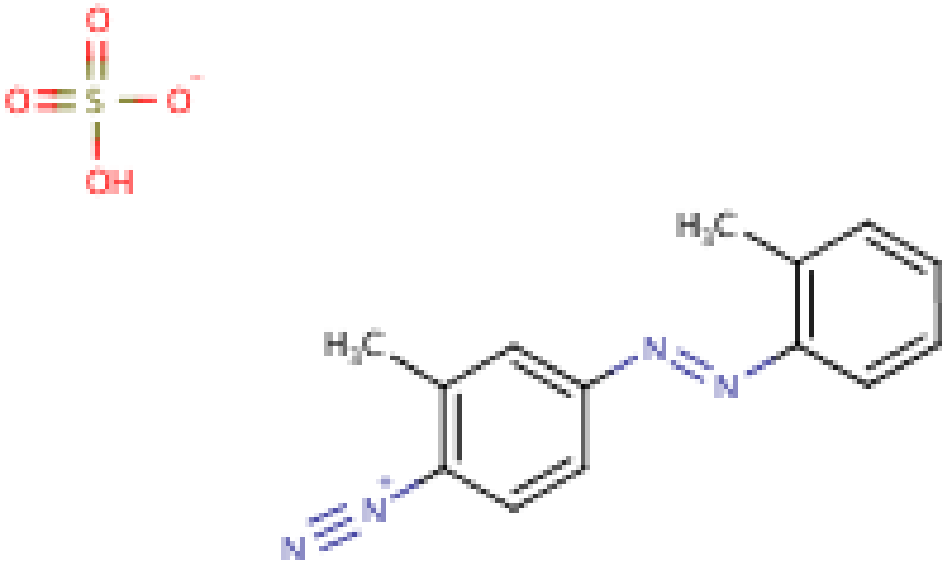
Molecular Formula	C14H13N4.HO4S
Molecular Weight	334.35

Chemical Name in the Inventory and Synonyms	**2-Naphthalenamine, 1-[(2-methylphenyl)azo]-** C. I. Solvent Yellow 6 1-(2-methylphenyl)azo-2-naphthalenamine 1-(o-tolylazo)-2-naphthylamine Ki405
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	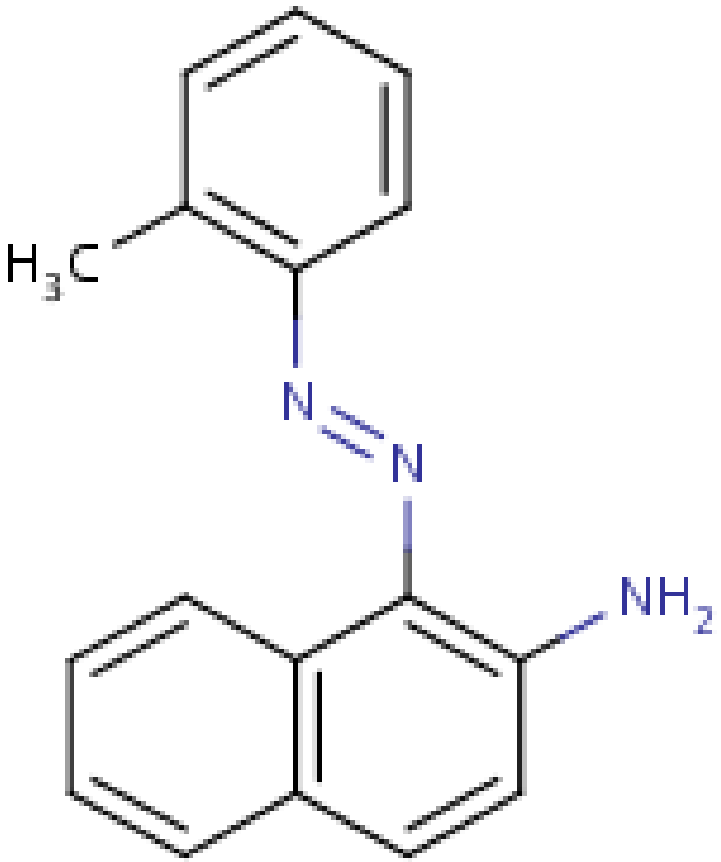
Molecular Formula	C17H15N3
Molecular Weight	261.33

Chemical Name in the Inventory and Synonyms	**2-Naphthalenol, 1-[(2-methoxyphenyl)azo]-** C. I. Solvent Red 1 2-naphthalenol, 1-((2-methoxyphenyl)azo)- 1-(o-anisylazo)-2-naphthol Brilliant Fast Scarlet R CI 12150
CAS Number	1229-55-6
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	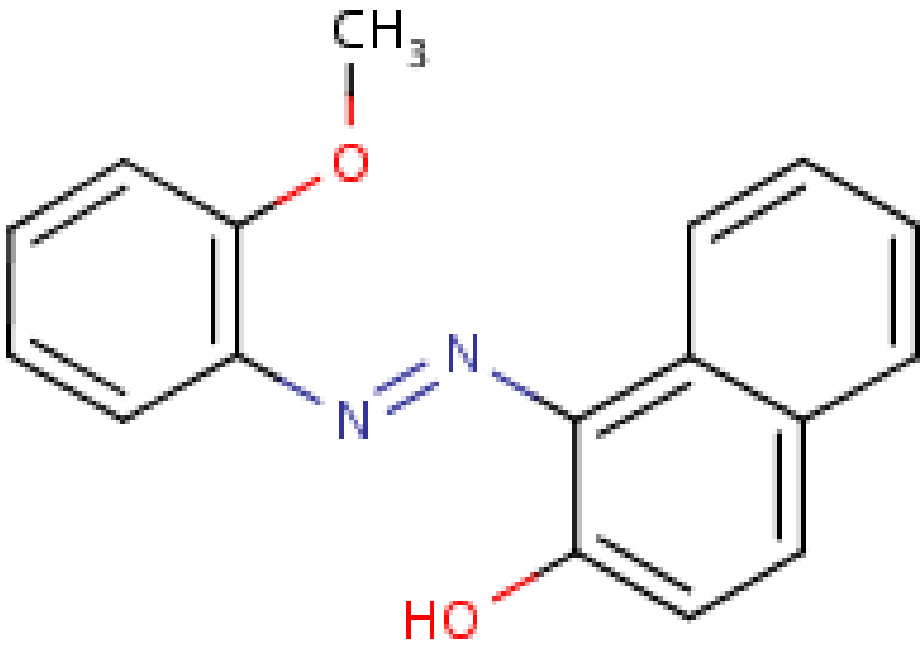
Molecular Formula	C17H14N2O2
Molecular Weight	278.31

Chemical Name in the Inventory and Synonyms	**2-Naphthalenol, 1-[(2-methylphenyl)azo]-** C.I. Solvent Orange 2 Oil Orange SS 1-(o-tolueneazo)-2-naphthol A.F. Orange No. 2 Daidai403
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	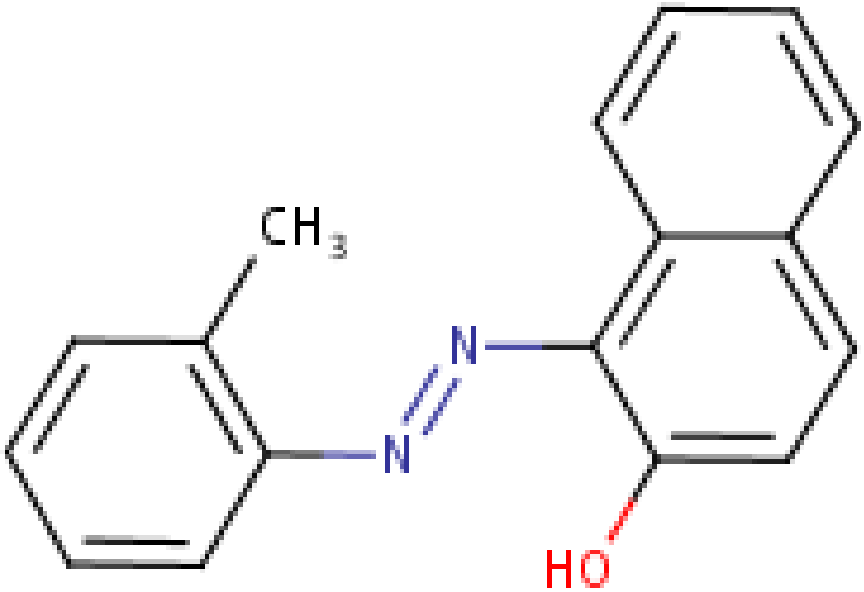
Molecular Formula	C17H14N2O
Molecular Weight	262.31

Chemical Name in the Inventory and Synonyms	**1-Naphthalenesulfonic acid, 4-[[1-hydroxy-6-[[[[5-hydroxy-6-[(2-methoxyphenyl)azo]-7-sulfo-2-naphthalenyl]amino]carbonyl]amino]-3-sulfo-2-naphthalenyl]azo]-, trisodium salt** 4-((7-((((6-((2-methoxyphenyl)azo)-5-hydroxy-7-sulfonaphth-2-yl)amino)carbonyl)amino)-4-hydroxy-2-sulfonaphth-3-yl)azo)-1-naphthalenesulfonic acid, trisodium salt C. I. Direct Red 26 Amanil Fast Scarlet 8BA trisodium 4-((6-((((6-((o-anisyl)azo)-5-hydroxy-7-sulphonato-2-naphthyl)amino)carbonyl)amino)-1-hydroxy-3-sulphonato-2-naphthyl)azo)naphthalene-1-sulphonate Triazol Fast Scarlet 8BS
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	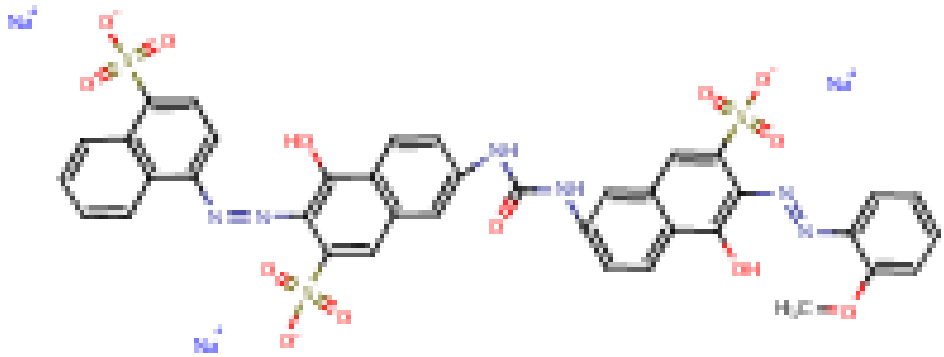
Molecular Formula	C38H28N6O13S3.3Na
Molecular Weight	938.81

Chemical Name in the Inventory and Synonyms	**2-Naphthalenol, 1-[[2,5-dimethyl-4-[(2-methylphenyl)azo]phenyl]azo]-** C. I. Solvent Red 26 Calco Oil Red N 1700 Calcogas Rocket Red
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	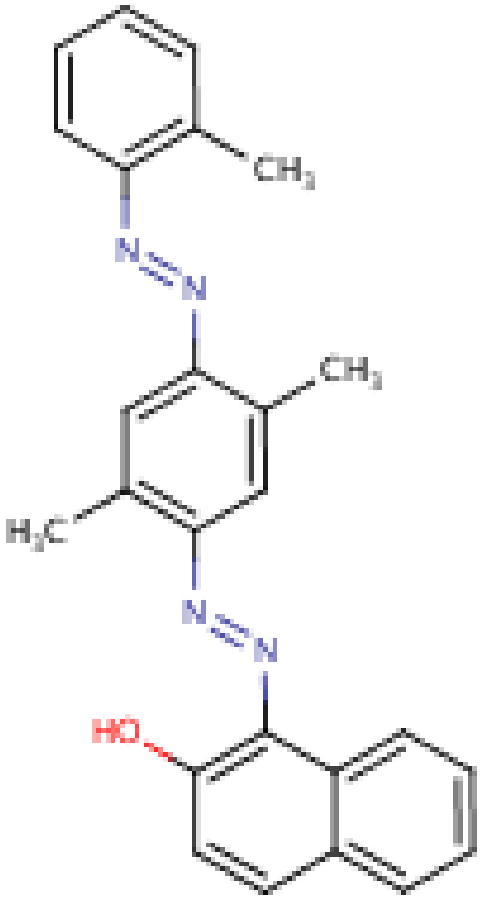
Molecular Formula	C25H22N4O
Molecular Weight	394.48

Chemical Name in the Inventory and Synonyms	**1,3-Benzenediamine, 4,4'-[(4-methyl-1,3-phenylene)bis(azo)]bis[6-methyl-** C. I. Basic Brown 4 4,4'-((4-methyl-1,3-phenylene)bis(azo))bis(6-methyl-1,3-benzenedi- amine 5,5'-((4-methyl-1,3-phenylene)bis(azo))bis(toluene-2,4-diamine) Bismarck Brown Base
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	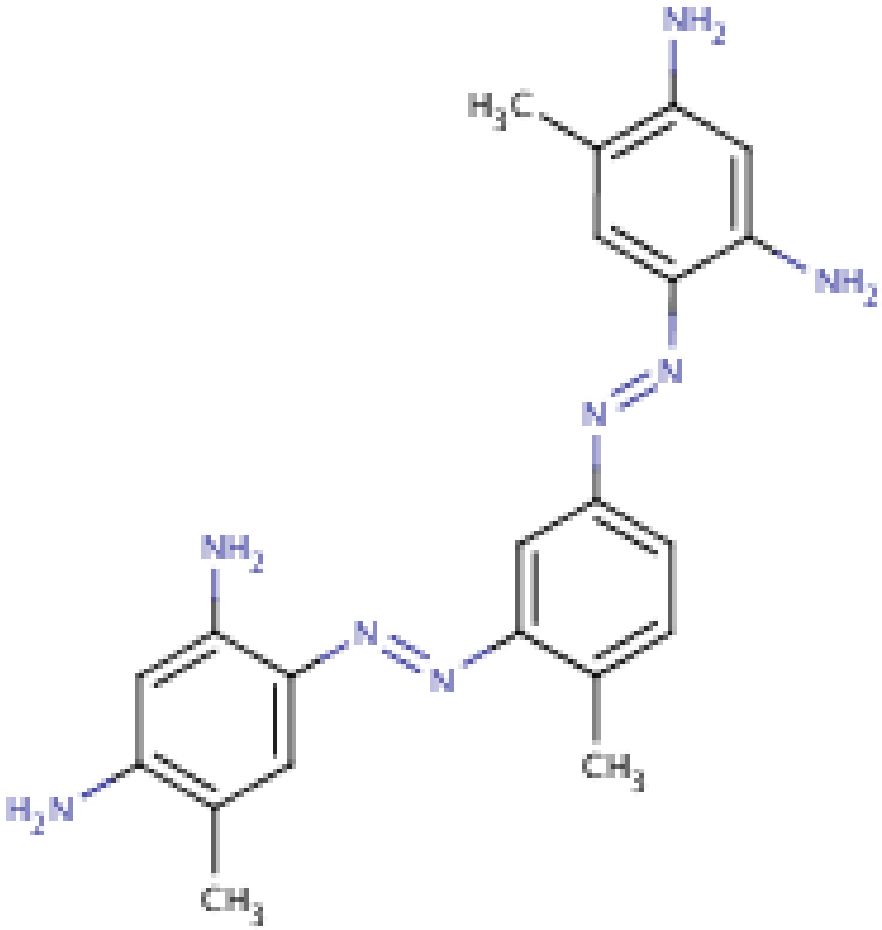
Molecular Formula	C21H24N8
Molecular Weight	388.48

Chemical Name in the Inventory and Synonyms	**3H-Pyrazol-3-one, 2,4-dihydro-4-[(2-methoxyphenyl)azo]-5-methyl-2-phenyl-** 4-((o-methoxyphenyl)azo)-3-methyl-1-phenyl-2-pyrazolin-5-one C. I. Solvent Yellow 72 2-pyrazolin-5-one, 4-((o-methoxyphenyl)azo)-3-methyl-1-phenyl- 4-((o-methoxyphenyl)azo)-3-methyl-1-phenyl-2-pyrazolin-5- 3H-pyrazol-3-one, 2,4-dihydro-4-((2-methoxyphenyl)azo)-5-methyl-2-phenyl-
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	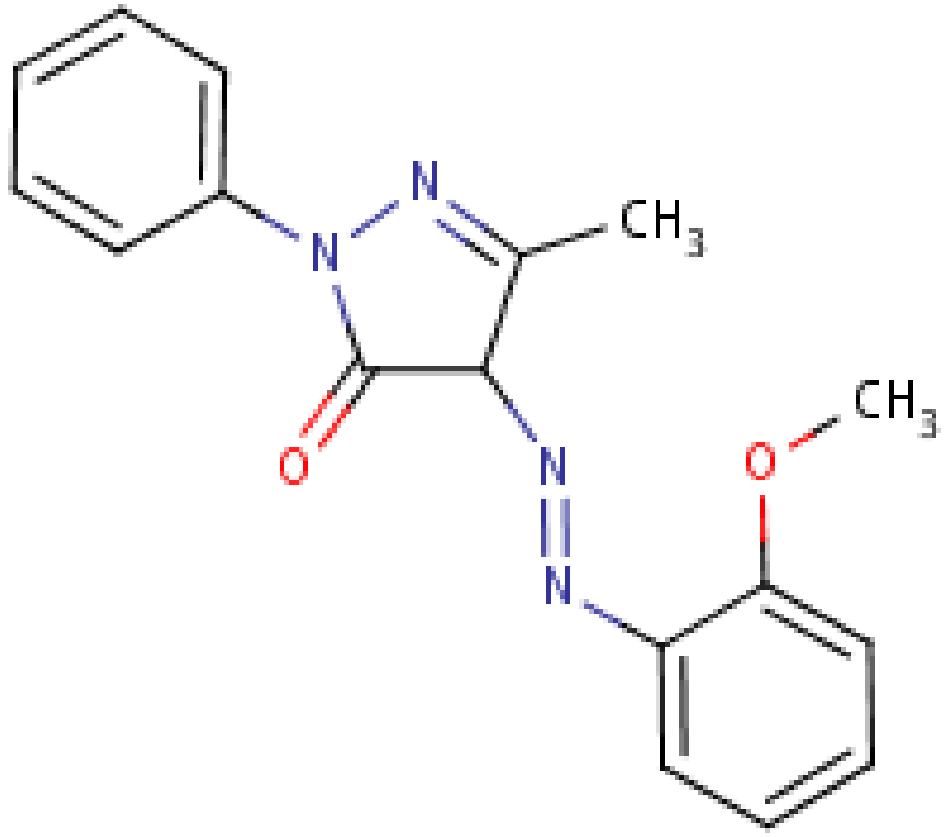
Molecular Formula	C17H16N4O2
Molecular Weight	308.34

Chemical Name in the Inventory and Synonyms	**1-Naphthalenol, 4-[(2-methylphenyl)azo]-** C. I. Solvent Red 2 1-naphthalenol, 4-(2-(2-methylphenyl)diazenyl)- 4-((2-methylphenyl)azo)naphthol
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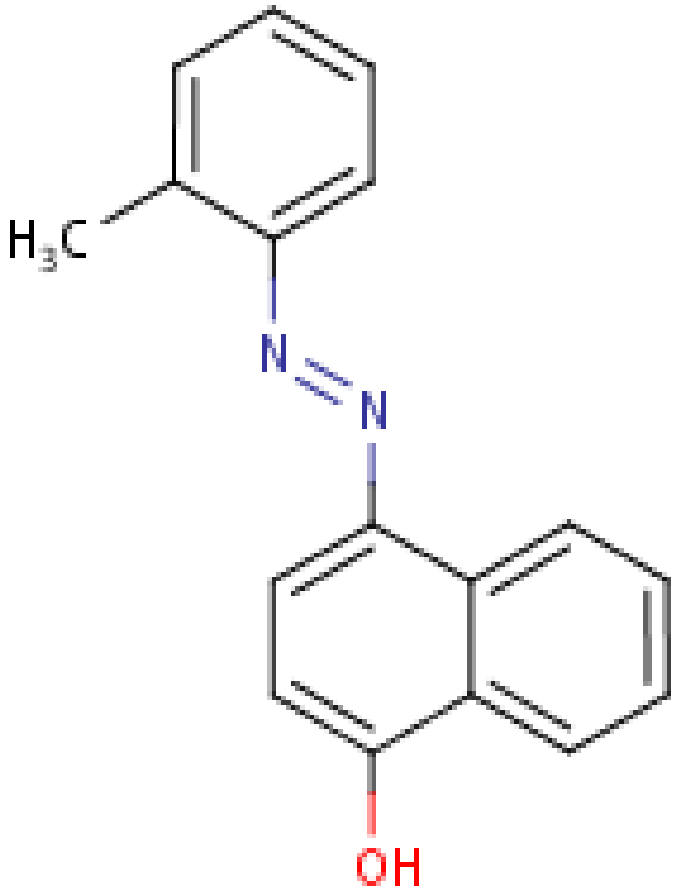
Structural Formula	

	
Molecular Formula	C17H14N2O
Molecular Weight	262.31

Chemical Name in the Inventory and Synonyms	**1,3-Naphthalenedisulfonic acid, 7-hydroxy-8-[[4-(phenylazo)phenyl]azo]-, disodium salt** C.I. Acid Red 73 7-hydroxy-8-((4-(phenylazo)phenyl)azo)-1,3-naphthalenedisulfonic acid, disodium salt Brilliant crocein Acid Fast Red RN CI 27290
CAS Number	5413-75-2
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	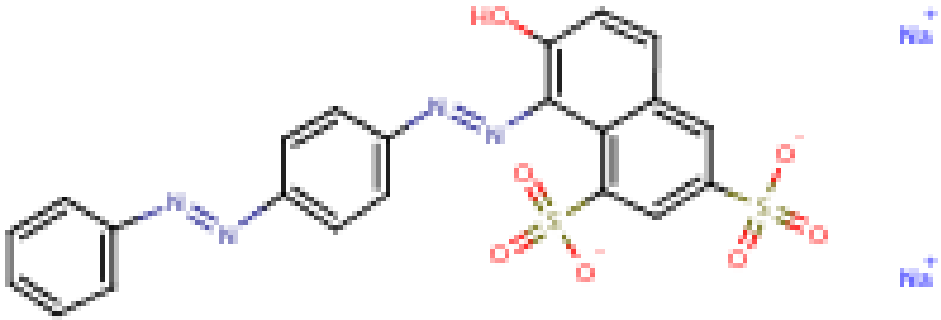
Molecular Formula	C22H16N4O7S2.2Na
Molecular Weight	556.49

Chemical Name in the Inventory and Synonyms	**1,3-Benzenediamine, 4,4'-[(4-methyl-1,3-phenylene)bis(azo)]bis[6-methyl-, dihydrochloride** C. I. Basic Brown 4 Astra Vesuvine B 2,4-bis(2,4-diamino-5-methyl-1-benzenazo)toluene Bismarck Brown R
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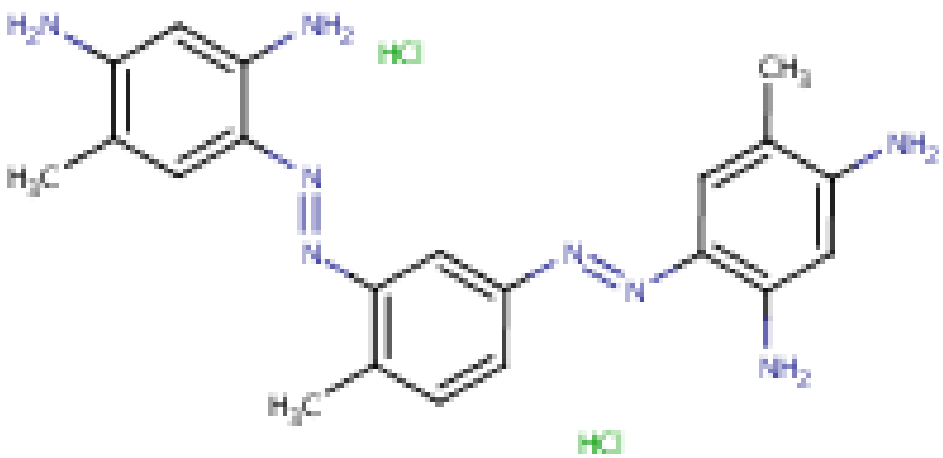
Structural Formula	

	
Molecular Formula	C21H24N8.2ClH
Molecular Weight	461.40

Chemical Name in the Inventory and Synonyms	**C.I. Acid Black 132** Irgalan Black Navilan Black RBL Pacid Black RBL
CAS Number	12219-02-2
Structural Formula	**No Structural Diagram Available**

Molecular Formula	Unspecified
Molecular Weight	

Chemical Name in the Inventory and Synonyms	**1-Naphthalenesulfonic acid, 4-hydroxy-3-[(2-methoxyphenyl)azo]-, monosodium salt** C.I. Acid Red 4 sodium 2-(4-(3-methyl-4-(phenylsulphonyloxy)phenylazo)phenylimino)-5-nitrobenzenesulphonate Acid Eosine G Atul Acid Fast Pink B Metamine Fast Acid Red N
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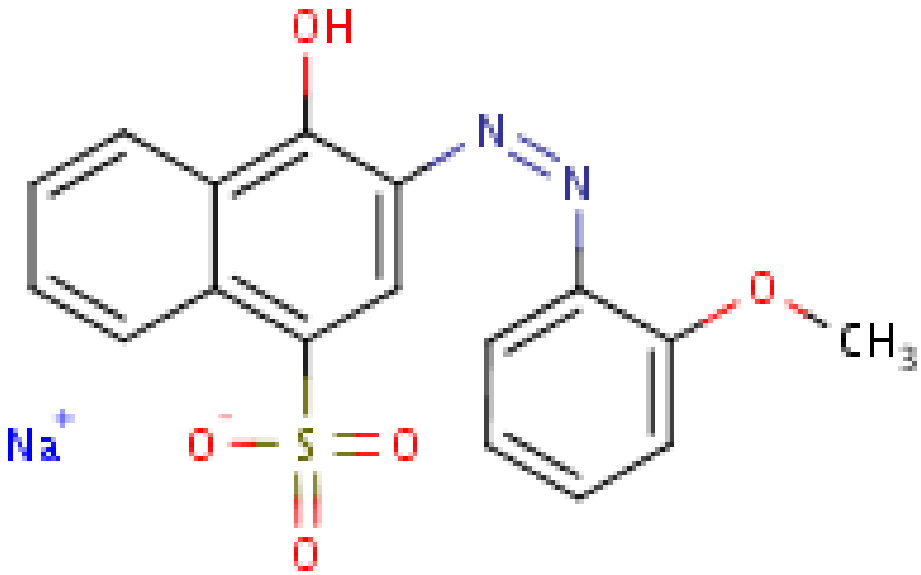
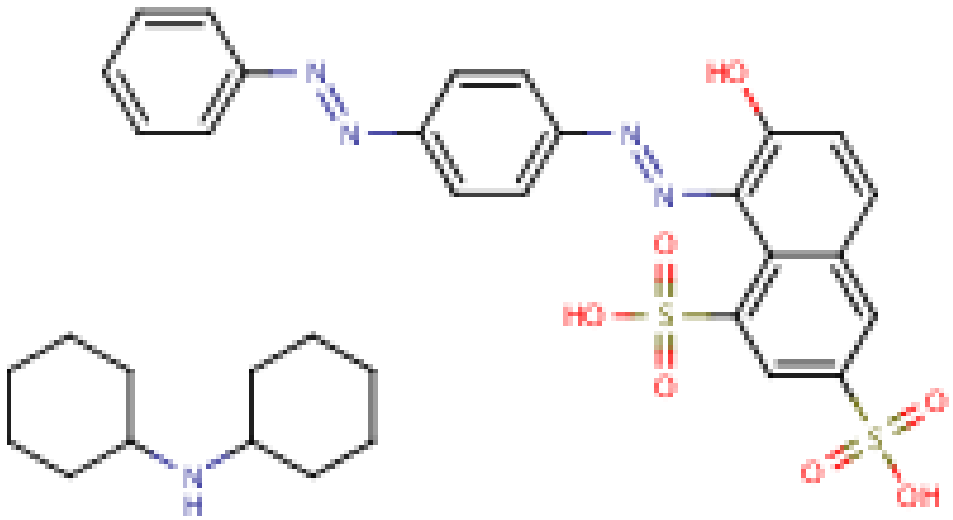
Structural Formula	
Molecular Formula	C17H14N2O5S.Na
Molecular Weight	380.36

Chemical Name in the Inventory and Synonyms	**1,3-Naphthalenedisulfonic acid, 7-hydroxy-8-[[4-(phenylazo)phenyl]azo]-, compound with N-**

	cyclohexylcyclohexanamine 7-Hydroxy-8-((4-(phenylazo)phenyl)azo)naphthalene-1,3-disulphonic acid, compound with dicyclohexylamine C.I. Solvent Red 30
CAS Number	6226-87-5
Structural Formula	
Molecular Formula	C22H16N4O7S2.xC12H23N
Molecular Weight	693.84

Chemical Name in the Inventory and Synonyms	**Phenol, 4-[[4-(phenylazo)phenyl]azo]-** C.I. Disperse Yellow 23 Acetoquinone Light Yellow 3RLLZ p-((p-(Phenylazo)phenyl)azo)phenol Phenol, 4-(2-(4-(2-phenyldiazenyl)phenyl)diazenyl)- Calcophen Yellow 4RL
CAS Number	6250-23-3
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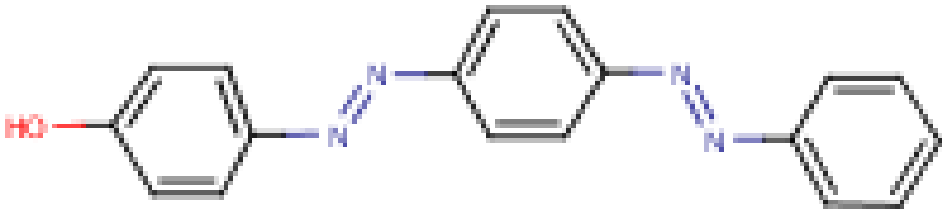
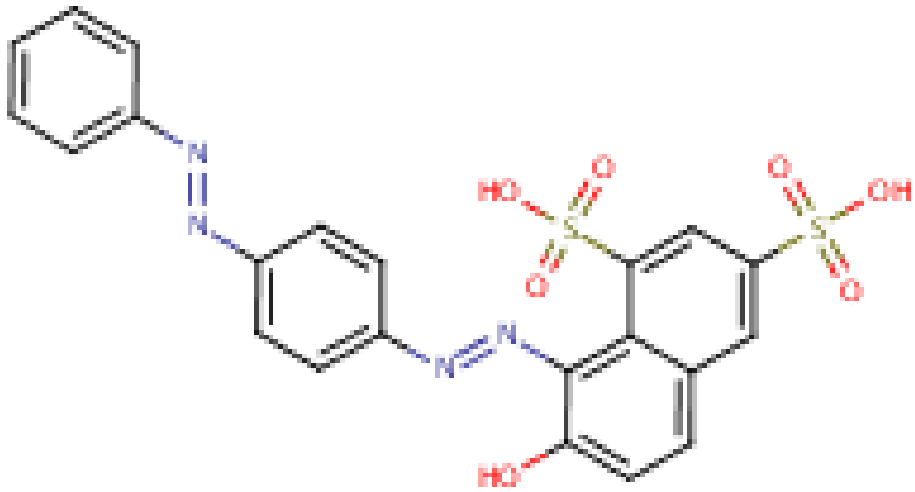
	
Molecular Formula	C18H14N4O
Molecular Weight	302.33

Chemical Name in the Inventory and Synonyms	**1,3-Naphthalenedisulfonic acid, 7-hydroxy-8-[[4-(phenylazo)phenyl]azo]-** 7-hydroxy-8-((4-(phenylazo)phenyl)azo)naphthalene-1,3-disulphonic acid
CAS Number	25317-39-9
Structural Formula	

	
Molecular Formula	C22H16N4O7S2
Molecular Weight	512.52

Chemical Name in the Inventory and Synonyms	**Phenol, 2-methyl-4-[[4-(phenylazo)phenyl]azo]-** C.I. Disperse Yellow 7 Disperse Fast Yellow 4K 4-((4-phenylazo)phenylazo)-2-methylphenol 4-((p-(phenylazo)phenyl)azo)-o-cresol benzene-1-azobenzene-4-azo-o-cresol
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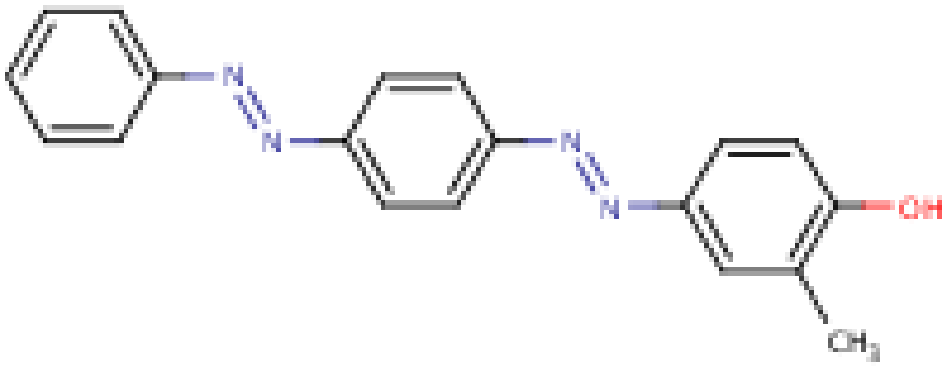
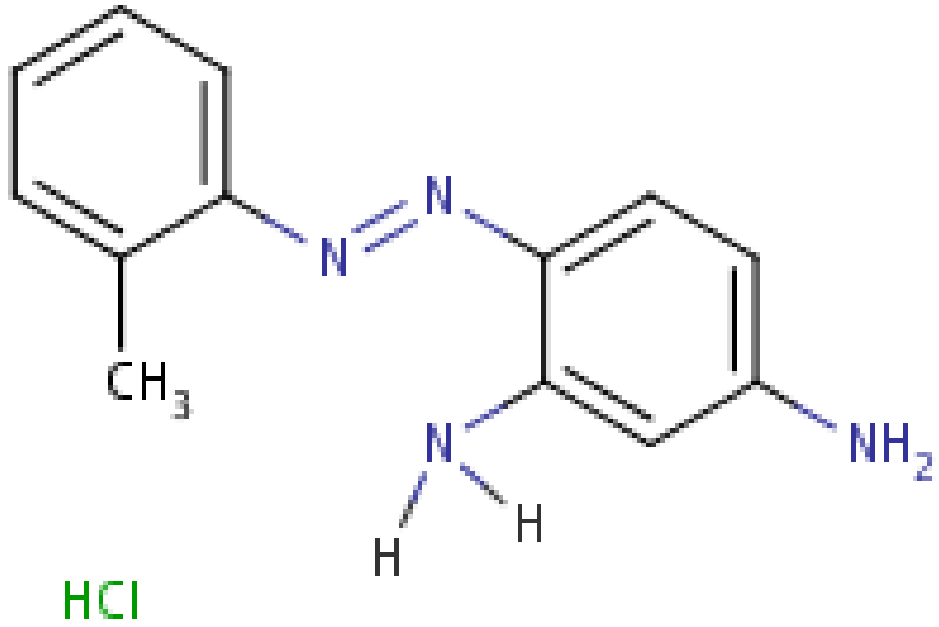
Structural Formula	

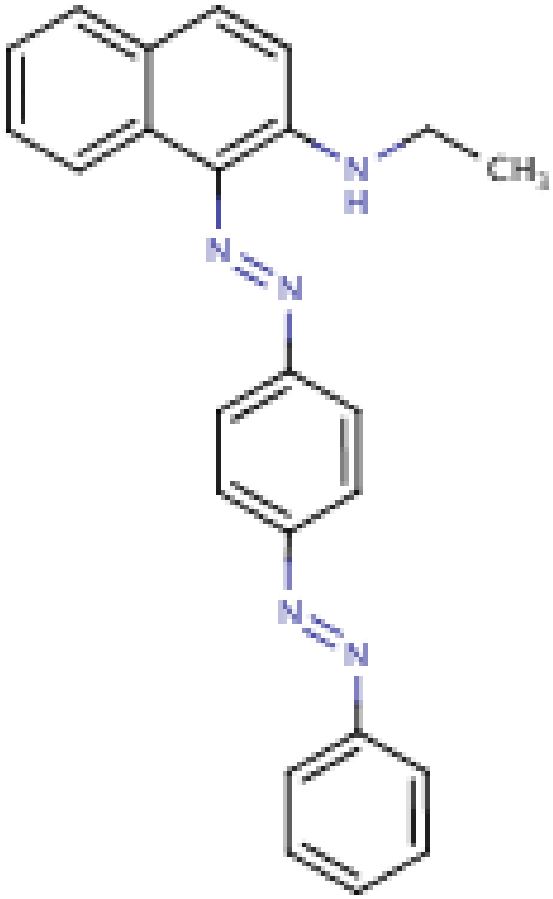
	
Molecular Formula	C19H16N4O
Molecular Weight	316.36

Chemical Name in the Inventory and Synonyms	**1,3-Benzenediamine, 4-[(2-methylphenyl)azo]-, monohydrochloride** C.I. 11280 4-(o-tolylazo)benzene-1,3-diamine monohydrochloride 4-((2-methylphenyl)azo)-1,3-benzenediamine, monohydrochloride
CAS Number	6364-35-8
Structural Formula	



Molecular Formula	C13H14N4.ClH
Molecular Weight	262.74

Chemical Name in the Inventory and Synonyms	**2-Naphthalenamine, N-ethyl-1-[[4-(phenylazo)phenyl]azo]-** C.I. Solvent Red 19 Fat Red 7B (phenylazo-4-phenylazo)-1-ethylamino-2-naphthalene Sudan Red 7B N-ethyl-1-(4-(phenylazo)phenylazo)-2-naphthylamine
CAS Number	6368-72-5
Structural Formula	

	
Molecular Formula	C24H21N5
Molecular Weight	379.47

Chemical Name in the Inventory and Synonyms	**1,3-Benzenediamine, 4-methyl-6-[(2-methylphenyl)azo]-, monohydrochloride** 4-((2-methylphenyl)azo)-6-methyl-1,3-benzenediamine, monohydrochloride 5-(o-tolylazo)toluene-2,4-diamine monohydrochloride
CAS Number	6416-59-7
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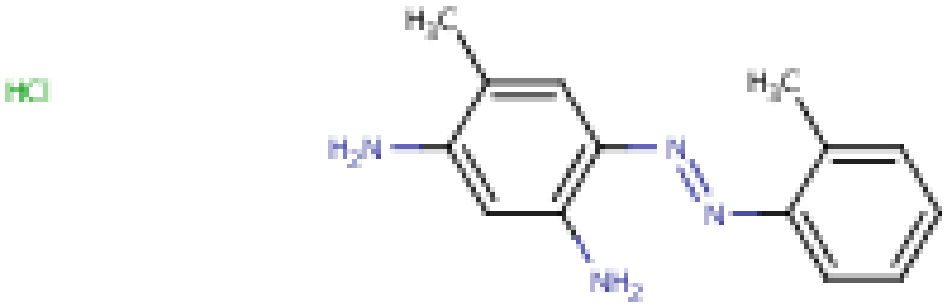
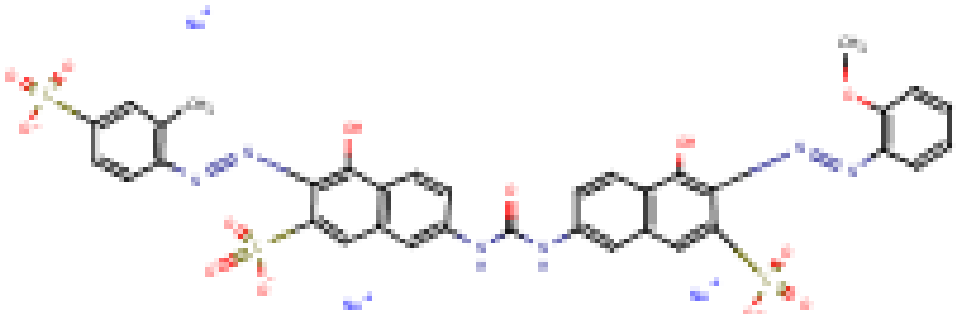
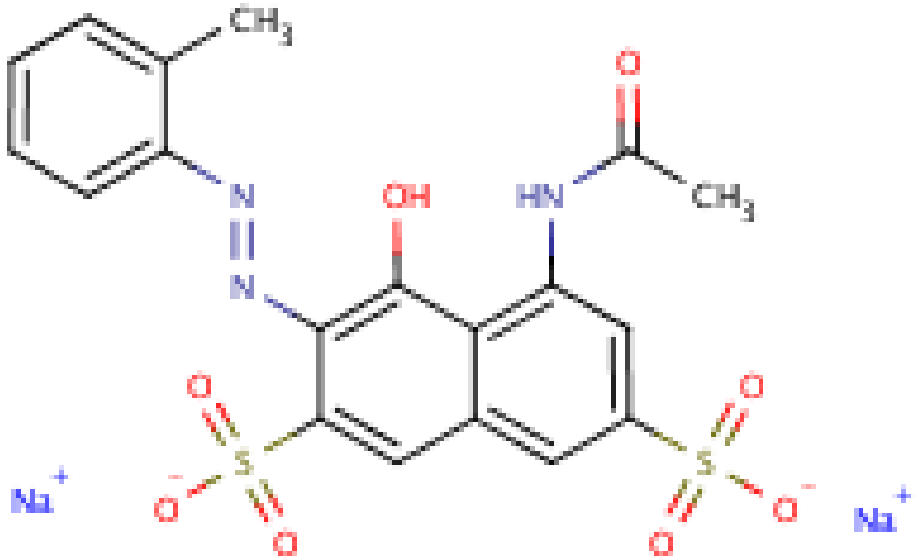
	
Molecular Formula	C14H16N4.ClH
Molecular Weight	276.77

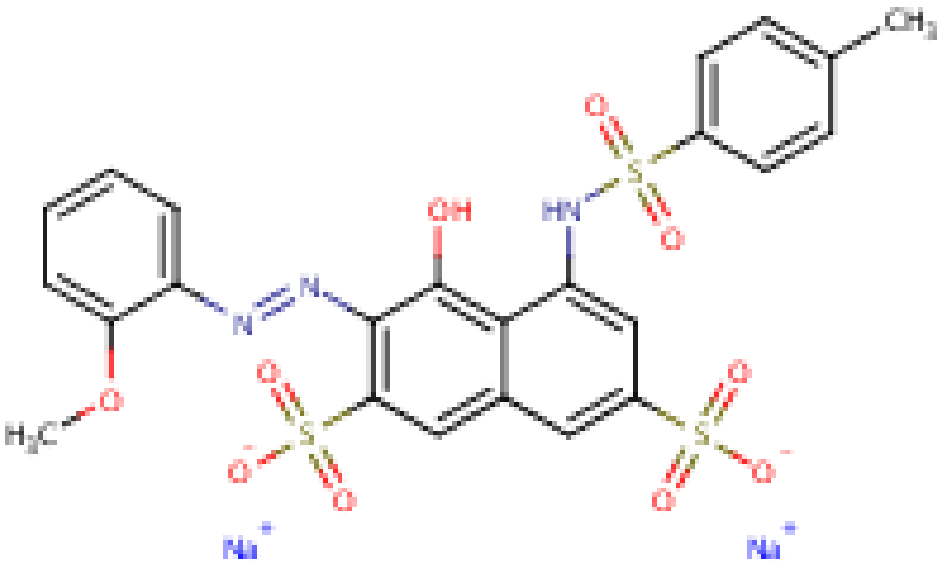
Chemical Name in the Inventory and Synonyms	**2-Naphthalenesulfonic acid, 4-hydroxy-7-[[[[5-hydroxy-6-[(2-methoxyphenyl)azo]-7-sulfo-2-naphthalenyl]amino]carbonyl]amino]-3-[(2-methyl-4-sulfophenyl)azo]-, trisodium salt** C.I. Direct Red 24 trisodium 4-hydroxy-7-((((5-hydroxy-6-((2-methoxyphenyl)azo)-7-sulphonato-2-naphthyl)amino)carbonyl)amino)-3-((2-methyl-4-sulphonatophenyl)azo)naphthalene-2-sulphonate Amanil Fast Scarlet 4BA Calcomine Scarlet 4BNC Direct Fast Scarlet 4BA
CAS Number	6420-44-6
Structural Formula	

	
Molecular Formula	C35H28N6O13S3.3Na
Molecular Weight	902.78

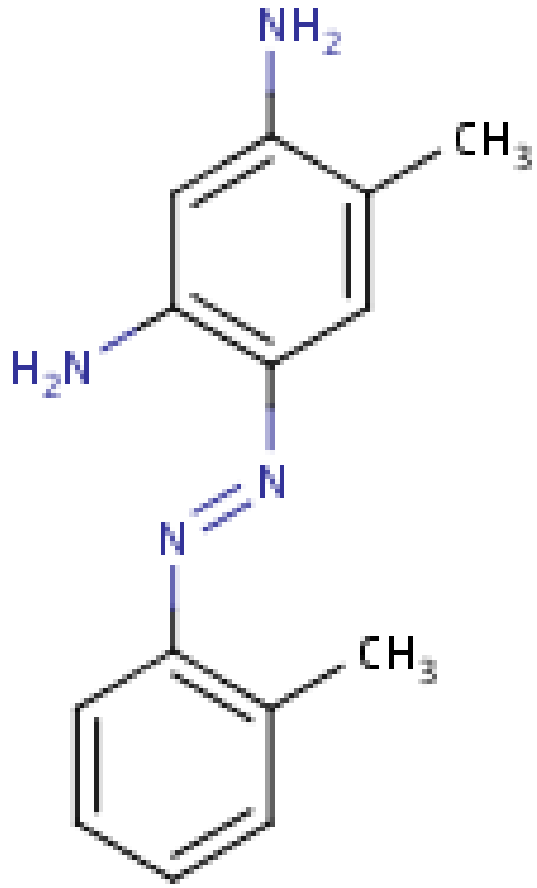
Chemical Name in the Inventory and Synonyms	**2,7-Naphthalenedisulfonic acid, 5-(acetylamino)-4-hydroxy-3-[(2-methylphenyl)azo]-, disodium salt** C.I. Acid Red 35 5-(acetylamino)-4-hydroxy-3-((2-methylphenyl)azo)-2,7-naphthalene-disulfonic acid, disodium salt disodium 5-(acetylamino)-4-hydroxy-3-((o-tolyl)azo)naphthalene-2,7-disulphonate CI 18065
CAS Number	6441-93-6
Structural Formula	

	
Molecular Formula	C19H17N3O8S2.2Na
Molecular Weight	523.45

Chemical Name in the Inventory and Synonyms	**2,7-Naphthalenedisulfonic acid, 4-hydroxy-3-[(2-methoxyphenyl)azo]-5-[[(4-methylphenyl)sulfonyl]amino]-, disodium salt** Disodium 4-hydroxy-3-((2-methoxyphenyl)azo)-5-(((p-tolyl)sulphonyl)amino)naphthalene-2,7-disulphonate C.I. Acid Red 264
CAS Number	6505-96-0
Structural Formula	

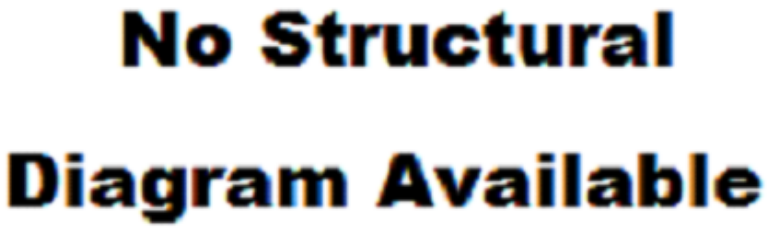
	
Molecular Formula	C24H21N3O10S3.2Na
Molecular Weight	651.60

Chemical Name in the Inventory and Synonyms	**1,3-Benzenediamine, 4-methyl-6-[(2-methylphenyl)azo]-** toluene-2,4-diamine, 5-(o-tolylazo)- (8CI) 2'-methyl-2,4-diamino-5-methylazobenzene 5-(o-tolylazo)toluene-2,4-diamine m-phenylenediamine, 4-methyl-6-((2-methylphenyl)azo)-
CAS Number	7467-29-0
Structural Formula	

	
Molecular Formula	C14H16N4
Molecular Weight	240.31

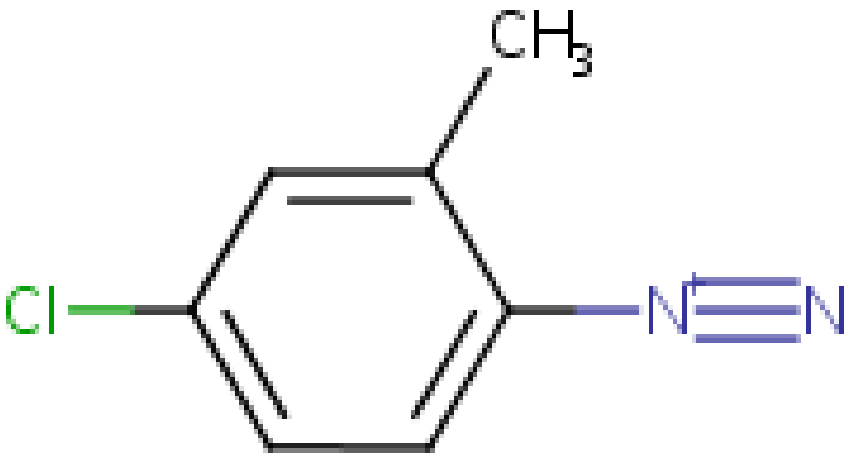
Chemical Name in the Inventory and Synonyms	**C.I. Acid Red 158** C.I. 20530 Diacid Fast Red 3BL Suminol Milling Red G Telon Fast Red ER
CAS Number	8004-55-5
Structural Formula	**No Structural Diagram Available**

Molecular Formula	Unspecified
Molecular Weight	

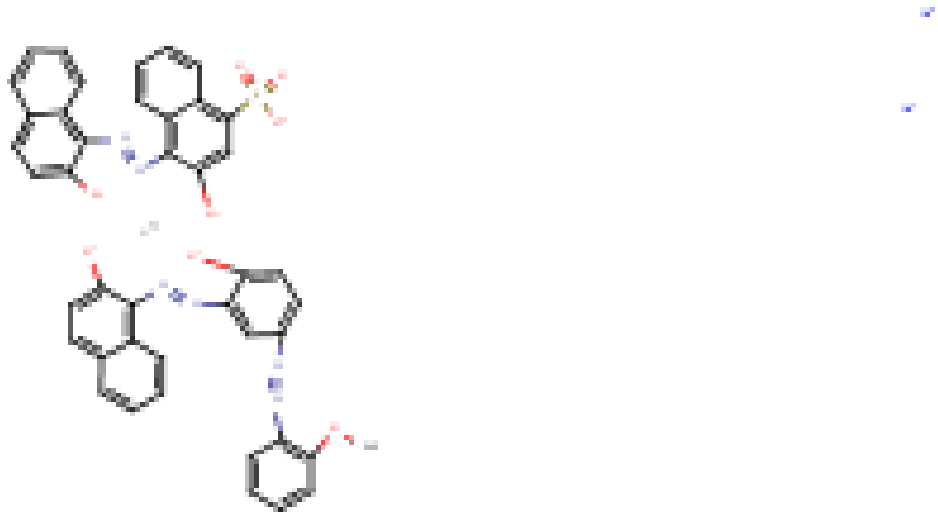
Chemical Name in the Inventory and Synonyms	**C.I. Basic Brown 4** Basic Brown 4 Bismark Brown R C.I. 21010
CAS Number	8005-78-5
Structural Formula	
Molecular Formula	Unspecified
Molecular Weight	

Chemical Name in the Inventory and Synonyms	**C.I. Basic Red 42** Lyrcamine Light Red BJ
CAS Number	12221-66-8
Structural Formula	

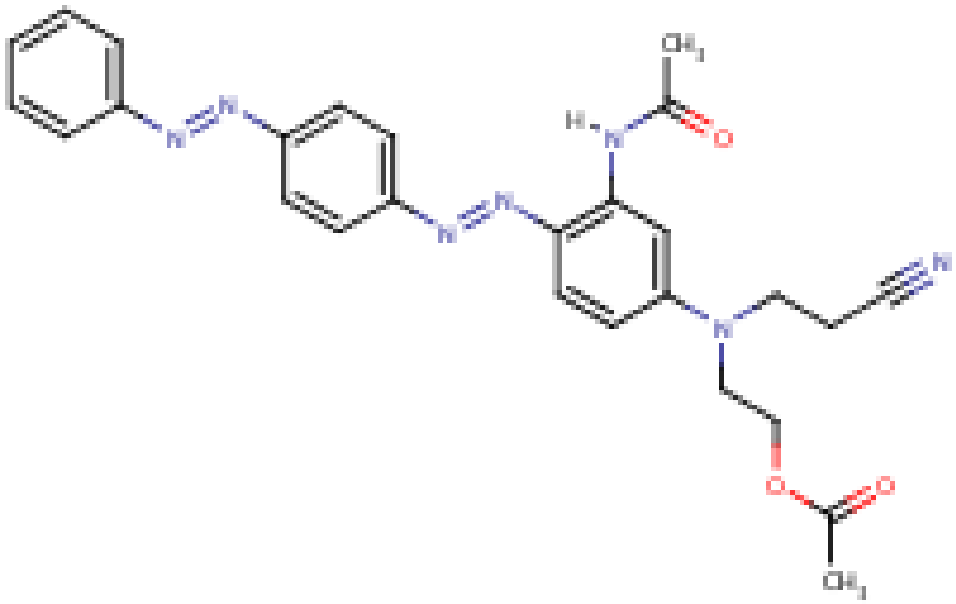
	No Structural Diagram Available
Molecular Formula	Unspecified
Molecular Weight	

Chemical Name in the Inventory and Synonyms	**Benzenediazonium, 4-chloro-2-methyl-** C.I. Azoic Diazo Component 11 Fast red TA 4-chloro-2-methylbenzenediazonium benzenediazonium, 4-chloro-2-methyl
CAS Number	27165-08-8
Structural Formula	

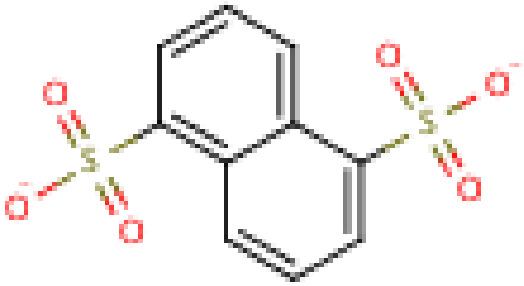
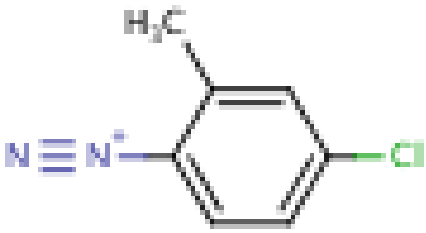
Molecular Formula	C7H6ClN2
Molecular Weight	153.591

Chemical Name in the Inventory and Synonyms	**Chromate(2-), [3-hydroxy-4-[(2-hydroxy-1-naphthalenyl)azo]-1-naphthalenesulfonato(3-)][1-[[2-hydroxy-5-[(2-methoxyphenyl)azo]phenyl]azo]-2-naphthalenolato(2-)]-, disodium** disodium (3-hydroxy-4-((2-hydroxy-1-naphthyl)azo)naphthalene-1-sulphonato(3-))(1-((2-hydroxy-5-((2-methoxyphenyl)azo)phenyl)azo)-2-naphtholato(2-))chromate(2-) C.I. Acid Black 132
CAS Number	27425-58-7
Structural Formula	
Molecular Formula	C43H27CrN6O8S.2Na
Molecular Weight	885.76

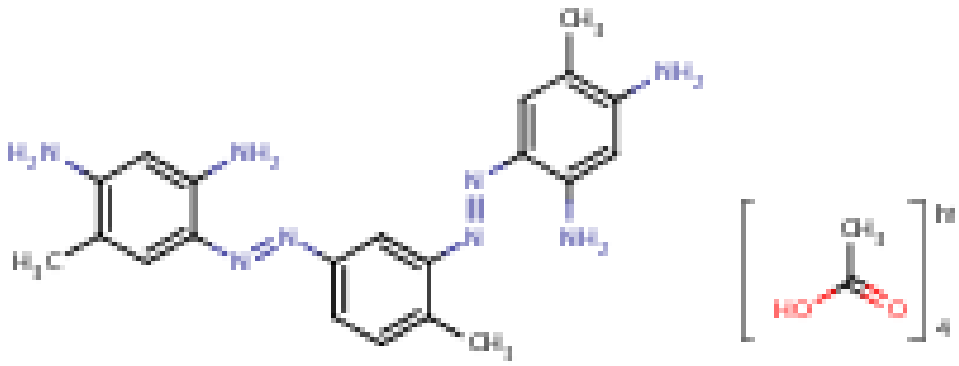
Chemical Name in the	**Acetamide, N-[5-[[2-(acetyloxy)ethyl](2-cyanoethyl)amino]-2-[[4-**

Inventory and Synonyms	**(phenylazo)phenyl]azo]phenyl]-** acetamide, N-(5-((2-(acetyloxy)ethyl)(2-cyanoethyl)amino)-2-(2-(4-(2-phenyldiazenyl)phenyl)diazenyl)phenyl)-
CAS Number	39230-20-1
Structural Formula	
Molecular Formula	C27H27N7O3
Molecular Weight	497.56

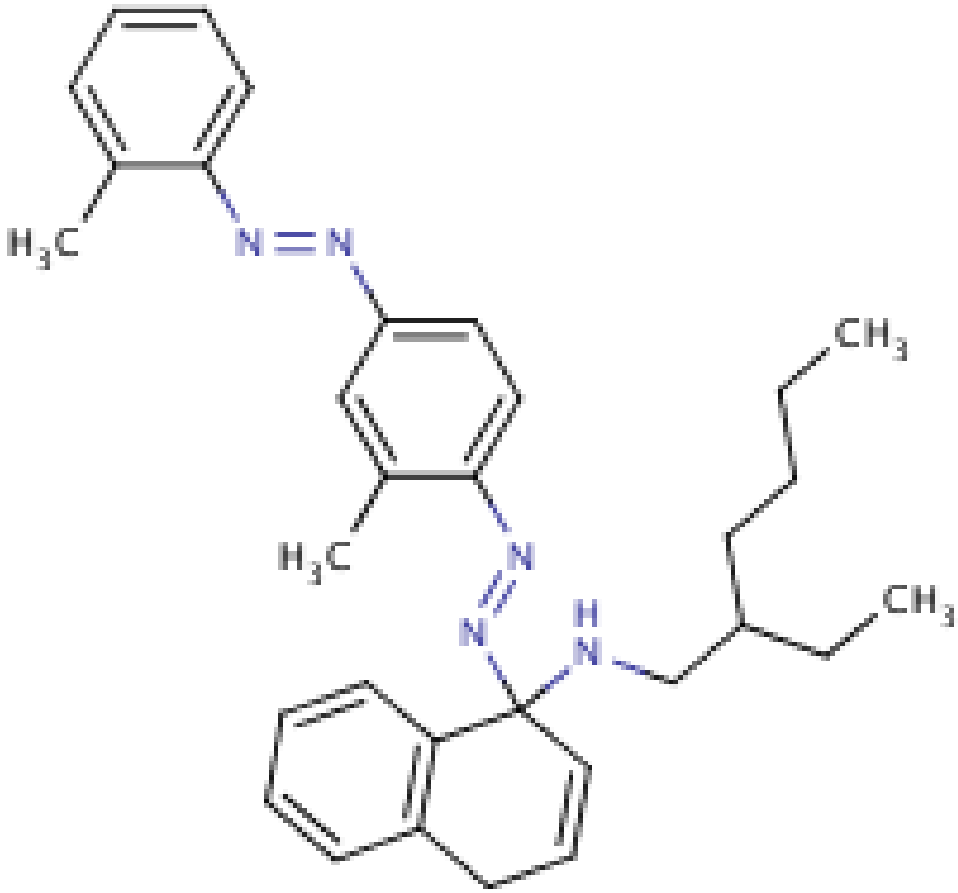
Chemical Name in the Inventory and Synonyms	**Benzenediazonium, 4-chloro-2-methyl-, 1,5-naphthalenedisulfonate (1:1)** benzenediazonium, 4-chloro-2-methyl-,1,5-naphthalenedisulfonic acid (1:1) 4-chloro-2-methylbenzenediazonium 1,5-naphthalenedisulphonate Fast Red TR Salt 1,5-naphthalenedisulfonate salt
CAS Number	51503-28-7
Structural Formula	

	 
Molecular Formula	C10H7O6S2.C7H6ClN2
Molecular Weight	439.88

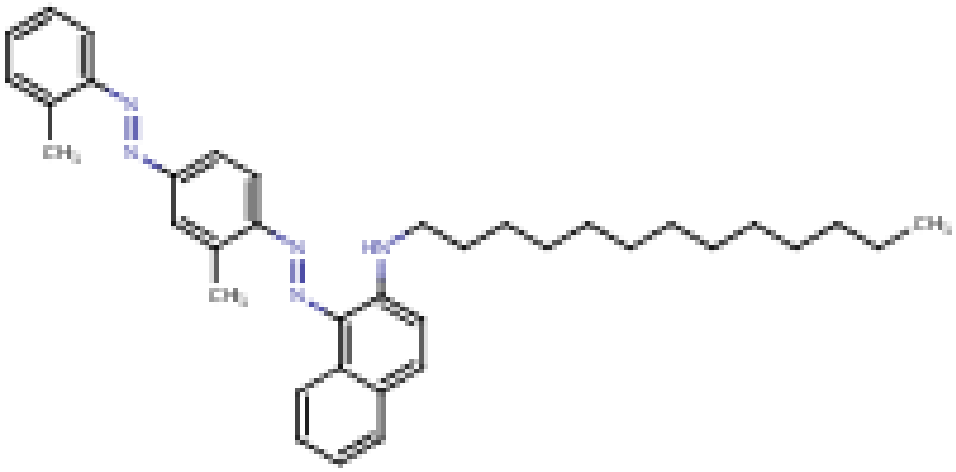
Chemical Name in the Inventory and Synonyms	**1,3-Benzenediamine, 4,4'-[(4-methyl-1,3-phenylene)bis(azo)]bis[6-methyl-, acetate** 4,4'-((4-methyl-1,3-phenylene)bis(azo))bis(6-methylbenzene-1,3-diammonium) acetate (1:4)
CAS Number	55772-47-9
Structural Formula	

	
Molecular Formula	C21H24N8.xC2H4O2
Molecular Weight	628.68

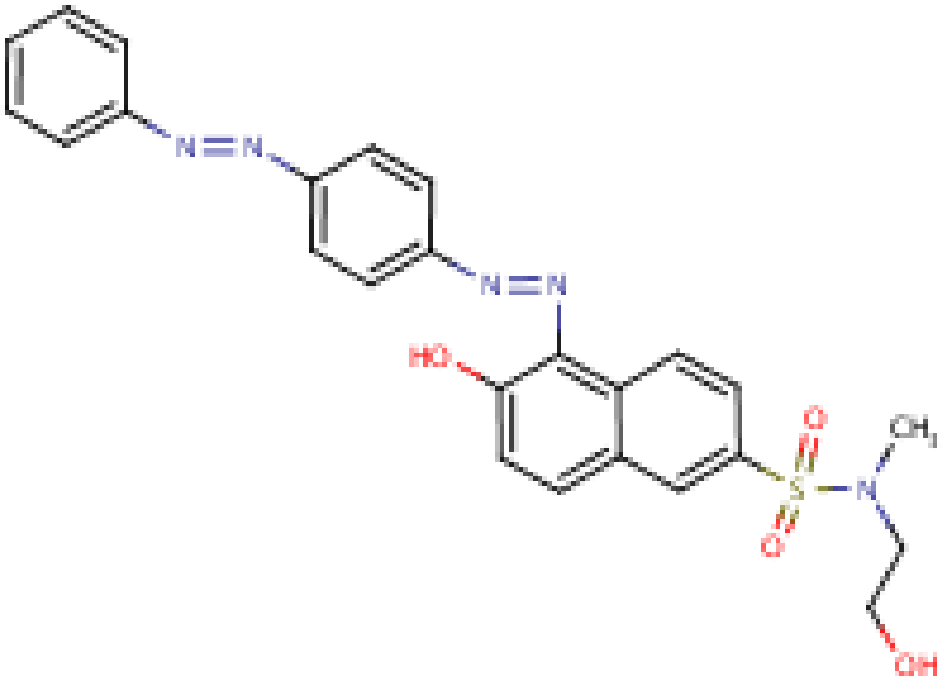
Chemical Name in the Inventory and Synonyms	**2-Naphthalenamine, N-(2-ethylhexyl)-1-[[2-methyl-4-[(2-methylphenyl)azo]phenyl]azo]-** N-(2-ethylhexyl)-1-((2-methyl-4-((2-methylphenyl)azo)phenyl)azo)naphthalen-1-amine
CAS Number	56358-09-9
Structural Formula	

	
Molecular Formula	C32H37N5
Molecular Weight	493.70

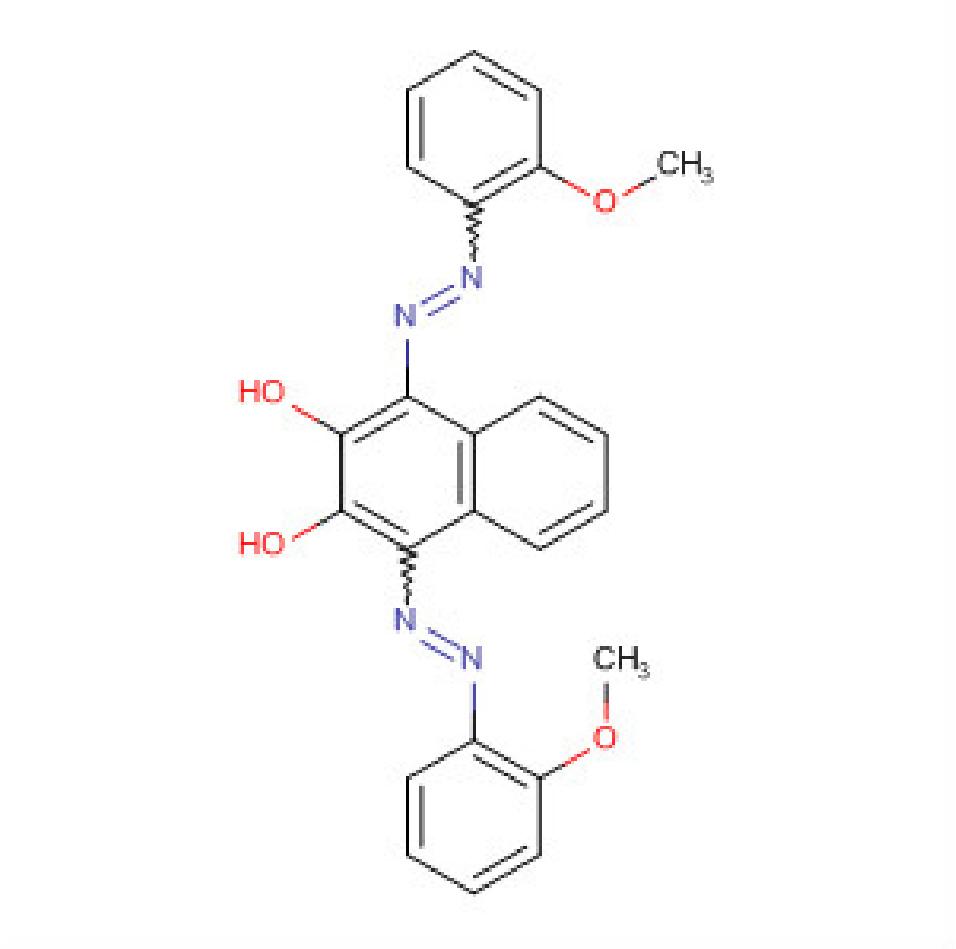
Chemical Name in the Inventory and Synonyms	**2-Naphthalenamine, 1-[[2-methyl-4-[(2-methylphenyl)azo]phenyl]azo]-N-tridecyl-** 1-((2-methyl-4-((2-methylphenyl)azo)phenyl)azo)-N-tridecylnaphthalen-2-amine
CAS Number	57712-94-4
Structural Formula	

	
Molecular Formula	C37H47N5
Molecular Weight	561.81

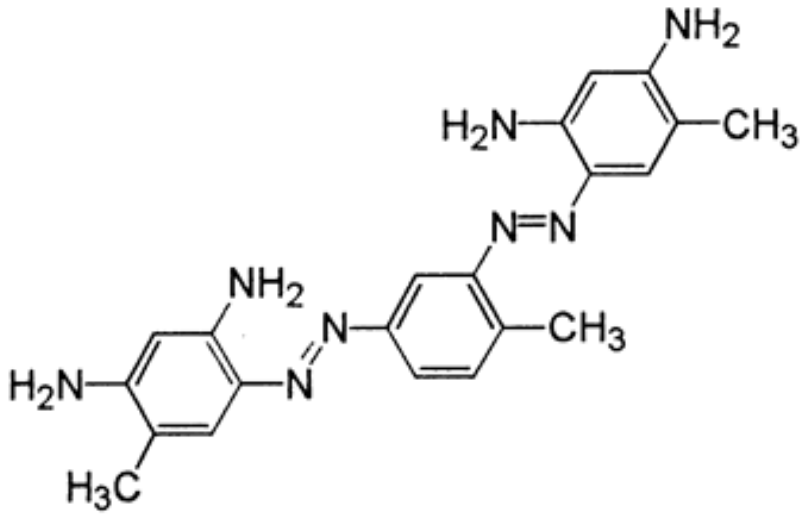
Chemical Name in the Inventory and Synonyms	**2-Naphthalenesulfonamide, 6-hydroxy-N-(2-hydroxyethyl)-N-methyl-5-[[4-(phenylazo)phenyl]azo]-** 1-((4-(phenylazo)phenyl)azo)-6-((2-hydroxyethyl)methylsulfamoyl)-2-naphthol 2-naphthalenesulfonamide, 6-hydroxy-N-(2-hydroxyethyl)-N-methyl-5-(2-(4-(2-phenyldiazenyl)phenyl)diazenyl)- 6-hydroxy-N-(2-hydroxyethyl)-N-methyl-5-((4-(phenylazo)phenyl)azo)naphthalene-2-sulphonamide
CAS Number	58104-55-5
Structural Formula	

	
Molecular Formula	C25H23N5O4S
Molecular Weight	489.55

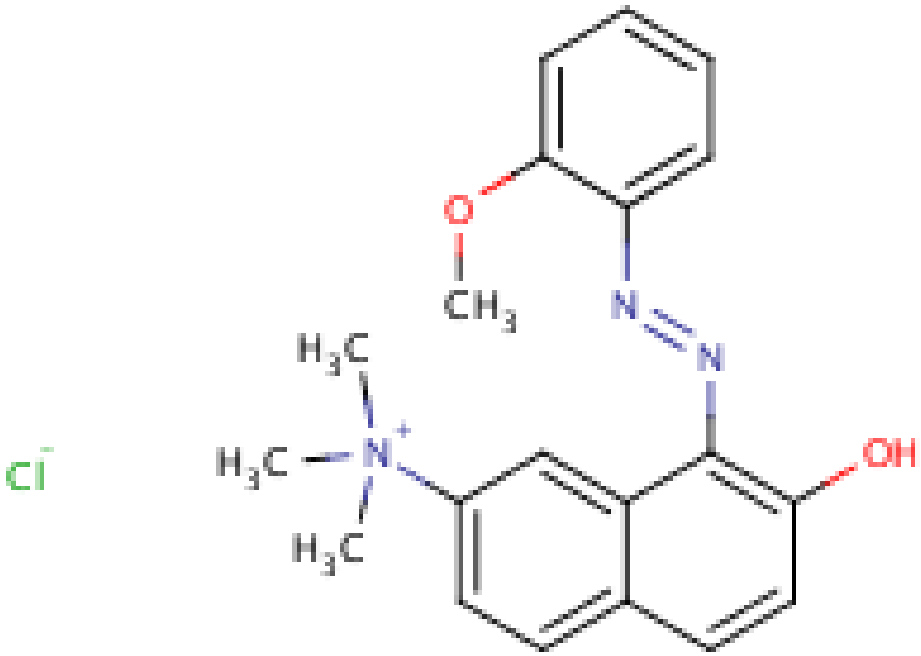
Chemical Name in the Inventory and Synonyms	**2,3-Naphthalenediol, 1,4-bis((2-methoxyphenyl)azo)-** 1,4-bis[(2-methoxyphenyl)hydrazinylidene]naphthalene-2,3-dione
CAS Number	61600-41-7
Structural Formula	

	
Molecular Formula	
Molecular Weight	428.44

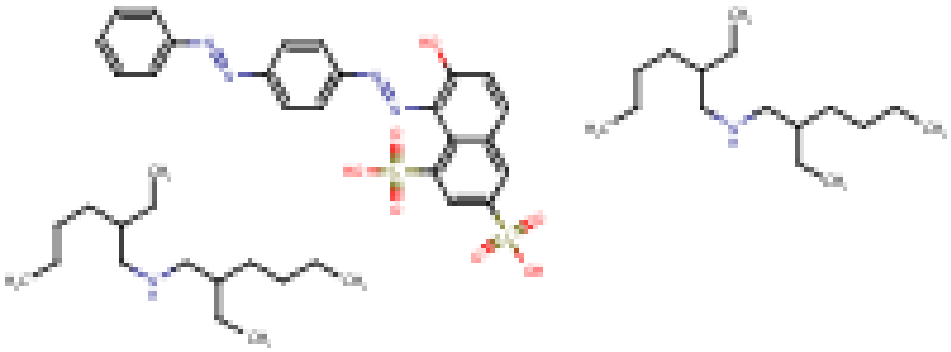
Chemical Name in the Inventory and Synonyms	**Tannins, compounds with 4,4'-[(4-methyl-1,3-phenylene)bis(azo)]bis[6-methyl-1,3-benzenediamine]** C.I. Basic Brown 4, tannic acid salt
CAS Number	68425-18-3
Structural Formula	

	
Molecular Formula	C21H24N8.
Molecular Weight	388.47

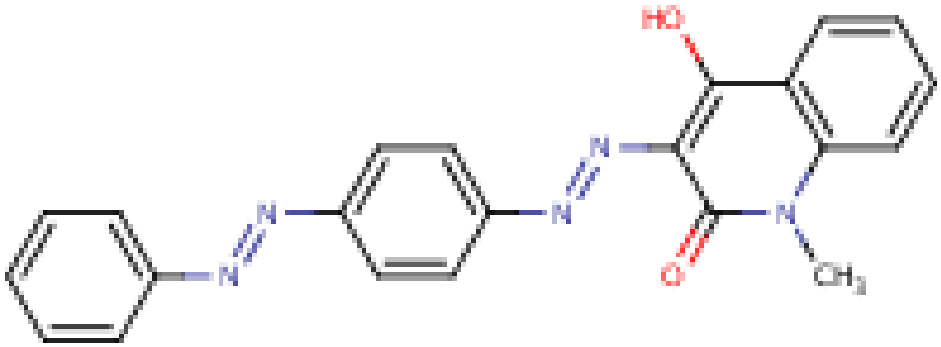
Chemical Name in the Inventory and Synonyms	**2-Naphthalenaminium, 7-hydroxy-8-[(2-methoxyphenyl)azo]-N,N,N-trimethyl-, chloride** 8-(2-methoxyphenylazo)-7-hydroxy-2-naphthyltrimethylammonium chloride C.I. Basic Red 76 7-hydroxy-8-((2-methoxyphenyl)azo)-N,N,N-trimethyl-2-naphthalenam- inium chloride Arianor Madder Red C.I. 12245
CAS Number	68391-30-0
Structural Formula	

	
Molecular Formula	C20H22N3O2.Cl
Molecular Weight	371.87

Chemical Name in the Inventory and Synonyms	**1,3-Naphthalenedisulfonic acid, 7-hydroxy-8-[[4-(phenylazo)phenyl]azo]-, compound with 2-ethyl-N-(2-ethylhexyl)-1-hexanamine (1:2)** 1-((4-(phenylazo)phenyl)azo)-2-hydroxy-6,8-naphthalenedisulfonic acid, di(2-ethylhexyl)ammonium salt (1:2) 7-hydroxy-8-((4-(phenylazo)phenyl)azo)naphthalene-1,3-disulphonic acid, compound with 2-ethyl-N-(2-ethylhexyl)hexylamine (1:2) C.I. Solvent Red 68
CAS Number	68555-82-8
Structural Formula	

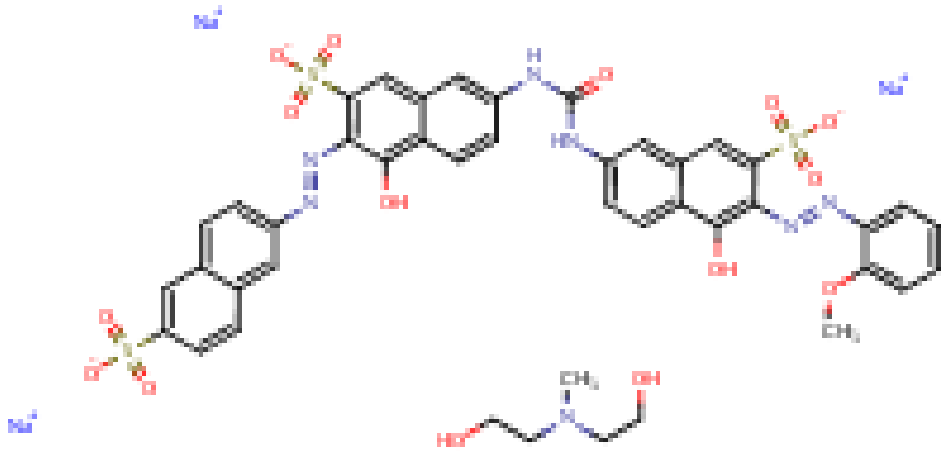
	
Molecular Formula	C22H16N4O7S2.2C16H35N
Molecular Weight	995.44

Chemical Name in the Inventory and Synonyms	**2(1H)-Quinolinone, 4-hydroxy-1-methyl-3-[[4-(phenylazo)phenyl]azo]-** carbostyril, 4-hydroxy-1-methyl-3-[[p-(phenylazo)phenyl 2(1H)-quinolinone, 4-hydroxy-1-methyl-3-(2-(4-(2-phenyldiazenyl)phenyl)diazenyl)- 4-hydroxy-1-methyl-3-((4-(phenylazo)phenyl)azo)-2-quinolone
CAS Number	73287-67-9
Structural Formula	

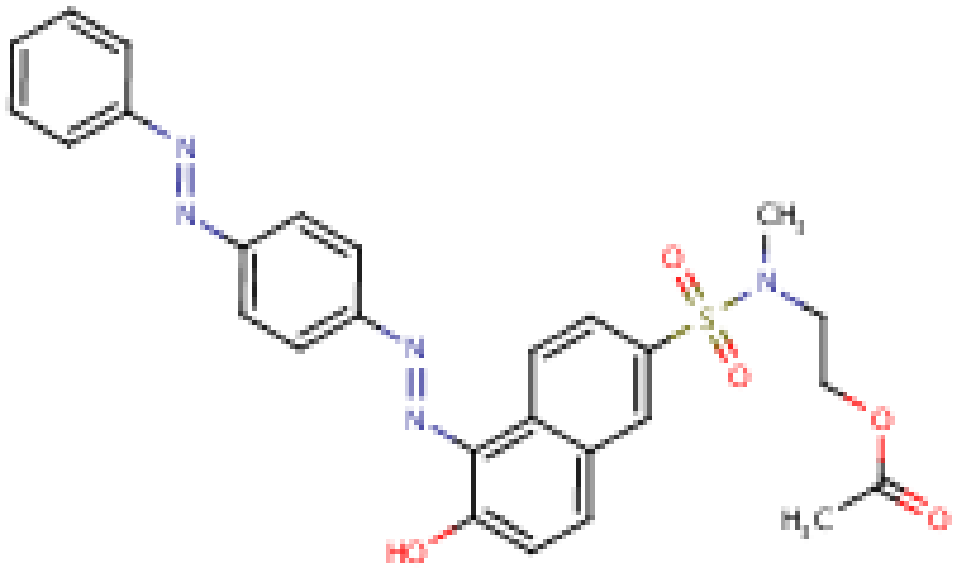
	
Molecular Formula	C22H17N5O2
Molecular Weight	383.41

Chemical Name in the Inventory and Synonyms	**1,3-Benzenediamine, 2(or 4)-methyl-, coupled with diazotized 2(or 4)-methyl-1,3-benzenediamine, hydrochlorides**
CAS Number	83968-21-2
Structural Formula	**No Structural Diagram Available**

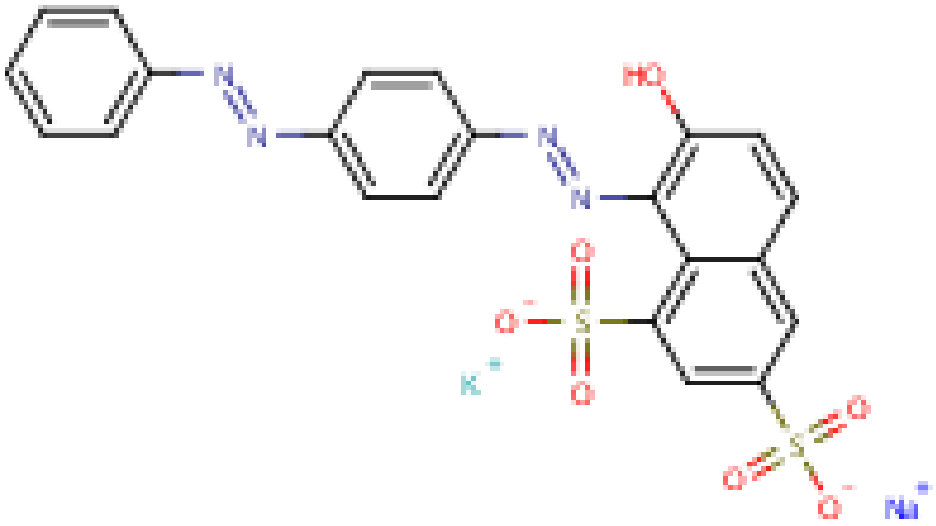
Molecular Formula	C7H10N2.ClH
Molecular Weight	

Chemical Name in the Inventory and Synonyms	**2-Naphthalenesulfonic acid, 4-hydroxy-7-[[[[5-hydroxy-6-[(2-methoxyphenyl)azo]-7-sulfo-2-naphthalenyl]amino]carbonyl]amino]-3-[(6-sulfo-2-naphthalenyl)azo]-, sodium salt, compound with 2,2'-(methylimino)bis[ethanol]** EINECS 280-775-1
CAS Number	83763-86-4
Structural Formula	
Molecular Formula	C38H28N6O13S3.xC5H13NO2.xNa
Molecular Weight	1057.98

Chemical Name in the	**2-Naphthalenesulfonamide, N-[2-(acetyloxy)ethyl]-6-hydroxy-N-methyl-**

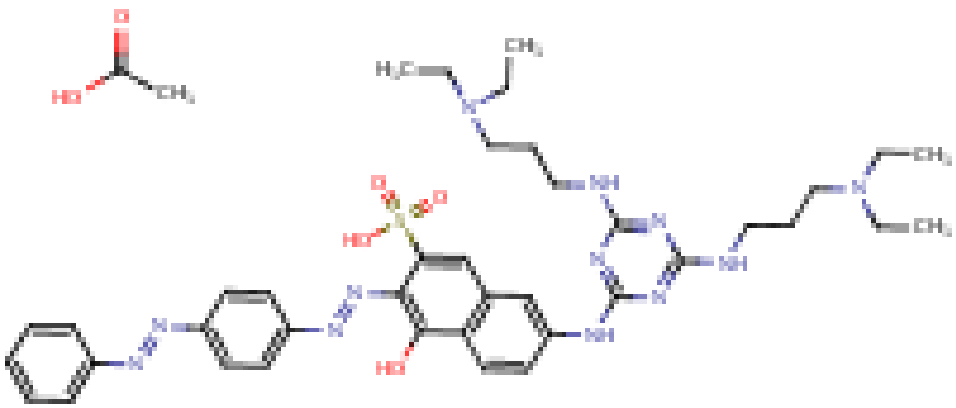
Inventory and Synonyms	**5-[2-[4-(2-phenyldiazenyl)phenyl]diazenyl]-** 1-((4-(phenylazo)phenyl)azo)-6-((2-acetoxyethyl)methylsulfamoyl)-2-naphthol C.I. Disperse Red 151 N-(2-acetoxyethyl)-6-hydroxy-N-methyl-5-((4-(phenylazo)phenyl)azo)naphthalene-2-sulphonamide
CAS Number	70210-08-1
Structural Formula	
Molecular Formula	C27H25N5O5S
Molecular Weight	531.59

Chemical Name in the Inventory and Synonyms	**1,3-Naphthalenedisulfonic acid, 7-hydroxy-8-[[4-(phenylazo)phenyl]azo]-, potassium sodium salt** 7-hydroxy-8-((4-(phenylazo)phenyl)azo)-1,3-naphthalenedisulfonic acid, potassium, sodium salt potassium sodium 7-hydroxy-8-((4-(phenylazo)phenyl)azo)naphthalene-1,3-disulphonate
CAS Number	70321-81-2
Structural Formula	

	
Molecular Formula	C22H16N4O7S2.xK.xNa
Molecular Weight	572.59

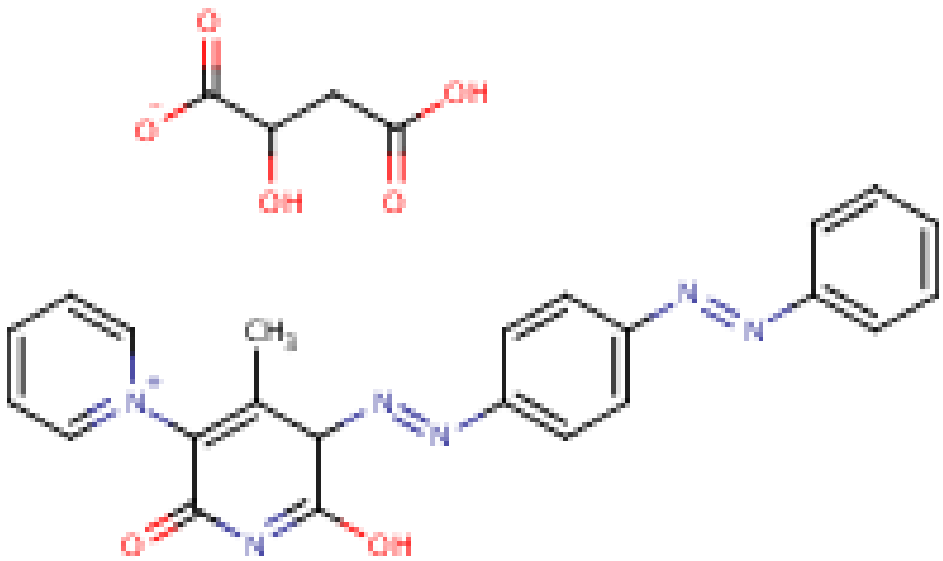
Chemical Name in the Inventory and Synonyms	**2-Naphthalenol, 1-[[4-(phenylazo)phenyl]azo]-, ar',ar''-methyl derivatives** 1-((p-(phenylazo)phenyl)azo)-2-naphthol, methyl derivs.
CAS Number	70879-65-1
Structural Formula	**No Structural Diagram Available**

Molecular Formula	Unspecified
Molecular Weight	

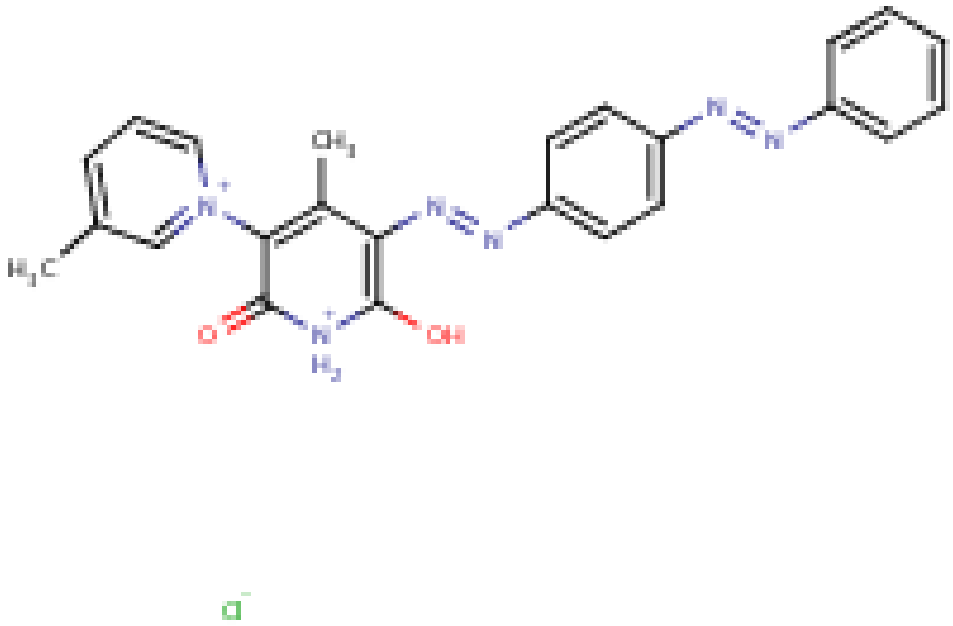
Chemical Name in the Inventory and Synonyms	**2-Naphthalenesulfonic acid, 7-[[4,6-bis[[3-(diethylamino)propyl]amino]-1,3,5-triazin-2-yl]amino]-4-hydroxy-3-[[4-(phenylazo)phenyl]azo]-, monoacetate (salt)** 2-naphthalenesulfonic acid, 7-((4,6-bis((3-(diethylamino)propyl)amino)-1,3,5-triazin-2-yl)amino)-4-hydroxy-3-((4-(phenylazo)phenyl)azo)-, monoacetate (salt) EINECS 275-136-9
CAS Number	71032-95-6
Structural Formula	
Molecular Formula	C39H50N12O4S.C2H4O2
Molecular Weight	843.02

Chemical Name in the Inventory and Synonyms	**C.I. Solvent Red 164** C.I. Solvent Red 164 Oil Red BS Automate Red B Dyeguard Red D
CAS Number	71819-51-7
Structural Formula	**No Structural Diagram Available**
Molecular Formula	Unspecified
Molecular Weight	

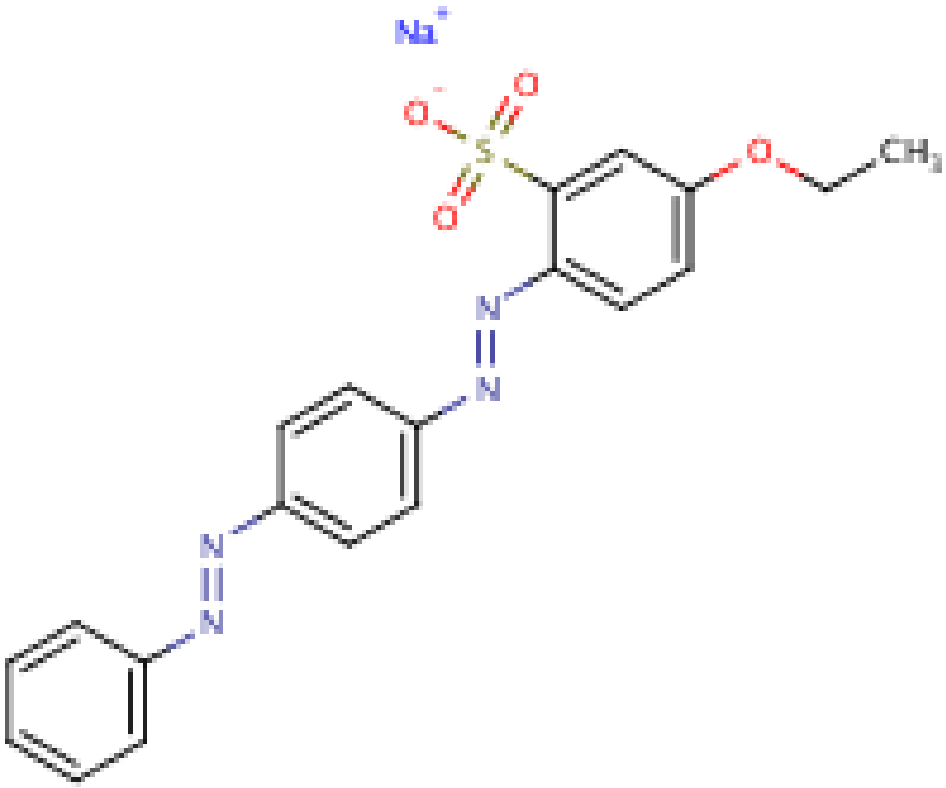
Chemical Name in the Inventory and Synonyms	**1,3'-Bipyridinium, 1',2'-dihydro-6'-hydroxy-4'-methyl-2'-oxo-5'-[[4-(phenylazo)phenyl]azo]-, salt with hydroxybutanedioic acid (1:1)** 1',2'-dihydro-6'-hydroxy-4'-methyl-2'-oxo-5'-((4-(phenylazo)phenyl)azo)-1,3'-bipyridinium malate pyridinium,1-(5-(4-(phenylazo)phenylazo)-6-hydroxy-4-methyl-2-oxo-3-pyridyl)-, malate
CAS Number	72765-55-0
Structural Formula	

	
Molecular Formula	C23H19N6O2.C4H5O5
Molecular Weight	544.52

Chemical Name in the Inventory and Synonyms	**1,3'-Bipyridinium, 1',2'-dihydro-6'-hydroxy-3,4'-dimethyl-2'-oxo-5'-[[4-(phenylazo)phenyl]azo]-, chloride** 1',2'-dihydro-6'-hydroxy-3,4'-dimethyl-2'-oxo-5'-((4-(phenylazo)phenyl)azo)-1,3'-bipyridinium chloride 3-methyl-1-(1,2-dihydro-6-hydroxy-4-methyl-2-oxo-5-((4-(phenyl azo)phenyl)azo)pyridin-3-yl)pyridinium chloride
CAS Number	75199-20-1
Structural Formula	

	
Molecular Formula	C24H21N6O2.Cl
Molecular Weight	461.93

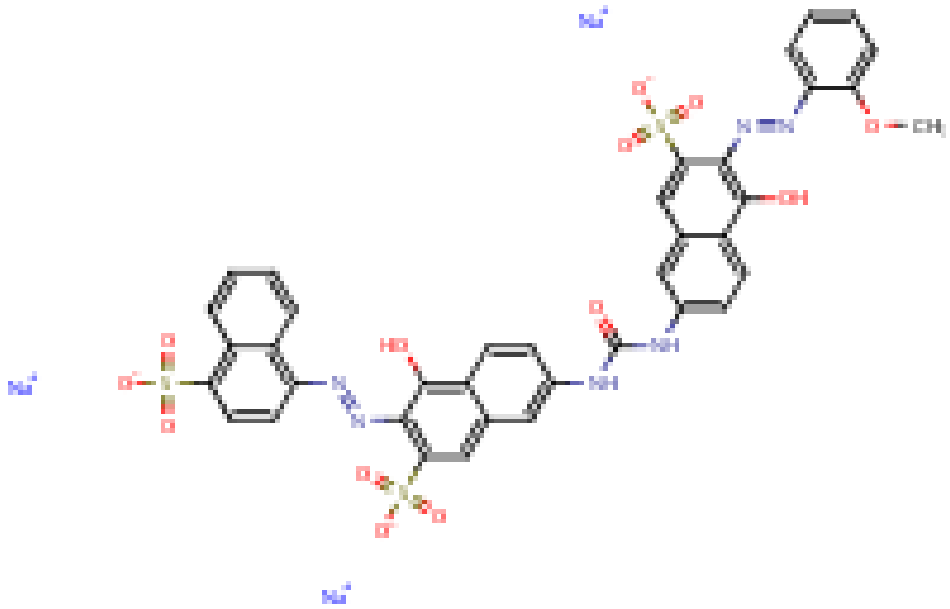
Chemical Name in the Inventory and Synonyms	**Benzenesulfonic acid, 5-ethoxy-2-[[4-(phenylazo)phenyl]azo]-, sodium salt** sodium 5-ethoxy-2-((4-(phenylazo)phenyl)azo)benzenesulphonate
CAS Number	83221-42-5
Structural Formula	

	
Molecular Formula	C20H18N4O4S.Na
Molecular Weight	432.43

Chemical Name in the Inventory and Synonyms	**2-Naphthalenesulfonic acid, 7,7'-(carbonyldiimino)bis[4-hydroxy-3-[(2-methoxyphenyl)azo]-, sodium salt** 7,7'-(carbonyldiimino)bis(4-hydroxy-3-((2-methoxyphenyl)azo)naphthalene-2-sulphonic) acid, sodium salt
CAS Number	83221-76-5
Structural Formula	

	No Structural Diagram Available
Molecular Formula	C35H28N6O11S2.xNa
Molecular Weight	

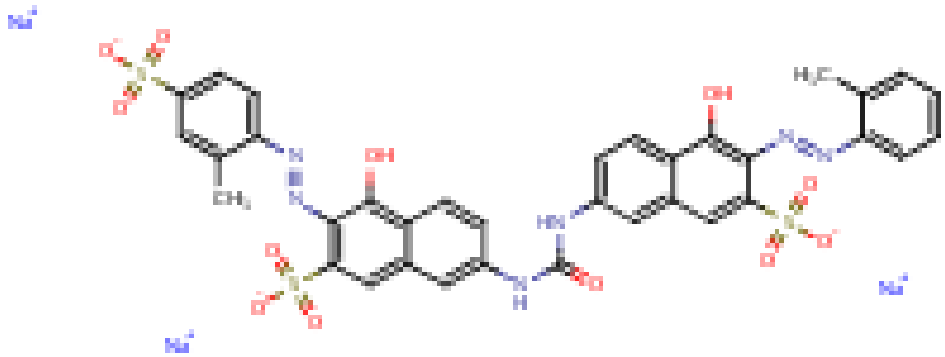
Chemical Name in the Inventory and Synonyms	**1-Naphthalenesulfonic acid, 4-[[1-hydroxy-6-[[[[5-hydroxy-6-[(2-methoxyphenyl)azo]-7-sulfo-2-naphthalenyl]amino]carbonyl]amino]-3-sulfo-2-naphthalenyl]azo]-, sodium salt** 4-((1-hydroxy-6-((((5-hydroxy-6-((2-methoxyphenyl)azo)-7-sulpho-2-naphthyl)amino)carbonyl)amino)-3-sulpho-2-naphthyl)azo)naphthalene-1-sulphonic acid, sodium salt
CAS Number	83221-78-7
Structural Formula	

	
Molecular Formula	C38H28N6O13S3.xNa
Molecular Weight	938.81

Chemical Name in the Inventory and Synonyms	**2-Naphthalenesulfonic acid, 7,7'-(carbonyldiimino)bis[4-hydroxy-3-[(2-methylphenyl)azo]-, sodium salt** 7,7'-(carbonyldiimino)bis(4-hydroxy-3-((o-tolyl)azo)naphthalene-2-sulphonic) acid, sodium salt
CAS Number	83232-30-8
Structural Formula	

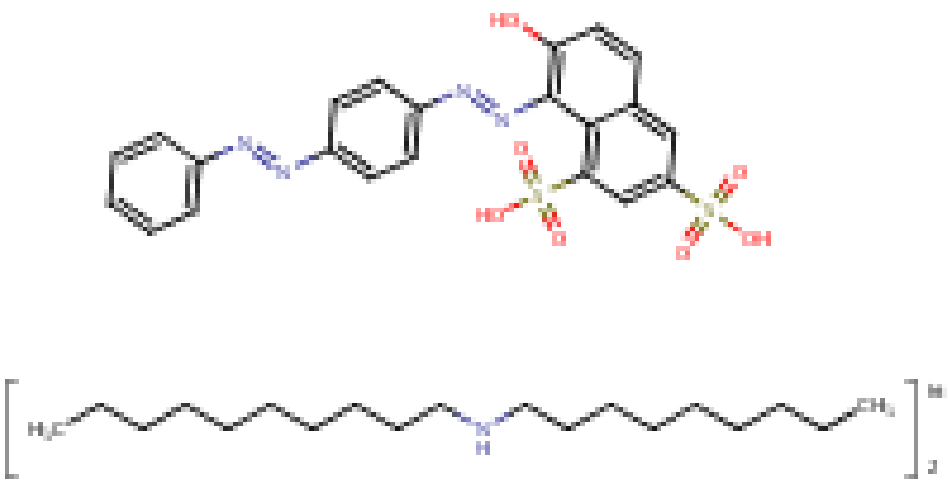
	No Structural Diagram Available
Molecular Formula	C35H28N6O9S2.xNa
Molecular Weight	

Chemical Name in the Inventory and Synonyms	**2-Naphthalenesulfonic acid, 4-hydroxy-7-[[[[5-hydroxy-6-[(2-methylphenyl)azo]-7-sulfo-2-naphthalenyl]amino]carbonyl]amino]-3-[(2-methyl-4-sulfophenyl)azo]-, sodium salt** 4-hydroxy-7-((((5-hydroxy-6-((o-tolyl)azo)-7-sulpho-2-naphthyl)amino)carbonyl)amino)-3-((2-methyl-4-sulphophenyl)azo)naphthalene-2-sulphonic acid, sodium salt
CAS Number	83232-32-0
Structural Formula	

	
Molecular Formula	C35H28N6O12S3.xNa
Molecular Weight	886.78

Chemical Name in the Inventory and Synonyms	**C.I. Disperse Yellow 218**
CAS Number	83929-90-2
Structural Formula	**No Structural Diagram Available**

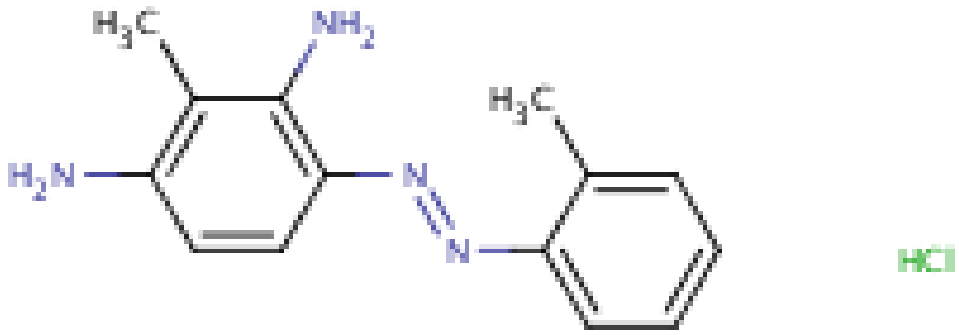
Molecular Formula	Unspecified
Molecular Weight	

Chemical Name in the Inventory and Synonyms	**1,3-Naphthalenedisulfonic acid, 7-hydroxy-8-[[4-(phenylazo)phenyl]azo]-, compound with 10-nonadecanamine (1:2)** 7-hydroxy-8-((4-(phenylazo)phenyl)azo)naphthalene-1,3-disulphonic acid, compound with nonyldecylamine (1:2)
CAS Number	84100-97-0
Structural Formula	
Molecular Formula	C22H16N4O7S2.2C19H41N
Molecular Weight	1079.60

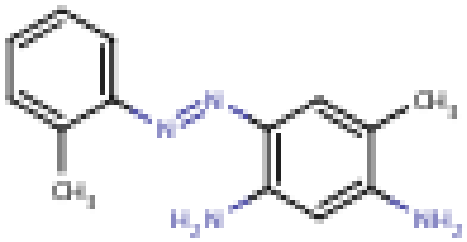
Chemical Name in the Inventory and Synonyms	**1,3-Benzenediamine, 2(or 4)-methyl-, coupled with diazotized 2(or 4)-methyl-1,3-benzenediamine**

CAS Number	84281-76-5
Structural Formula	
Molecular Formula	Unspecified
Molecular Weight	

Chemical Name in the Inventory and Synonyms	**1,3-Benzenediamine, 2(or 4)-methyl-, coupled with diazotized 2(or 4)-methyl-1,3-benzenediamine, acetate**
CAS Number	84281-77-6
Structural Formula	
Molecular Formula	Unspecified
Molecular Weight	

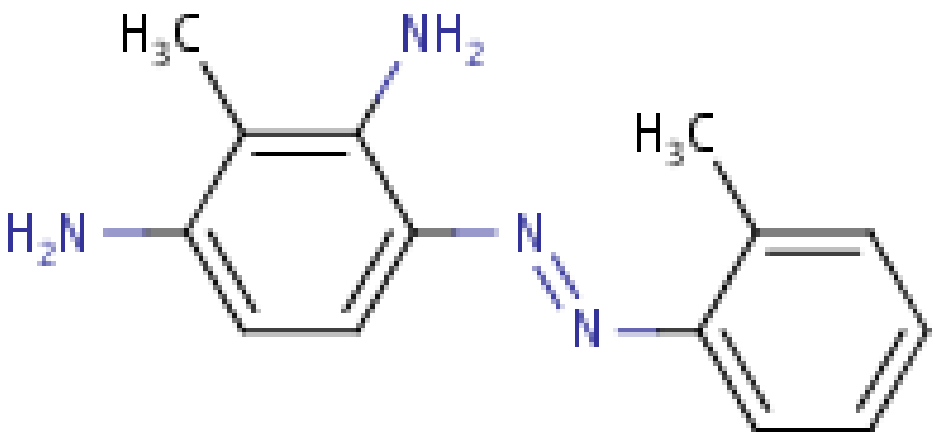
Chemical Name in the Inventory and Synonyms	**1,3-Benzenediamine, 2-methyl-4-[(2-methylphenyl)azo]-, monohydrochloride** 3-(o-tolylazo)toluene-2,6-diamine monohydrochloride
CAS Number	84434-40-2
Structural Formula	
Molecular Formula	C14H16N4.ClH
Molecular Weight	276.77

Chemical Name in the Inventory and Synonyms	**1,3-Benzenediamine, 4-methyl-6-[(2-methylphenyl)azo]-, monoacetate** 5-(o-tolylazo)toluene-2,4-diamine monoacetate
CAS Number	84434-44-6
Structural Formula	



Molecular Formula	C14H16N4.C2H4O2
Molecular Weight	300.36

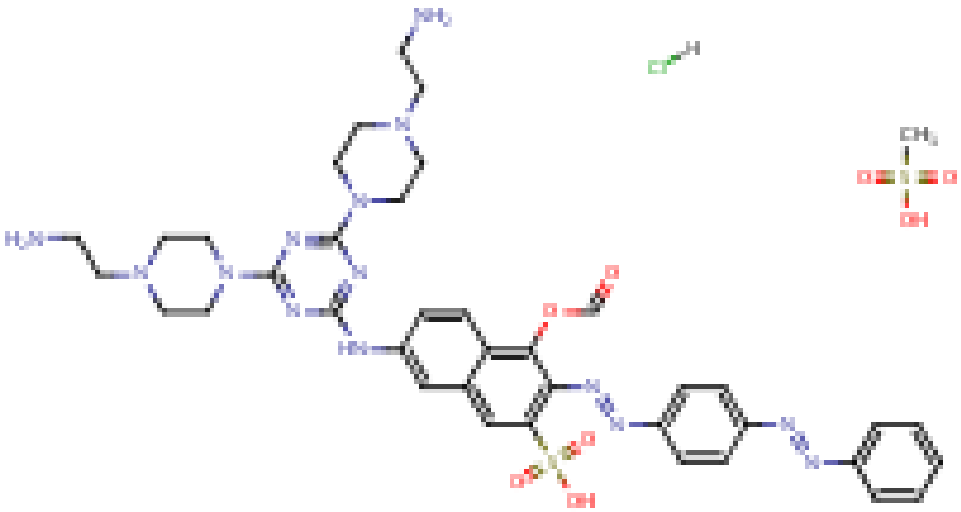
Chemical Name in the Inventory and Synonyms	**1,3-Benzenediamine, 2-methyl-4-[(2-methylphenyl)azo]-** 2'-methyl-2,4-diamino-3-methylazobenzene 2-methyl-4-((2-methylphenyl)azo)-1,3-benzenediamine m-phenylenediamine, 2-methyl-4-((2-methylphenyl)azo)-
CAS Number	84434-45-7
Structural Formula	

	
Molecular Formula	C14H16N4
Molecular Weight	240.31

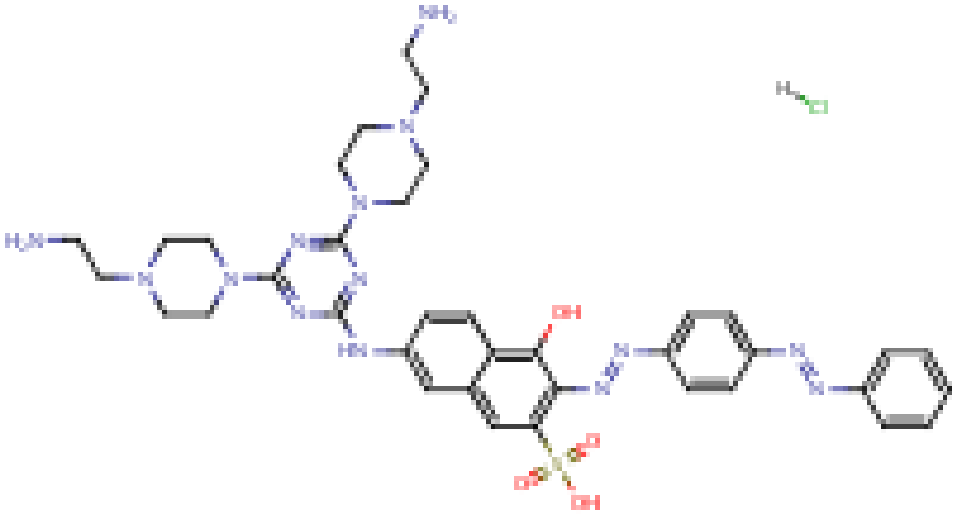
Chemical Name in the Inventory and Synonyms	**1,3-Benzenediamine, 4,4'-[[2(or 4)-methyl-1,3-phenylene]azo]bis[2(or 6)-methyl-, diacetate** 4,4'-((2(or 4)-methyl-1,3-phenylene)azo)bis(2(or 6)-methylbenzene-1,3-diamine) diacetate
CAS Number	84560-08-7
Structural Formula	

	No Structural Diagram Available
Molecular Formula	C21H24N8.2C2H4O2
Molecular Weight	

Chemical Name in the Inventory and Synonyms	**2-Naphthalenesulfonic acid, 7-[[4,6-bis[4-(2-aminoethyl)-1-piperazinyl]-1,3,5-triazin-2-yl]amino]-4-hydroxy-3-[[4-(phenylazo)phenyl]azo]-, formate (salt, hydrochloride methanesulfonate (salt)** 7-((4,6-bis(4-(2-aminoethyl)-1-piperazinyl)-1,3,5-triazin-2-yl)amino)-4-hydroxy-3-((p-(phenylazo)phenyl)azo)naphthalene-2-sulphonic acid, formate, hydrochloride, methanesulphonate
CAS Number	85305-11-9
Structural Formula	

	
Molecular Formula	C37H44N14O4S.xCH4O3S.xCH2O2.xClH
Molecular Weight	941.49

Chemical Name in the Inventory and Synonyms	**2-Naphthalenesulfonic acid, 7-[[4,6-bis[4-(2-aminoethyl)-1-piperazinyl]-1,3,5-triazin-2-yl]amino]-4-hydroxy-3-[[4-(phenylazo)phenyl]azo]-, hydrochloride** 7-((4,6-bis(4-(2-aminoethyl)piperazin-1-yl)-1,3,5-triazin-2-yl)amino)-4-hydroxy-3-((4-(phenylazo)phenyl)azo)naphthalene-2-sulphonic acid hydrochloride
CAS Number	85305-12-0
Structural Formula	

	
Molecular Formula	C37H44N14O4S.xClH
Molecular Weight	817.38

Chemical Name in the Inventory and Synonyms	**3-Pyridinecarbonitrile, 1,2-dihydro-6-hydroxy-4-methyl-1-[3-(1-methylethoxy)propyl]-2-oxo-5-[[4-(phenylazo)phenyl]azo]-** C.I. Disperse Orange 149
CAS Number	85136-74-9
Structural Formula	**No Structural Diagram Available**

Molecular Formula	C25H26N6O3
Molecular Weight	

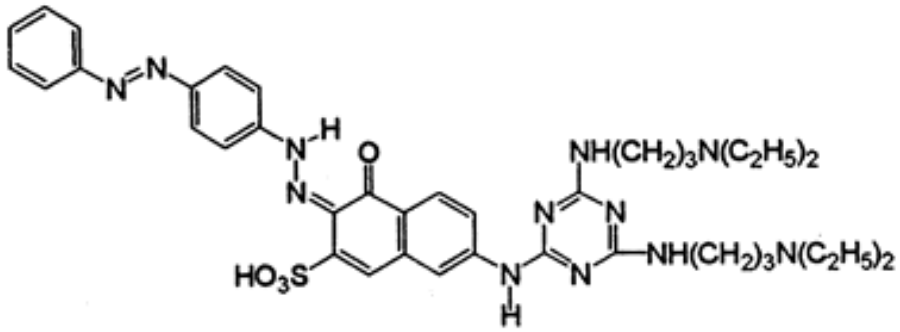
Chemical Name in the Inventory and Synonyms	**2-Naphthalenol, 1-[[2-methyl-4-[(2-methylphenyl)azo]phenyl]azo]-, ar-styrenated**
CAS Number	85203-90-3
Structural Formula	**No Structural Diagram Available**
Molecular Formula	Unspecified
Molecular Weight	

Chemical Name in the Inventory and Synonyms	**1,3-Benzenediamine, 2(or 4)-methyl-, coupled with diazotized 2(or 4)-methyl-1,3-benzenediamine, acetates hydrochlorides**
CAS Number	91696-40-1
Structural Formula	

	
Molecular Formula	Unspecified
Molecular Weight	

Chemical Name in the Inventory and Synonyms	**2-Naphthalenesulfonic acid, 7-[[4,6-bis[(2-aminopropyl)amino]-1,3,5-triazin-2-yl]amino]-4-hydroxy-3-[(2-methoxyphenyl)azo]-, monoformate (salt)** formic acid, compound with 7-[[4,6-bis[(2-aminopropyl)amino (6-(4-hydroxy-3-(2-methoxyphenylazo)-2-sulfonato-7-naphthylamino)-1,3,5-triazin-2,4-diyl)bis[(amino-1-methylethyl)ammonium] formate
CAS Number	108225-03-2
Structural Formula	
Molecular Formula	C26H32N10O5S.CH2O2
Molecular Weight	

Chemical Name in the Inventory and Synonyms	**Propanoic acid, 2-hydroxy-, compound with 7-[[4,6-bis[[3-(diethylamino)propyl]amino]-1,3,5-triazin-2-yl]amino]-4-hydroxy-3-[[4-**

	(phenylazo)phenyl]azo]-2-naphthalenesulfonic acid acetate (salt) 2-naphthalenesulfonic acid, 7-[[4,6-bis[[3-(diethylamino)propyl C.I. Basic Red 111 Cartasol Red K-2B
CAS Number	118658-98-3
Structural Formula	
Molecular Formula	C39H50N12O4S.xC3H6O3.xC2H4O2
Molecular Weight	782.96

Chemical Name in the Inventory and Synonyms	**1,3'-Bipyridinium, 5',5'''-[methylenebis(4,1-phenyleneazo)]bis[1'-[3-(dimethylamino)propyl]-1',2'-dihydro-6'-hydroxy-4'-methyl-2'-oxo-, dichloride, dihydrochloride**
CAS Number	118658-99-4
Structural Formula	**No Structural Diagram Available**
Molecular Formula	C45H52N10O4.2ClH.2Cl
Molecular Weight	

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