p-Toluidine and its salts: Human health tier II assessment

24 April 2015

Chemicals in this assessment

Chemical Name in the Inventory	CAS Number
Benzenamine, 4-methyl-	106-49-0
Benzenamine, 4-methyl-, hydrochloride	540-23-8
Benzenamine, 4-methyl-, sulfate (1:1)	540-25-0

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 chemical p-toluidine (CAS No. 106-49-0) and two of its salts (p-toluidine hydrochloride, CAS No. 540-23-8 and p-toluidine sulfate (1:1), CAS No. 540-25-0) are assessed together in this report as they have the same hazard classifications in the Hazardous Substances Information System (HSIS) (Safe Work Australia) and have similar international uses.

In this report, p-toluidine is referred to as 'the chemical'.

Import, Manufacture and Use

Australian

No specific Australian use, import, or manufacturing information has been identified.

International

The following international uses have been identified through the European Union (EU) Registration, Evaluation, Authorization and Restrictions of Chemicals (REACH) dossiers; the Organisation for Economic Co-operation and Development (OECD) Screening Information Dataset Initial Assessment Report (SIAR); Galleria Chemica; the Substances and Preparations in the Nordic countries (SPIN) database; and the United States (US) National Library of Medicine's Hazardous Substances Data Bank (HSDB).

The chemicals have reported domestic use in acrylate glue (maximum 0.01 %).

The chemicals have reported site-limited uses including:

- as intermediates for producing other organic chemicals;
- as intermediates for producing dyestuff; and
- for preparing ion-exchange resins.

The chemicals have reported non-industrial uses in pesticides and pharmaceuticals.

Restrictions

Australian

No known restrictions have been identified.

International

The chemicals are listed on the following (Galleria Chemica):

- EU Cosmetics Regulation 1223/2009 Annex II—List of substances prohibited in cosmetic products;
- New Zealand Cosmetic Products Group Standard—Schedule 4: Components cosmetic products must not contain;
- Health Canada List of prohibited and restricted cosmetic ingredients (The Cosmetic Ingredient ‘Hotlist’); and
- China List of banned substances for use in cosmetics.

Existing Worker Health and Safety Controls

Hazard Classification

All three chemicals are classified as hazardous, with the following risk phrases for human health in the HSIS (Safe Work Australia):

- T; R22/24/25 (acute toxicity)
- Xi; R36 (irritation)
- Xi; R43 (sensitisation)
- R40 Carc. Cat 3 (carcinogenicity)

Exposure Standards

Australian

The parent chemical p-toluidine has an exposure standard of 8.8 mg/m^3 (2 ppm) time weighted average (TWA).

International

The following exposure standards are identified for the parent chemical (Galleria Chemica).

TWA of:

- 8.8–9.0 mg/m^3 (2 ppm) in Canada, Denmark, Indonesia, Spain, Taiwan and the United States of America (USA); and
- 0.9–1.0 mg/m^3 (0.2 ppm) in Germany, Ireland and Hungary

Short-term exposure limit (STEL) of:

- 1–4 mg/m^3 in Hungary and Latvia; and
- 4 ppm in Canada (Saskatchewan) and the USA (Washington).

It is noted that the European Commission (EC) Scientific Committee on Occupational Exposure Limits (SCOEL) has recommended a lower TWA of 1 ppm (4.38 mg/m^3) and a STEL of 2 ppm (8.77 mg/m^3) for p-toluidine (CAS No. 106-49-0) (EC, 2013).

Health Hazard Information

Except when specifically stated, the test substance used in the studies below was p-toluidine and was referred to as 'the chemical'. The presence of hydrochloride or sulfate anions is unlikely to significantly alter the systemic toxicity of the two salts.

Toxicokinetics

Following oral exposure in rats, the radio-labelled chemical was absorbed through the gastrointestinal tract and was detected in all organs. Most of the absorbed chemical was detected in abdominal fat, liver, skin, kidneys and blood, and to a lesser extent in the brain, bone marrow, muscle and testes (OECD, 2005).

In rats, metabolism was reported to occur via ring hydroxylation followed by conjugation to form the metabolite 2-amino-5-methylphenol, which was excreted in the urine. The parent compound was also detected in the urine at 2.5 % of the administered dose after 24 hours. Binding of the chemical or its corresponding nitroso metabolite to haemoglobin was observed in female rats following oral administration at a dose of 64 mg/kg bw (OECD, 2005; EC, 2013; HSDB).

The metabolites identified in rabbit liver microsomes were 4-hydroxymethylaniline and 4-aminobenzaldehyde. In cats, the N-hydroxylation of the chemical (mediated by cytochrome P450), which forms the nitroso derivative of the aromatic amine, is paralleled by methaemoglobin (MHb) production (OECD, 2005; EC, 2013; HSDB).

The biological half-life for plasma elimination in rats, following oral administration of 500 mg/kg bw of the chemical was determined to be 12–15 hours. Intravenous (i.v.) administration of the chemical in dogs gave a half-life of one hour (OECD, 2005).

In several human biomonitoring studies to evaluate p-toluidine-haemoglobin (Hb) adduct formation, the chemical was detected in the blood and urine of non-smokers and non-occupationally exposed smokers. The level of Hb adducts in human blood was dependent on the type of tobacco smoked, and was doubled in smokers compared with non-smokers (OECD, 2005; HSDB).

Acute Toxicity

Oral

The chemicals are classified as hazardous with the risk phrase ‘Toxic if swallowed’ (T; R25) in the HSIS (Safe Work Australia). Although the available data support a lower classification, the existing classification is not amended due to the lack of available comprehensive information.

The median lethal doses (LD50) for the chemical (CAS No. 106-49-0) were 620–794 mg/kg bw in rats, 330–794 mg/kg bw in mice, and 270 mg/kg bw in rabbits. Reported clinical signs included hypoactivity, emaciation (extreme weight loss), cyanosis, bloodshot eyes and narcosis (OECD, 2005; EC, 2013).

In an acute oral study, methaemoglobinaemia was observed in rats following administration of 200 mg/kg bw single dose of the chemical (administered area not reported). A maximum MHb level of 21.7 % was reported two hours post exposure (EC, 2013; REACH).

An LD50 of 1285 mg/kg was reported in rats for p-toluidine hydrochloride (CAS No. 540-23-8) (EC, 2013).

Dermal

The chemicals are classified as hazardous with the risk phrase ‘Toxic in contact with skin’ (T; R24) in the HSIS (Safe Work Australia). While the available LD50 value supports a lower hazard classification, the existing classification is not proposed to be amended due to a lack of more comprehensive information.

The dermal LD50 for the chemical was 890 mg/kg bw in rabbits. Reported clinical signs included hypoactivity, muscular weakness, convulsions, vocalisation and dermal irritation (moderate to severe erythema, mild oedema, focal chemical burns and subdermal haemorrhages) (REACH).

Dermal application of the chemical at 0.25–1.25 % in solution on rat skin for 2–6 hours resulted in a dose-related increase in MHb levels in the blood up to 40 % (OECD, 2005; HSDB).

Inhalation

The chemicals are classified as hazardous with the risk phrase ‘Toxic by inhalation’ (T; R23) in the HSIS (Safe Work Australia). The available data are insufficient to derive a conclusion on acute inhalation toxicity of the chemicals. Therefore, the existing hazard classification is not amended.

The median lethal concentration (LC50) for the chemical was >0.64 mg/L in rats. Reported signs of toxicity included generalised inactivity, rhinitis and lacrimation. No mortalities occurred at the highest dose of 0.64 mg/L (OECD, 2005; HSDB).

Observation in humans

The available human data showed that inhalation exposure to these chemicals can cause MHb formation in the blood. The chemical was reported to produce toxic effects (stranguria and haemoglobinuria, dizziness and headache) similar to aniline (CAS No. 62-53-3) (NICNAS) at exposure levels ≥22 mg/m^3, but with less pronounced cyanosis compared with aniline (OECD, 2005; HSDB).

Severe intoxication within 60 minutes following inhalation exposure to 40 ppm (176 mg/m^3) toluidines was reported in workers. Inhalation exposure to 10 ppm (44 mg/m^3) led to illness. The effects were due to the reaction of toluidine metabolites with haemoglobin (EC, 2013; HSDB). Details of the symptoms and isomers exposed were not available.

Corrosion / Irritation

Skin Irritation

The chemicals are not considered to be skin irritants.

In a study conducted according to the OECD Test Guideline (TG) 404, the chemical (500 mg) was applied to the dorsal areas of rabbits (n = 3) for four hours, and observed up to 72 hours. No skin irritation was observed in rabbits (REACH). The salts of p-

toluidine are not expected to have different extremes in pH, and therefore, irritancy will not be different.

Eye Irritation

The chemicals are classified as hazardous with the risk phrase 'Irritating to eyes' (Xi; R36) in the HSIS (Safe Work Australia). The available data support this classification.

In an eye irritation study in rabbits (OECD TG 405), the chemical was instilled into the conjunctival sac of one eye of each rabbit (n = 3), with observation up to seven days. Conjunctival redness, swelling and lacrimation were observed at 24, 48 and 72 hours post-exposure, but these effects were reversible at the end of the observation period. The mean scores for all observation timepoints were 1.6 for chemosis, 2.1 for conjunctival redness, 0.7 for iritis and 0.7 for corneal opacity. Two out of three animals each had an average score of 1.0 for iritis. Based on the iritis scores, the chemical was considered an eye irritant (OECD, 2005; REACH).

Sensitisation

Skin Sensitisation

The chemicals are classified as hazardous with the risk phrase ‘May cause sensitisation by skin contact’ (R43) in the HSIS (Safe Work Australia). The available data support this classification.

In an occlusive patch test, guinea pigs (n = 10/dose) were epicutaneously administered the chemical (2 % in petrolatum), every second day for a total of four applications. The positive control used was p-phenylenediamine. After 14 days, the animals were challenged with 0.1, 0.5, 1.0 and 2.0 % of the chemical in petrolatum and positive reactions were observed in 0/10, 4/10, 6/10 and 8/10 guinea pigs, respectively, indicating the chemical to be a skin sensitiser (OECD, 2005; REACH).

Observation in humans

In an epicutaneous study conducted on 58 patients who showed sensitisation to p-phenylenediamine, positive skin reactions were observed following exposure to 2 % of the chemical (HSDB).

Repeated Dose Toxicity

Oral

Based on the limited data available, the chemicals are not considered to cause serious damage to health from repeated oral exposure. The available studies indicate the blood and liver as the main target organs for toxicity with MHb formation as the main toxic mechanism producing symptoms.

The OECD (2005) report stated that: 'There are no adequate repeated dose toxicity studies available for p-toluidine. There are a number of limited studies sufficient to support a weight of evidence approach. Limitations include documentation of the experiments in general, number of animals under test, treatment time as well as the lack of necessary investigations. Nevertheless, the overall weight of evidence indicates low systemic toxicity with liver and blood as target organs.'

In a 28-day repeated dose oral toxicity study, male rats (n = 10/dose) were administered the chemical at doses of 0, 165, 825 or 1650 ppm (0, 13.8, 66.8, 125.7 mg/kg bw/day) in the diet. No mortalities or clinical symptoms of toxicity were observed. Decreased body weight gain was observed at the highest dose. No gross pathological lesions were found at necropsy. A no observed adverse effect level (NOAEL) of 165 ppm (13.8 mg/kg bw/day) was reported based on increased relative liver weights at ≥825 ppm (OECD, 2005; REACH).

In a combined chronic/carcinogenicity study (OECD TG 452), male rats (n = 25/dose) were administered the chemical at 0, 1000 or 2000 ppm (0, 75 or 150 mg/kg bw/day) in the diet for 18 months. A NOAEL of 2000 ppm was established based on no mortalities or signs of toxicity at the highest dose. In a similar study conducted in male mice, dose levels administered were decreased to 500 and 1000 ppm (75 and 160 mg/kg bw/day) due to increased mortalities and decreased body weights at ≥1000 ppm. Hepatomas were observed at ≥500 ppm (see **Carcinogenicity**) (OECD, 2005; REACH).

Rats were administered p-toluidine hydrochloride in two kinds of diets (with 4 % or 14 % fat) at doses of 0, 40, 80 or 160 mg/kg bw/day for one or three months. After three months, decreased body weight gain was observed at the highest dose in both diet groups. The MHb levels in blood significantly increased during the treatment period at all dose levels in both diet groups.

In a similar study to that above, the MHb levels increased up to 10.5 % at the same doses (details not reported) in rats, following a six-month treatment period. No further increase was observed after prolonged treatment for 12 months. Increased concentrations of glutathione-S-transferase (GST) in the liver after one and three months at all dose levels were observed. Hepatic lipid peroxidation increased in parallel with the increased GST concentrations, compared with controls. A slight increase in alanine aminotransferase was also observed, especially after the rats were administered a high fat diet for three months. No NOAEL could be derived (OECD, 2005; EC, 2013).

In a 12-day repeated dose toxicity study, rats administered the chemical at 200 mg/kg bw/day by gavage, were pale and weak after the sixth treatment. These symptoms were reversible after a one-week recovery period. However, damage to the spleen and liver was observed after the final treatment (details not available) (REACH).

Dermal

No data are available.

Inhalation

No data are available.

Genotoxicity

Only limited data are available. The available information is not sufficient to derive a conclusion on genotoxicity of the chemicals.

An OECD (2005) report concluded that, 'Overall, there is some indication for clastogenic activity *in vitro* and some residual suspicion for such action *in vivo*' for the chemical.

The chemical gave largely positive results in several in vitro genotoxicity assays (OECD, 2005; EC, 2013; REACH):

- generally negative results in several bacterial reverse mutation assays with strains of *Salmonella typhimurium* and *Escherichia coli*, with or without metabolic activation; but positive in a *S. typhimurium* strain TA100 with metabolic activation (hamster liver S9-mix);
- negative for mitotic recombination and gene conversion in *Saccharomyces cerevisiae*, with or without metabolic activation;
- positive in a cytogenetic assay with Chinese hamster lung (CHL) fibroblast cells with metabolic activation at ≥0.5 mg/mL;
- induced DNA damage in human lung fibroblast cells; and
- induced unscheduled DNA synthesis in rat hepatocytes.

Only one in vivo genotoxicity study was available. The chemical induced DNA strand breaks in the liver and kidneys of male Swiss mice following a single intraperitoneal (i.p.) injection at 35 mg/kg bw, a dose that corresponded to 2/3 of the i.p. LD50 (OECD, 2005; REACH). The OECD stated that 'it cannot be decided definitely whether the effects occurred due to cytotoxicity or real genotoxic mechanisms' (OECD, 2005).

Carcinogenicity

The chemicals are classified as hazardous—Category 3 carcinogenic substance—with the risk phrase 'Limited evidence of carcinogenic effect' (Xn; R40) in the HSIS (Safe Work Australia). The available data support this classification.

In a combined chronic/carcinogenicity study (non-guideline) in rats and mice, p-toluidine hydrochloride did not induce tumours in rats, but hepatic adenomas were observed in male mice. The animals were orally administered the chemical for 18 months at 0, 1000 or 2000 ppm (0, 75 or 150 mg/kg bw/day) in rats and at 0, 500 or 1000 ppm (0, 37.5 or 75 mg/kg bw/day) in mice. Male mice exhibited a significant increase in hepatomas at both dose levels (8/18 and 9/19 for the low and high dose, respectively). Increased incidences of benign liver tumours (details not reported) were observed in female mice (3/17) at the high dose (OECD, 2005; EC, 2013).

In another carcinogenicity study (non-guideline), Sprague Dawley rats (n = 30/sex/dose) were subcutaneously injected with the chemical in peanut oil at 0, 25 or 75 mg/kg bw, once a week for two years. Liver cell necrosis was observed in both controls and treated rats. A slight increase in malignant tumours at the injection site was observed at both dose levels in both sexes (controls (male and female): 6/30 and 1/30; low dose (male and female): 9/30 and 2/30; high dose (male and female): 8/30, 5/30). An increased incidence of benign liver tumours was observed at the high dose (males: 1/30, females: 6/30). The authors concluded that the chemical causes tumours under extreme conditions (OECD, 2005; EC, 2013).

Cystoscopic examination was conducted in 75/81 workers employed in a toluidine (o- and p-toluidine) production facility. The air concentrations of o-toluidine were 0.7–28.6 mg/m^3, but not specified for p-toluidine. Two cases of bladder papilloma were reported: a 23-year-old worker exposed for 20 months only to p-toluidine, and a 49-year-old worker exposed to both chemicals for 23 years. In addition, six cases of bladder tumours (four carcinomas, one papilloma and one multiple papilloma) were identified in 16 workers exposed to both chemicals for 12–17 years. As o-toluidine is a known carcinogen and limited exposure data were available for p-toluidine, no conclusions can be drawn as to the carcinogenicity of p-toluidine in humans (OECD, 2005; EC, 2013).

Reproductive and Developmental Toxicity

No reproductive or developmental studies are available for the chemicals. Reproductive and developmental toxicity data are available for m-toluidine, which is of limited applicability to the chemical. There are limited information as to whether these chemicals are, or are not, toxic to reproduction or development.

In mice orally administered the chemical up to 1000 ppm (150 mg/kg bw/day) for 18 months, no gross or histopathological findings were reported upon examination of the reproductive organs (OECD, 2005).

An oral dose of 200 mg/kg bw/day of the chemical was reported to inhibit DNA synthesis in the mouse testicular tissue (details not available) (EC, 2013).

An isomer of these chemicals, m-toluidine, is reported to have a no observed effect level (NOEL) of 30 mg/kg bw/day for reproductive toxicity and 100 mg/kg bw/day for developmental toxicity, in rats. However, m-toluidine is more potent in forming methaemoglobin, compared with p-toluidine (OECD, 2005).

Risk Characterisation

Critical Health Effects

The critical health effects for risk characterisation include:

- systemic long-term effects (carcinogenicity);
- systemic acute effects through oral, dermal and inhalation exposure;
- local effects (skin sensitisation); and

- eye irritation.

Public Risk Characterisation

No Australian domestic uses were identified. The international uses indicated that the chemicals are present in acrylate glue at very low concentrations (up to 0.01 %). Hence, the public risk from these chemicals is not considered to be unreasonable and further risk management is not considered necessary for public safety.

Occupational Risk Characterisation

Given the critical health effects, the chemicals could pose an unreasonable risk to workers unless adequate control measures to minimise 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.

Based on the available data, the hazard classification in the HSIS (Safe Work Australia) is considered appropriate.

NICNAS Recommendation

Current risk management measures are considered adequate to protect public and workers' health and safety, provided that all requirements are met under workplace health and safety, and poisons legislation as adopted by the relevant state or territory. No further assessment is required.

Regulatory Control

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.

Hazard	Approved Criteria (HSIS)[a]	GHS Classification (HCIS)[b]
Acute Toxicity	Toxic if swallowed (T; R25)* Toxic in contact with skin (T; R24)* Toxic by inhalation (T; R23)*	Toxic if swallowed - Cat. 3 (H301) Toxic in contact with skin - Cat. 3 (H311) Toxic if inhaled - Cat. 3 (H331)
Irritation / Corrosivity	Irritating to eyes (Xi; R36)*	Causes serious eye irritation - Cat. 2A (H319)
Sensitisation	May cause sensitisation by skin contact (Xi; R43)*	May cause an allergic skin reaction - Cat. 1 (H317)
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 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;
- health monitoring for any worker who is at risk of exposure to the chemicals, if valid techniques are available to monitor the effect on the worker's health;
- air monitoring to ensure control measures in place are working effectively and continue to do so;
- 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.

References

ChemIDPlus Advanced. Accessed February 2015 at **http://chem.sis.nlm.nih.gov/chemidplus/**

Galleria Chemica. Accessed February 2015 at **http://jr.chemwatch.net/galeria/** .

Hazardous Substances Information System (HSIS) Safe Work Australia. Accessed February 2015 at **http://hsis.safeworkaustralia.gov.au/HazardousSubstance**

National Industrial Chemical Notification and Assessment Scheme (NICNAS). Inventory Multi-Tiered Assessment and Prioritisation (IMAP) Human Health Tier II Assessment for Benaenamine. Accessed February 2015 at **http://www.nicnas.gov.au/chemical-information/imap-assessments/imap-assessments/tier-ii-environment-assessments/aniline**

Organisation for Economic Cooperation and Development (OECD) 2005. SIDS Initial Assessment Report (SIAR) on p-Toluidine (CAS No. 106-49-0). Accessed February 2015 at **http://webnet.oecd.org/Hpv/UI/SIDS_Details.aspx?id=3290444E-F4CA-408F-A79F-B714FE025560**

Registration, Evaluation and Authorisation of Chemicals (REACH) Dossier. p-Toluidine (CAS No. 106-49-0). Accessed February 2015 at **http://echa.europa.eu/web/guest/information-on-chemicals/registered-substances**

Scientific Committee on Occupational Exposure Limits (SCOEL) 2013. Recommendation from the Scientific Committee on Occupational Exposure Limits for 4-Aminotoluene (p-Toluidine). June 2013. SCOEL/SUM/145, European Commission - Employment, Social Affairs& Inclusion. Accessed February 2015 at ec.europa.eu/social/BlobServlet?docId=7308&langId=en

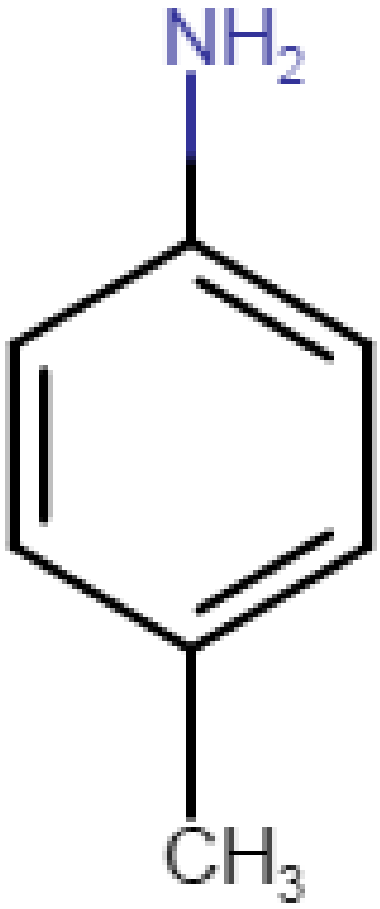
Substances in Preparations in Nordic Countries (SPIN). Accessed February 2015 at **http://188.183.47.4/dotnetnuke/Home/tabid/58/Default.aspx**

US National Library of Medicine's Hazardous Substances Data Bank (HSDB). Accessed February 2015 at **http://toxnet.nlm.nih.gov/cgi-bin/sis/htmlgen?HSDB**

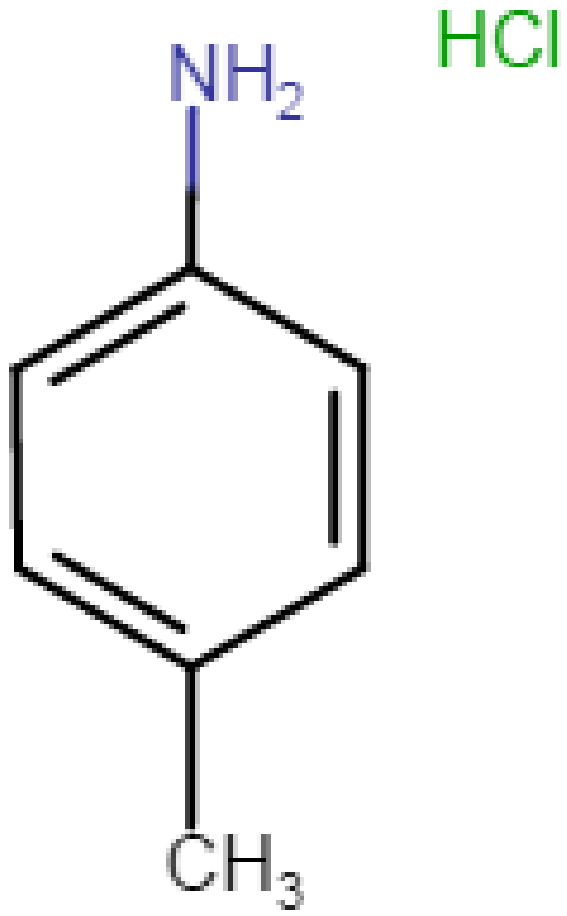
Last Update 24 April 2015

Chemical Identities

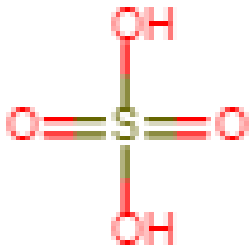
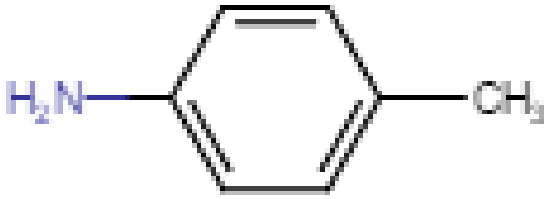
Chemical Name in the Inventory and Synonyms	**Benzenamine, 4-methyl-** p-toluidine 4-aminotoluene 1-amino-4-methylbenzene 4-methylaniline
CAS Number	106-49-0
Structural Formula	

	
Molecular Formula	C7H9N
Molecular Weight	107.155

Chemical Name in the Inventory and Synonyms	**Benzenamine, 4-methyl-, hydrochloride** toluidinium chloride p-toluidine hydrochloride 4-methylaniline hydrochloride 4-methylanilinium chloride 4-aminotoluene hydrochloride
CAS Number	540-23-8
Structural Formula	

	
Molecular Formula	C7H9N.ClH
Molecular Weight	143.616

Chemical Name in the Inventory and Synonyms	**Benzenamine, 4-methyl-, sulfate (1:1)** 4-Aminotoluene sulfate (1:1) p-toluidine, sulfate (1:1)
CAS Number	540-25-0
Structural Formula	

	 
Molecular Formula	C7H9N.H2O4S
Molecular Weight	205.233

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