

# Aniline

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## Hazard Summary

Exposure to aniline may occur from breathing contaminated outdoor air, smoking tobacco, or working or being near industries where it is produced or used. The acute (short-term) and chronic (long-term) effects of aniline in humans consist mainly of effects on the lung, such as upper respiratory tract irritation and congestion. Chronic exposure may also result in effects on the blood. Human cancer data are insufficient to conclude that aniline is a cause of bladder tumors while animal studies indicate that aniline causes tumors of the spleen. EPA has classified aniline as a Group B2, probable human carcinogen.

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Please Note: The main sources of information for this fact sheet are EPA's Integrated Risk Information System (IRIS) (5), which contains information on inhalation chronic toxicity of aniline and the RfC, and the carcinogenic effects of aniline including the unit cancer risk for oral exposure and EPA's Health and Environmental Effects Profile for Aniline (1). Other secondary sources include the Hazardous Substances Data Bank (HSDB) (2), a database of summaries of peer-reviewed literature and the Registry of Toxic Effects of Chemical Substances (RTECS) (3), a database of toxic effects that are not peer reviewed.

## Uses

- Aniline is predominantly used as a chemical intermediate for the dye, agricultural, polymer, and rubber industries. It is also used as a solvent, and has been used as an antiknock compound for gasolines. (1,6)

## Sources and Potential Exposure

- Aniline can be formed from the breakdown of certain pollutants found in outdoor air, from the burning of plastics, or from burning tobacco. (1)
- Airborne exposure to aniline may occur from breathing contaminated air, from smoking tobacco or proximity to someone who is smoking, or from being near industrial sources that use large quantities of aniline. (1)
- Occupational exposure to aniline could occur in industries that use aniline to make other chemicals. (1)
- Small amounts of aniline may be found in some foods, such as corn, grains, rhubarb, apples, beans, and rapeseed cake (animal feed). Aniline has also been found as a volatile component of black tea. (1)
- Aniline has been detected in drinking water and has also been found in surface water. (1)

## Assessing Personal Exposure

- There are tests currently available to determine personal exposure to aniline through the analysis of the blood or urine. (2)

## Health Hazard Information

### Acute Effects:

- Acute inhalation exposure to high levels of aniline in humans has resulted in effects on the lung, such as upper respiratory tract irritation and congestion. (1,2)
- Aniline has been classified as very toxic in humans, with a probable oral lethal dose in humans at 50 to 500

milligrams per kilogram body weight (mg/kg). (2)

- Aniline is considered to have high acute toxicity, based on short-term animal tests in rats. (3)

#### Chronic Effects (Noncancer):

- The major effects from chronic inhalation exposure to aniline in humans is the formation of methemoglobin, which can cause cyanosis (interference with the oxygen-carrying capacity of the blood). (1,2)
- Aniline is severely irritating to mucous membranes and affects the eyes, skin, and upper respiratory tract in humans. (1,2)
- Significant amounts of aniline can be absorbed through the skin. (2)
- Animals studies have reported a dose-related decrease in red blood cell count, hemoglobin levels, and hematocrit. (1,2)
- The Reference Concentration (RfC) for aniline is 0.001 milligrams per cubic meter ( $\text{mg}/\text{m}^3$ ) based on spleen toxicity in rats. The RfC is an estimate (with uncertainty spanning perhaps an order of magnitude) of a continuous inhalation exposure to the human population (including sensitive subgroups) that is likely to be without appreciable risk of deleterious noncancer effects during a lifetime. It is not a direct estimator of risk but rather a reference point to gauge the potential effects. At exposures increasingly greater than the RfC, the potential for adverse health effects increases. Lifetime exposure above the RfC does not imply that an adverse health effect would necessarily occur. (4)
- EPA has low confidence in the studies on which the RfC was based because one of the principal studies is poorly reported and used a single exposure concentration and small numbers of animals and the other principal study is of short duration; low confidence in the database because no appropriate reproductive studies were located; and, consequently, low confidence in the RfC. (4)
- EPA has not established a Reference Dose (RfD) for aniline. (4)

#### Reproductive/Developmental Effects:

- No information is available on the reproductive or developmental effects of aniline in humans. (1,2)
- Birth defects were observed in animals given aniline by gavage (placing the chemical experimentally in the stomachs of the animals). (1,2)
- The total number of offspring in mice given aniline by gavage was lower than in the control group even though the average number of offspring per litter was not affected. However, some of the pregnant mice treated with aniline died during pregnancy. Survival of offspring in the aniline-treated group was decreased. (1)

#### Cancer Risk:

- A study of British workers in the chemical dye industry exposed to aniline and other chemicals concluded that there was insufficient evidence to suggest that aniline itself is a cause of bladder tumors. (4)
- Animal studies have shown an increase in tumors of the spleen in rats exposed to aniline hydrochloride. (4)
- EPA considers aniline to be a probable human carcinogen (cancer-causing agent) and has ranked it in EPA's Group B2. (4)
- EPA uses mathematical models, based on human or animal studies, to estimate the probability of a person developing cancer from ingesting water containing a specified concentration of a chemical. EPA calculated an oral cancer slope factor of  $5.7 \times 10^{-3} \text{ (mg/kg/d)}^{-1}$  and an oral unit risk estimate of  $1.6 \times 10^{-7} \text{ (}\mu\text{g/L)}^{-1}$ . EPA estimates that, if an individual were to continuously ingest water containing aniline at an average of 6  $\mu\text{g/L}$  over his or her entire lifetime, that person would theoretically have no more than a one-in-a-million increased chance of developing cancer as a direct result of drinking water containing this chemical. Similarly, EPA estimates that drinking water containing 60  $\mu\text{g/L}$  would result in not greater than a one-in-a-hundred thousand increased chance of developing cancer, and water containing 600  $\mu\text{g/L}$  would result in not greater than a one-in-ten thousand increased chance of developing cancer. (4)
- The California Environmental Protection Agency (CalEPA) (5) has established an inhalation unit risk estimate of  $1.6 \times 10^{-6} \text{ (}\mu\text{g}/\text{m}^3\text{)}^{-1}$  for aniline. (5)

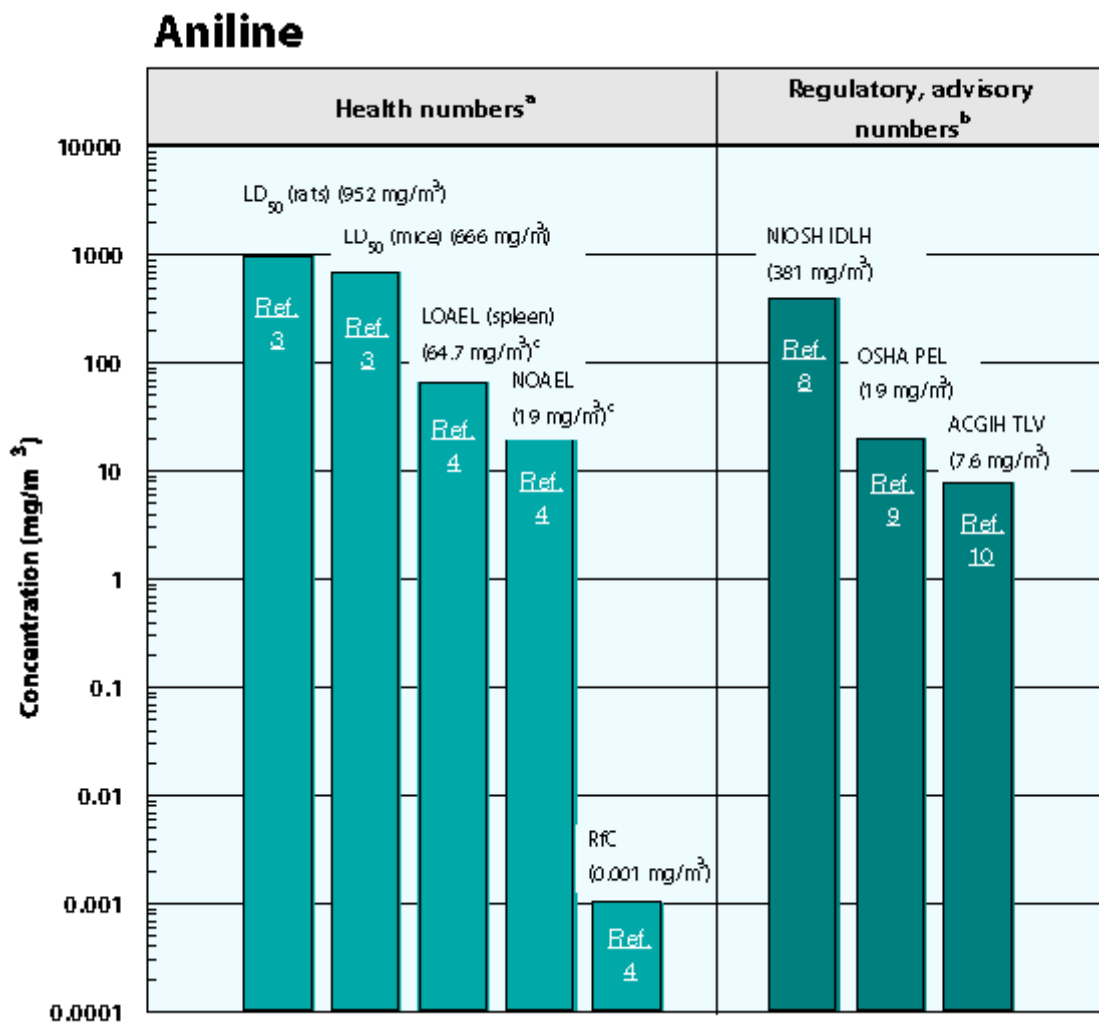
# Physical Properties

- Aniline is a colorless oily liquid with a characteristic taste. (6)
- Aniline is soluble in water. (1,6)
- The chemical formula for aniline is  $C_6H_7N$  and the molecular weight is 93.12 g/mol. (1)
- The vapor pressure for aniline is 0.67 mm Hg at 25 °C and it has an octanol/water partition coefficient ( $\log K_{ow}$ ) of 0.90. (1)
- Aniline has a characteristic odor and an odor threshold of 1.1 parts per million (ppm).(7)

## Conversion Factors:

To convert concentrations in air (at 25°C) from ppm to  $mg/m^3$ :  $mg/m^3 = (ppm) \times (\text{molecular weight of the compound}) / (24.45)$ . For aniline: 1 ppm = 3.8  $mg/m^3$ .

## Health Data from Inhalation Exposure



ACGIH TLV--American Conference of Governmental and Industrial Hygienists' threshold limit value expressed as a time-weighted average; the concentration of a substance to which most workers can be exposed without adverse effects.

LC<sub>50</sub> (Lethal Concentration<sub>50</sub>)--A calculated concentration of a chemical in air to which exposure for a specific length of time is expected to cause death in 50% of a defined experimental animal population.

LOAEL--Lowest-observed-adverse-effect level.

NIOSH IDLH--National Institute of Occupational Safety and Health's immediately dangerous to life or health limit; NIOSH recommended exposure limit to ensure that a worker can escape from an exposure condition that is likely to cause death or immediate or delayed permanent adverse health effects or prevent escape from the environment.

NOAEL--No-observed-adverse-effect level.

OSHA PEL--Occupational Safety and Health Administration's permissible exposure limit expressed as a time-weighted average; the concentration of a substance to which most workers can be exposed without adverse effect averaged over a normal 8-h workday or a 40-h workweek.

The health and regulatory values cited in this factsheet were obtained in December 1999.

<sup>a</sup> Health numbers are toxicological numbers from animal testing or risk assessment values developed by EPA.

<sup>b</sup> Regulatory numbers are values that have been incorporated in Government regulations, while advisory numbers are nonregulatory values provided by the Government or other groups as advice. OSHA numbers are regulatory, whereas NIOSH and ACGIH numbers are advisory.

<sup>c</sup> The NOAEL and LOAEL are from the critical studies used as the basis for the EPA RfC.

## References

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