MELAMINE

Chemical Description

Melamine (CAS No. 108-78-1) is an organic base and a trimer of cyanamide, with a 1,3,5-triazine skeleton. Like cyanamide, it contains 66% Nitrogen by mass and, if mixed with resins, has fire-retardant properties due to its release of nitrogen gas when burned or charred, and it also has several other industrial uses. Melamine was found as a metabolite of the pesticide cyromazine in plants, goats, hens, and rats. Cyanuric Acid (CAS No 108-80-5) is a structural analogue of melamine that may be found as an impurity of melamine. Cyanuric Acid is an Food and Drug Administration-accepted component of feed-grade biuret, a ruminant feed additive. It is also found in swimming pool water as the dissociation product of dichloroisocyanurates used for water disinfection. Consumers may be exposed toCyanuric Acid by swallowing swimming pool water, by drinking water processed from surface water, and by eating fish in which the chemical has accumulated (OECD 1999). When used in drinking water for disinfection purposes, sodium dichloroisocyanurate is rapidly dechlorinated to cyanurate.
Melamine cyanurate, also known as melamine-Cyanuric Acid adduct or melamine-Cyanuric Acid complex, is a crystalline complex formed from a 1:1 mixture of melamine and Cyanuric Acid.

Uses

The primary use of melamine is in the production of plastics. These manufactured plastics include countertops, dry-erase boards, glues, fabrics, housewares, and fire retardants. Melamine is also included in Yellow 150, which is used in ink production and to dye plastics, and it is also used in cement to increase its workability when laying it down. The latest concern with melamine surrounds its use as a protein replacement: melamine allows for protein-free consumption of Nitrogen. Adding melamine to fertilizers as a cheaper Nitrogen source increases crop yields, and crops produced with melamine-fortified fertilizers can be used to feed livestock - most importantly, cattle. These cattle then appear to contain more protein than is actually present.

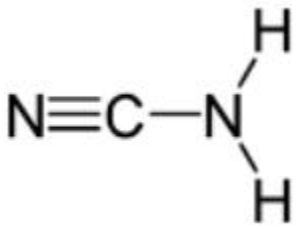
History

Melamine was developed by a German scientist in the 1830s and has been used in the manufacture of plastics and laminates, specifically dishwasher-safe plastic dishware, which was popular until ceramic and glass dishes became more favorable in the 1970s. Protein levels in foods are determined by nitrogen content, and melamine has also been used to increase the nitrogen content of foods, which gives the impression that the foods contain more protein. In the 1960s, South African veterinarians attempted to

supplement sheep feed with the chemical, wrongly believing the bacteria in the guts of the animals would be able to convert the melamine to biological proteins. Even at low doses, the by-product of melamine, Cyanuric Acid, forms fatal kidney crystals. In the 1970s, Italian scientists developed a way to test for melamine in fish foods and found that almost 60% of tested samples contained melamine. More recently, manufacturers have added melamine, disguised as wheat gluten or rice protein, to everything from baby formula to pet foods in order to label their products as containing greater amounts of protein.

Health Effects

Human Exposure and Health Effects



Human exposure to melamine has occurred mainly through ingestion of baby formula and some brands of biscuits and instant coffee. The Food and Drug Administration (FDA) has released a study stating that products containing less than 1 ppm of melamine are safe to consume, and it found that many common baby formulas contain 0.14 ppm. Chinese manufacturers have added melamine to their products to disguise protein content, and four infants in China have died from overexposure. Only trace amounts are found in food products in the U.S., but melamine levels in Chinese products have been found to be considerably higher (though the exact amounts are still unspecified). Reports of adult melamine exposure have been minimal because melamine is excreted from the body within three or four hours. Children are at greatest risk for melamine poisoning because of their undeveloped kidneys and their consumption of baby formula. Further tests by the FDA are ongoing.

Acute Animal Toxicity

A basic conclusion about melamine's acute animal toxicity is that melamine alone is not hazardous to animals. However, melamine combined with Cyanuric Acid has an enhanced toxic effect. The Hazardous Substances Data Bank reported several experimental cases to evaluate the toxicity of melamine in animals, and very few, and minor, effects were observed under acute exposure (Bingham, 2001). Melamine, when applied to a rabbit at a dose as high as 1g/kg for 18 hours, did not cause primary skin irritation or signs of system toxicity (Bingham, 2001). In contrast,feeding of melamine and Cyanuric Acid to fish and pigs resulted in the presence of renal crystals (Reimschuessel, 2008). Those animals exposed to only melamine (400 mg/kg) showed few symptoms after three days, while the combination of

the two chemicals (400 mg of each compound/kg) caused renal failure and the formation of renal crystals (Reimschuessel , 2008). Another study occurred with different species of fish, rats, rabbits, and algae, which were given very high doses of melamine, ranging from an average of 1000mg/l for a species of fish, 3296 mg/kg for mice, and 940 mg/l for algae. The test durations ranged from 48 to 96 hours, and LD50 values were obtained. Theconclusion from these tests was that melamine has a low acute toxicity for the three trophic levels. The study stated, "The Bioaccumulation potential of melamine and the aquatic concentrations are low. No remarkable contribution of food from aquatic organisms to the uptake of melamine in humans is therefore expected" (UNEP, 1998). According to the Food and Drug Administration, the toxicity of the combination of melamine and Cyanuric Acid is a "concentration dependent phenomenon," in which only high doses will produce any effects such as the renal crystals (FDA, 2007).

Melamine can cause acute renal failure in dogs and cats (Thompson, 2008) when ingested at concentrations of 50 ppb and above, particularly in the presence of Cyanuric Acid (FDA, 2007). Melamine, in combination with Cyanuric Acid, causes the deposition of crystals in the kidneys which can lead to kidney failure (Yang and Batlle, 2008). Animals have experienced renal failure through ingestion of melamine-contaminated pet food, which may have contained melamine to artificially boost protein content determination (Thompson, 2008).

Chronic Animal Toxicity

Chronic exposure to melamine in animals has been proven to cause urinary tract-related problems. Animals primarily obtain melamine by ingesting contaminated pet food, and an intake of 3% melamine over one year was linked to a variety of symptoms in dogs. These included a decrease in the number of urinary particles (urinary specific gravity), increased amounts of urine, and melamine crystallization. Additionally, chronic exposure may eventually result in kidney stones and damage to the reproductive tract and bladder (including bladder cancer).

Source : http://www.toxipedia.org/display/toxipedia/Melamine