



נוהג טוב בביצוע תהליכי עבודה

TGIC (Triglycidylisocyanurate)

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TGIC (Triglycidylisocyanurate, Triglycidyl-s-triazinetrione, CAS no. 2451-62-9) is a synthetic chemical that does not occur naturally. It is produced industrially by reacting cyanuric acid with excess epichlorohydrin [WHO, The Nordic Expert Group]. TGIC is a solid that comes in the form of a white opaque powder or granules or as clear crystals. The chemical has no discernible odor at room temperature. TGIC reacts rapidly with primary and secondary amines, carboxylic acids and anhydrides, thiols, phenols, and alcohols. It can be polymerized by catalysts and may undergo violent autopolymerization. Combustion products include carbon dioxide, carbon monoxide, and oxides of nitrogen.

According to British Health and Safety Executive (HSE), powders containing TGIC are no longer manufactured in the UK and Europe, but it is still widely used in Israel. In February of 2016 the Occupational Safety and Health Administration of Israeli Ministry of Economy and Industry advised manufacturers to replace TGIC with other materials [Israeli Ministry of Economy].

Usage and Exposure

TGIC is used mainly in the manufacture of polyester powder paint coatings for metal finishing that are sprayed onto metal objects by an electrostatic process. The coated metal objects are then placed in an oven at a temperature of about 200°C. During the heating process the resin melts, flows, and chemically cross-links to form a paint film. These coatings are durable and resist ultraviolet damage and are therefore typically used in outdoor applications. They usually contain between 4 and 10% TGIC.

TGIC is also used in electrical insulation materials, resin-molding systems, laminated sheetings, silk-screen printing coatings, tools, inks, adhesives, lining materials, and stabilizers for plastics.

TGIC is also used in solder “mask” inks in the printed circuit board industry. The two-part inks contain approximately 60% TGIC in the hardener component. The inks are applied by curtain coating, electrostatic spraying, or screen printing. The coated circuit board is then passed through an oven at 150 °C to complete the curing process.

High levels of exposure are liable to occur during the manufacture of TGIC powder coatings. Workers weighing out TGIC, filling hoppers, mixing, transferring powder mixes in open vessels, extruding, milling, bagging, cleaning up spills and cleaning equipment are at high risk. The highest level of exposure occurs when handling technical grade TGIC. However, data regarding particle size of granules of technical grade TGIC indicate that only very small fractions are respirable - 99.6% are >400 µm and only 0.003% are <10 µm. There is considerable potential for airborne dust to be generated during decanting of the powder and filling hoppers in preparation for spraying. The spraying process itself also provides considerable potential for exposure to powder coatings, especially if the area is not fully enclosed and the objects are sprayed manually. Cleaning-up spills, equipment, and spray booths may lead to exposure to large amounts of TGIC [The Nordic Expert Group].

It has been estimated that there were 5000–10000 users of coating powders in the UK in the 1990s. The Health and Safety Executive has issued guidelines to firms regarding the control of coating powders. Alternative curing systems have recently been developed that do not contain TGIC [Roff].

TGIC has long been investigated as a potential medicine known as Teroxirone for treatment of cancer [Ames, Wang].

Routes of Exposure

The most likely routes of occupational exposure are inhalational and dermal. Some oral ingestion may occur when a fraction of the inhaled material is swallowed [The Nordic Expert Group, White].

Target organs:

Skin, eyes, hematopoietic system, male reproductive system.

Metabolism

No information is available concerning the mechanism of toxicity of TGIC.

Health hazards

Acute effects

TGIC can cause severe irritation to the eyes and mild irritation to the skin and nasal passages [White]. It can also have severe effects on the central nervous system, kidneys, liver, lungs and gastrointestinal tract, resulting in tissue lesions [CDC].

Chronic Effects

Pure TGIC and powder coatings containing TGIC have the potential to cause skin sensitization that can lead to severe rashes. Cases of allergic contact

dermatitis to TGIC verified by patch testing have been described in literature [The Nordic Expert Group].

TGIC has been reported to induce asthma and other respiratory symptoms [Anees, White].

The American Conference of Governmental Industrial Hygienists (ACGIH) published a documentation of TGIC in 2001. Hematopoietic effects were observed in humans, mice and dogs. Repeated inhalation exposures in mouse studies resulted in cytotoxicity to spermatogonial cells (mutagenic effect). Fertility effects in male mice were also observed [ACGIH].

The Globally Harmonized System of Classification and Labeling of Chemicals (GHS) classified germ cell mutagens into 2 categories:

Category 1 is divided into two sub-categories:

Category 1A – Substances known to induce heritable mutation in human germ cells

Category 1B – Substances that should be regarded as they induce heritable mutation in the human germ cells

Category 2 – Substances which cause concern for humans owing the possibility that they may induce heritable mutation in the human germ cells [GHS].

The European Regulation on Classification, Labeling and Packaging of substances and mixtures (CLP), classified TGIC as Mutagen, Category 1B [CLP].

Carcinogenicity

No studies were found that confirmed the carcinogenicity of TGIC.

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