

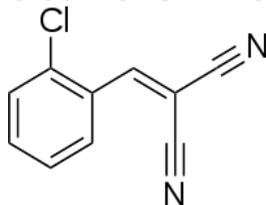
CHLOROBENZYLIDENE-MALONONITRILE

Overview

Chlorobenzylidene-malononitrile, also known as CS or CS Gas, is the active chemical compound that is found in the most commonly used type of tear gas in North America and Europe. Two British scientists, Ben Corson and Roger Stoughton, developed the compound while at Middlebury College. Effects of exposure to this compound through its most common form, tear gas, range from an irritation of eyes and mucous membrane to vomiting which are often over within an hour. However, research has shown that people with prior conditions such as asthma, cardiovascular disease, and hypertension may experience longer lasting effects and a worsening of their prior conditions. While extremely uncommon, exposure to CS under the right conditions, such as a confined space, a person with pre-existing conditions, and a strong concentration of the compound, can be fatal.

CS gas has replaced its similar counterpart CN gas in use because CS Gas is ten times stronger while significantly less toxic (Sommer and Wilkinson, 1999).

Chemical Background



CS is synthesized by the reaction of 2-chlorobenzaldehyde and malononitrile via the Knoevenagel condensation

The reaction is catalysed with weak base like piperidine or pyridine. The production method has not changed since the substance was discovered by Carson and Staughton. Other bases, solvent free methods and microwave promotion have been suggested to improve the production of the substance.

As 2-chlorobenzalmalononitrile is a solid at room temperature, not a gas, a variety of techniques have been used to make this solid usable as an aerosol:

- ♣ Melted and sprayed in the molten form.
- ♣ Dissolved in organic solvent.
- ♣ CS₂ dry powder (CS₂ is a siliconized, micro-pulverized form of CS).
- ♣ CS from thermal grenades by generation of hot gases.[1](#)

Adverse Health Effects

MOST COMMON EFFECTS

CS, when used in its most common form of aerosol, causes an irritation of the mucous membranes of the eye, nose, throat, and stomach. The effect of exposing these membranes to CS include tearing, conjunctivitis, uncontrolled blinking, headache, and a burning sensation. Other effects include vomiting and redness of the skin. These effects normally dissipate within an hour of exposure, however several studies have shown oral and respiratory irritation to last for a month following initial exposure.

SEVERE EFFECTS

In addition to the common effects of CS exposure, several cases have been recorded that detail more severe, longer lasting effects of the chemical compound.

Bullous Dermatitis

Extreme blistering and inflammation of the skin. This symptom is most often seen in people who have experienced repeated exposures to CS. Researchers believe that people can develop a contact allergy after their first exposure to CS, making the effects in future exposures more intense and long lasting.

Vocal Cord and Throat Damage

In one case, when the subject was exposed to high levels of CS Gas in a confined area for ten seconds, serious health conditions took five weeks to fully clear up. The vocal cords were swollen and a crust had built up in the trachea causing respiratory problems. Researchers expect severity and duration of these effects to increase with longer exposures. Longer lasting

effects such as sleep apnea and loss of breath after exercise or strenuous work were experienced by several people months after exposure.

EFFECTS FROM INGESTION

When CS is ingested, the effects are typical of other types of exposure such as eye irritation, headache, burning sensation in the mouth and throat, and irritated skin on the face. Less common and more intense effects include vomiting, diarrhea, and abdominal pain.

Treatment

If exposed to CS, the first thing a person should do is move to fresh air. The longer you inhale the gas for the longer the effects will last, with the potential for harsher effects to occur. Watch breathing as shortness of breath may occur. If this lasts for over 60 seconds, supplemental oxygen may be necessary.

With eye exposure, it is necessary to wash eyes with room temperature water or saline solution for 15 minutes. If irritation continues consult a doctor.

CS Gas Residue

After being released as a gas CS will settle and reform as a powder solid. The powder has the same irritating effects as the gas. This is more of a concern when the gas has been released in an enclosed area as the powder that forms makes its way into every corner of the room or structure. Without proper cleaning and management of the powder, it will persist for months, if not years. This poses a serious issue, as repeated exposure can create an allergic reaction to CS, making future exposures more dangerous.

Source : <http://www.toxipedia.org/display/toxipedia/Chlorobenzylidene-malononitrile>