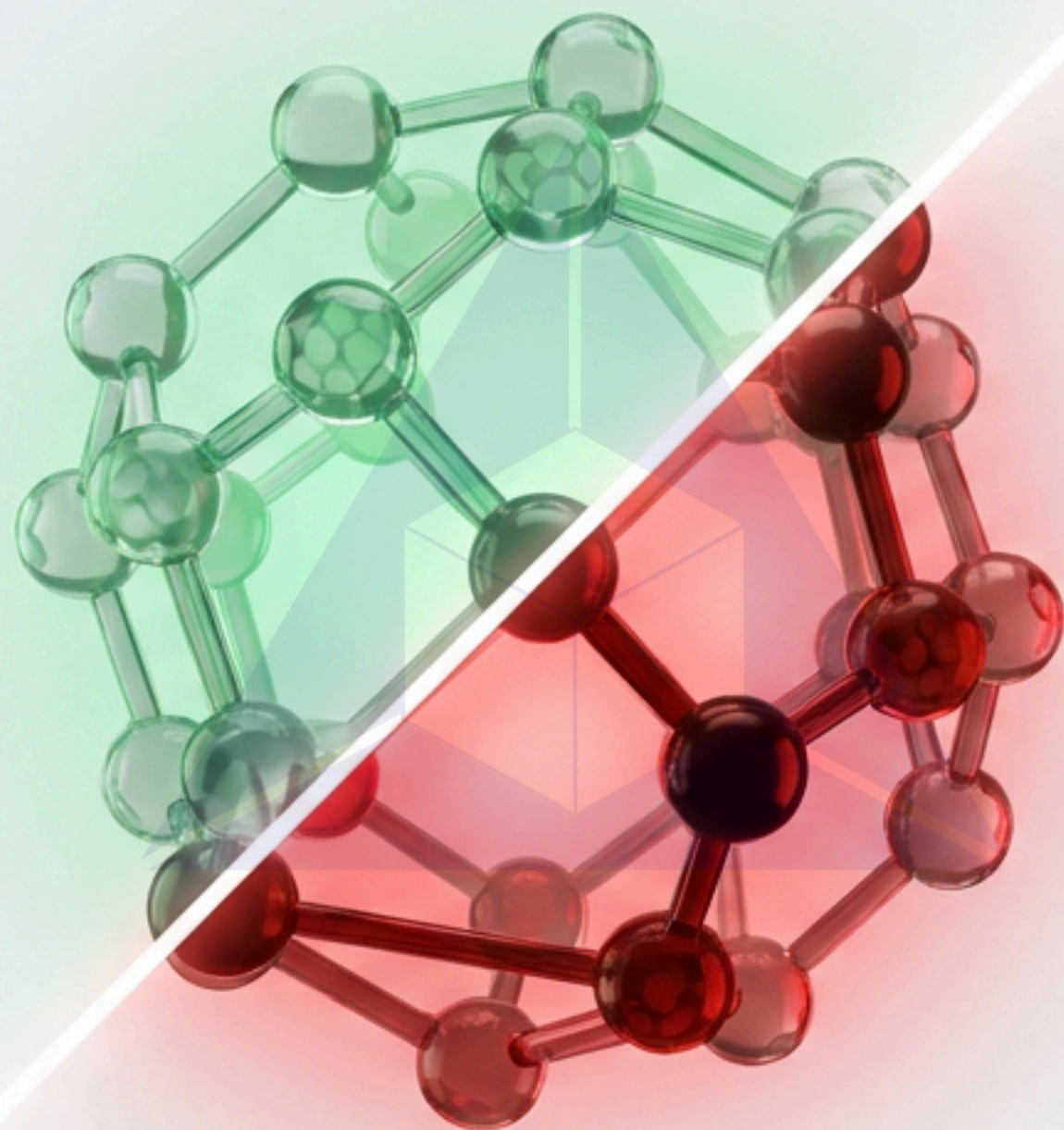


Clinical Dossier

Hazard Analysis

Polyhalogen Compounds: Useful but Risky

Balancing 20th-century industrial application with long-term biological and environmental hazards.



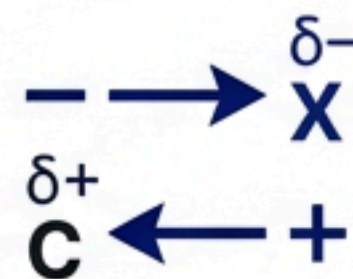
Defining Polyhalogen Compounds



● Carbon
● Halogens

Carbon compounds containing more than one halogen atom.

$X = F, Cl, Br, I$



Highly polarized C—X bonds. Carbon holds a partial positive charge; Halogens hold a partial negative charge.



Heavier than water.
High boiling points.
Immiscible in water but highly soluble in organic solvents.

The Ecological Paradox



Widely utilized across industry and agriculture, yet fundamentally persistent in the environment due to their high resistance to breakdown by soil bacteria.

Dichloromethane

CH₂Cl₂ / Methylene Chloride



Industrial Applications

- ✓ Solvent for paint removers.
- ✓ Propellant in aerosols.
- ✓ Process solvent in pharmaceutical drug manufacture.
- ✓ Metal cleaning and finishing fluid.

CNS Toxicity Alerts

Low-Level Air Exposure

Slightly impaired hearing and vision.

High-Level Air Exposure

Dizziness, nausea, tingling, and numbness in the fingers and toes.

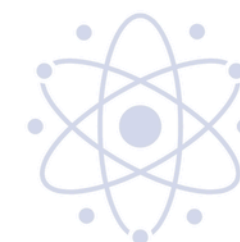
Direct Contact

Intense skin burning and redness; directly burns the cornea upon eye contact.



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Chloroform

CHCl_3 / Trichloromethane



Historical

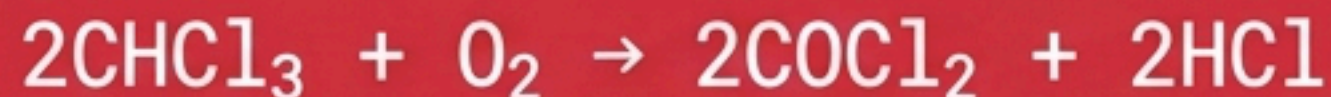
Once widely utilized as a general surgical anaesthetic.

Modern

Solvent for fats and alkaloids; primary feedstock for producing Freon R-22 refrigerants.

Alert Box

Slowly oxidizes in air and light to produce **carbonyl chloride (phosgene)**—an extremely poisonous gas. To prevent this, it must be stored in **completely filled, dark-colored bottles**.



Depresses the central nervous system (CNS). Chronic exposure damages the kidneys and liver, where chloroform actively metabolizes into phosgene.

Clinical profile

Iodoform

CHI₃ / Triiodomethane

Historical Application

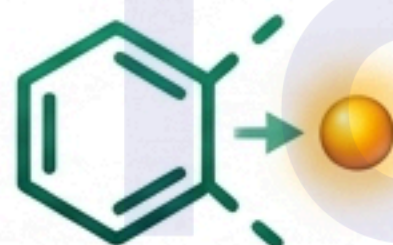


Historical Application

Historically produced in large quantities as a topical medical antiseptic.

Mechanism of Action

The Free Iodine Mechanism



The antiseptic properties do not originate from the iodoform molecule itself. Instead, efficacy relies entirely on the continuous liberation of free iodine upon contact with tissues.

Modern Status



Modern Status

Largely abandoned in modern medicine. Replaced by newer iodine-containing formulations specifically due to iodoform's highly objectionable and lingering odor.

Carbon tetrachloride (CCl₄)

Utility: Refrigerant manufacture, aerosol propellant, historical degreaser and fire extinguisher.

Hazard: Severe liver toxicity/cancer, coma, irregular heartbeat.

Macro Impact: Rises to atmosphere, causing severe ozone layer depletion.

Freons (e.g., Freon 12 - CCl₂F₂)

Utility: Aerosol propellants and global air conditioning. Extremely stable, non-toxic, non-corrosive gases.

Hazard: Their extreme stability allows them to diffuse unchanged into the stratosphere.

Macro Impact: Initiates radical chain reactions that upset the natural ozone balance.

p,p'-DDT



Utility: First chlorinated organic insecticide. Eradicated malaria/typhus (Nobel Prize, 1948).

Hazard: Mass insect resistance and extreme toxicity to fish.

Macro Impact: **Bioaccumulation.** High fat solubility means it is never metabolized rapidly; it builds up continuously in animal fatty tissues.



The Utility: Essential solvents, global disease vector control (malaria), medical synthesis, and the foundation of global refrigeration.



Ozone Depletion: Increased UV rays, skin cancer, immune system disruption.

Persistence: Absolute resistance to soil bacteria breakdown.

Bioaccumulation: Toxic buildup concentrating in the fatty tissues of global food webs.

The Great Paradox: The exact chemical stability that made polyhalogen compounds foundational to 20th-century progress is what makes them enduring threats to the global ecosystem.



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