

5. CHLORINATED ORGANIC SOLVENTS AND FOOD CONTAMINATION

Trichloroethylene, tetrachloroethylene and dichloromethane are examples of chlorinated organic solvents: carbon- and chlorine-containing substances used mainly in industry. Their behaviour and distribution differ from those of many persistent organic pollutants, and they are not ubiquitous food contaminants. They may nevertheless come into contact with water resources, certain raw materials or processing environments. Understanding these circumstances is more useful than indiscriminately labelling them all 'poisons in food'.

WHAT ARE THEY AND WHY HAVE THEY BEEN USED?

A solvent is a substance capable of dissolving other substances. Some chlorinated solvents have been used to degrease metals, clean equipment, treat materials or serve as chemical manufacturing intermediates. Trichloroethylene (TCE, historically known as trichloroethylene degreasing solvent) and tetrachloroethylene (PCE or perc, also called perchloroethylene) are two historically important examples. Dichloromethane, or methylene chloride, is also a chlorinated solvent, but has different properties, applications and exposure profiles. Findings concerning one molecule should not be extended to all the others.

Volatility is an important characteristic: many of these substances can pass from water or a damp surface into the air. For some, a density higher than water and their behaviour in the ground can promote persistent subsurface contamination sources. However, 'volatile' does not mean that a substance disappears immediately or is harmless.

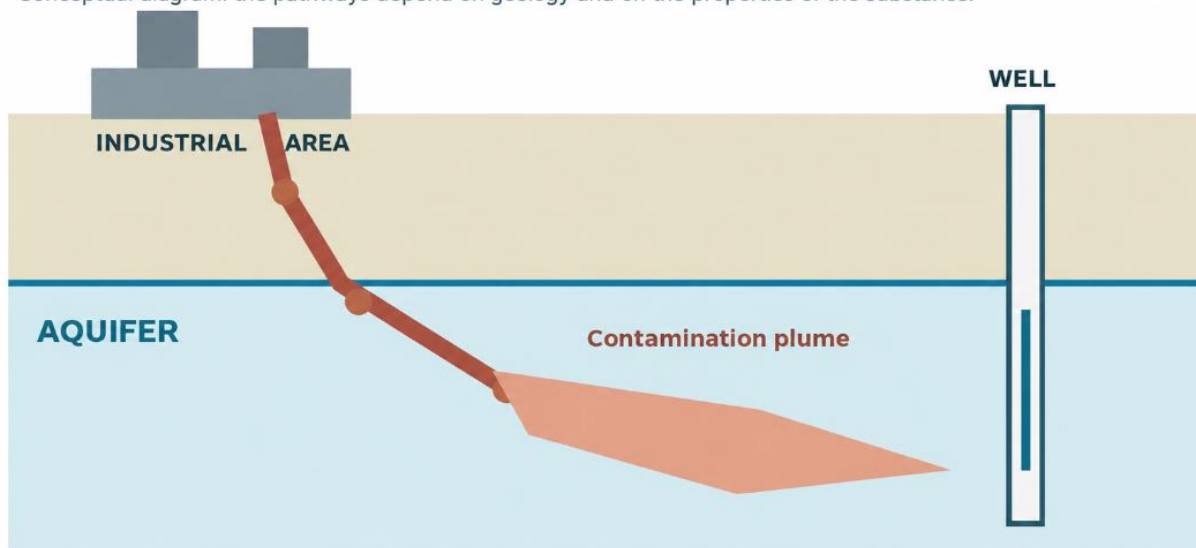
FROM INDUSTRIAL ACTIVITIES TO SOIL AND WATER

Release pathways include accidental leaks, improper disposal, seepage from older facilities and historical pollution of industrial sites. After reaching the ground, some solvent may evaporate, some may spread through soil pores and some may reach groundwater. Under favourable geological and hydrogeological conditions, a contamination plume may extend beyond the original release area.

For food safety, a particularly plausible pathway at contaminated sites is the use of affected water for drinking, preparing or washing food, or certain processing operations. The importance of agricultural transfer depends on crop species, compound, soil properties, irrigation and the substance's fate during growth and processing. Finding a solvent in groundwater does not automatically establish that it is present in the harvested crop.

CHLORINATED SOLVENTS: FROM THE INDUSTRIAL SITE TO THE AQUIFER

Conceptual diagram: the pathways depend on geology and on the properties of the substance.



Detection in groundwater does not automatically demonstrate presence in food.

FOOD CONTAMINATION: POSSIBLE EVENTS, NOT A GENERAL RULE

Apart from water, food or its packaging may occasionally be exposed to solvent vapours in storage or processing premises, or to residues from contaminated materials and equipment. Such possibilities require case-by-case documentation. They do not demonstrate that chlorinated solvents are ordinarily present across all product categories.

Dietary exposure depends on the concentration in the food consumed and on the quantity and frequency of consumption. Volatility may reduce concentrations during some processing operations, but the outcome depends on time, temperature, ventilation, process geometry and matrix composition. Cooking should therefore not be presented as an invariably effective decontamination method.

TRICHLOROETHYLENE AND TETRACHLOROETHYLENE: TWO DISTINCT PROFILES

The International Agency for Research on Cancer (IARC) has classified trichloroethylene as carcinogenic to humans (Group 1), on evidence that includes its association with kidney cancer. Tetrachloroethylene is classified as probably carcinogenic to humans (Group 2A). These classifications identify carcinogenic hazard; they do not establish the probability of developing cancer from consumption of a particular food.

Toxicological assessments also consider non-cancer outcomes and distinguish acute from chronic exposure, uptake routes and vulnerable populations. Much evidence comes

from occupational, environmental or experimental studies. Applying it directly to dietary scenarios requires caution and a specific dose estimate.

DICHLOROMETHANE AND OTHER CHLORINATED SOLVENTS

Dichloromethane usefully illustrates that chemical families are not homogeneous risk categories. Its high volatility makes inhalation particularly important in certain applications. Before assuming its presence in food, an investigation must establish a plausible source, contact conditions and whether residues could persist until consumption.

Other chlorinated compounds, such as chloroform, may arise from different processes, including the formation of water-disinfection by-products. These cases must not be confused with industrial solvent releases, as sources and prevention measures can differ considerably.

HOW ARE THEY TESTED IN SAMPLES?

Many volatile solvents are analysed by gas chromatography combined with detection systems, frequently mass spectrometry. Sampling and sample preservation are critical because volatile compounds can be lost before analysis. A 'not detected' result must therefore be interpreted alongside the detection or quantification limit, the exact list of analytes and the method's suitability for the matrix.

The AOX parameter (adsorbable organically bound halogens) is an aggregate indicator used mainly for certain aqueous matrices; it is not a measurement of individual volatile solvents. An AOX value does not identify TCE, PCE or dichloromethane. Conversely, targeted analysis of those solvents does not necessarily measure every compound contributing to AOX. These analytical approaches answer different questions.

WHAT DOES EUROPEAN LEGISLATION PROVIDE?

Directive 2009/32/EC governs extraction solvents that may be used in the manufacture of food and ingredients, setting conditions and maximum residues where applicable. The list of solvents authorised for particular processes must not be confused with a general authorisation to use any industrial solvent. TCE and PCE do not appear among the authorised extraction solvents in the Annex I examined.

Regulation (EU) 2023/915 establishes maximum levels for certain contaminants in the foods expressly specified in Annex I. It is not, by itself, a universal schedule of food limits for every chlorinated solvent. Individual cases require a distinction between rules applying

to food, drinking water, chemicals and general food safety. These are not interchangeable benchmarks.

HOW TO INTERPRET A POSSIBLE FINDING

An analytical finding must be accompanied by a concentration, reliable sampling information and evidence of method performance. Exposure estimates must then account for the amount of food consumed and its frequency of consumption. Only then, by comparison with relevant toxicological reference points and uncertainties, can risk be discussed. Detecting a substance classified as hazardous is not in itself a diagnosis of health risk to consumers.

The most effective prevention involves controlling industrial sources, protecting water resources, monitoring contaminated sites and applying food-chain self-check procedures. Food testing can be valuable when there is a credible exposure scenario, but it cannot replace environmental source control.

SCIENTIFIC AND REGULATORY REFERENCES

- [1. IARC \(2014\). Trichloroethylene, Tetrachloroethylene, and Some Other Chlorinated Agents. Monographs, Vol. 106.](#)
- [2. WHO \(2022\). Chemical fact sheets: Trichloroethene. Guidelines for Drinking-water Quality.](#)
- [3. WHO \(2022\). Chemical fact sheets: Tetrachloroethene. Guidelines for Drinking-water Quality.](#)
- [4. European Union. Directive 2009/32/EC on extraction solvents used in the production of foodstuffs and food ingredients \(consolidated text\).](#)
- [5. European Union. Regulation \(EU\) 2023/915 on maximum levels for certain contaminants in food \(current and consolidated versions\).](#)
- [6. IARC. Agents classified by the IARC Monographs \(current list and explanation of classification groups\).](#)