

CHLORINATED PARAFFINS

Overview

Chlorinated paraffins (CPs) are a complex group of manmade compounds, primarily used as coolants and lubricants in metal forming and cutting. They also are used as plasticizers and flame retardants in rubber, paints, adhesives, sealants and plastics ([#Environmental Health News, 2010](#)).

They present an important class of chlorinated straight-chained hydrocarbons in the carbon range of C10 to C30+. CPs are typically subdivided into three categories based on their carbon chain lengths:

Short-chain	C10-C13
Mid-chain	C14-C17
Long-chain	C17-C30+

Mid-chain chlorinated paraffins (MCCPs) represent the largest production and use category in North America; long-chain chlorinated paraffins (LCCPs) are the second-most common, and short-chain chlorinated paraffins (SCCPs) account for the rest ([#Chlorinated Paraffins, 2009](#)).

SSCP have the greatest potential to present a risk of environmental effects.

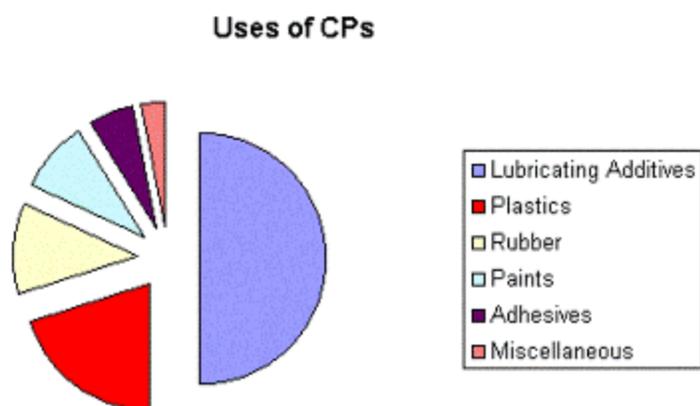
SCCPs are found worldwide in the environment, wildlife and humans. They are [bioaccumulative](#) in wildlife and humans, are persistent and transported globally in the environment, and toxic to aquatic organisms at low concentrations ([#EPA](#)).

Since their introduction in the 1930s, chlorinated paraffins have received little attention from U.S. authorities. But now the EPA, in an unprecedented move, has placed SCCPs on a short list of worrisome chemicals that the agency may regulate because of the risks they pose to wildlife and the environment. Although Europe has restricted use of SCCPs, their manufacture is growing in China and possibly in India, raising concerns that worldwide exposure levels for people and wildlife might be increasing ([#Environmental Health News, 2010](#)).

A global ban on SCCPs is being considered under the [Stockholm Convention](#).

Uses

The primary application of CPs is in industrial cutting fluids, particularly in the manufacture of automobiles and automobile parts. In addition to their use in cutting oils, CPs are also used in a lot of commercial paints, adhesives, sealant and caulks. The figure below provides an estimated breakdown on the different uses of CPs in the United States ([#CPIA](#)):



The major CP producer in North America is Dover Chemical Corporation, located in Dover, OH ([#CPIA](#)):

Chemical Description

Chlorinated paraffins (CPs) are produced by chlorination of straight-chained paraffin fractions. The carbon chain length of commercial chlorinated paraffins is usually between 10 and 30 carbon atoms, and the chlorine content is usually between 40 and 70% by weight. Chlorinated paraffins are viscous colourless or yellowish dense oils with low vapour pressures, except for those of long carbon chain length with high chlorine content (70%), which are solid.

Chlorinated paraffins are practically insoluble in water, lower alcohols, glycerol and glycols, but are soluble in chlorinated solvents, aromatic hydrocarbons, ketones, esters, ethers, mineral oils and some cutting oils. They are moderately soluble in unchlorinated aliphatic hydrocarbons. Chlorinated paraffins consist of extremely complex mixtures, owing to the many possible positions for the chlorine atoms. The products can be subdivided into groups depending on chain length (short C10-13, intermediate C14-17 and long C18-30) and degree of chlorination (low (< 50%) and high (> 50%)) ([#IPCS](#)).

Synonyms: Chlorinated alkanes; chlorinated hydrocarbon waxes; chlorinated paraffin waxes; chlorinated waxes; chloroalkanes; chlorocarbons; chloroparaffin waxes; paraffin, chlorinated; paraffins, chloro; paraffin waxes, chlorinated; paraffins, chlorinated; poly-chlorinated alkanes; polychloro alkanes ([#Wisconsin, Department of Natural Resources](#)).

Routes of Exposure and Metabolism

The primary non-occupational routes of exposure to SCCPs include ingestion, both directly and through contaminated food, and dermal contact with products. Chlorinated paraffins have been isolated from human liver, kidneys, adipose tissue and breast milk. Due to their potential for environmental transport, SCCP exposure may occur from sources far from their use and release. For example, SCCPs have been found in breast milk samples taken from Inuit women ([#UNEP, 2009](#)).

There is potential for inhalation exposure to SCCPs in metalworking fluids from mists generated during metal shaping operations. EPA estimated that potential inhalation exposure ranges from 1.8 to 8.3 mg/day for this scenario. There is also potential inhalation exposure to mists in uses where products containing SCCPs are spray applied such as in paints, adhesives and sealants. EPA estimated the potential for occupational dermal exposure for various manufacturing, formulation and use scenarios to range up to 1800 mg/day. These exposures could be mitigated by the use of personal protection equipment, such as gloves that have been demonstrated to be effective in preventing permeation by SCCPs and formulations containing SCCPs ([#EPA](#)).

The [toxicokinetics](#) of chlorinated paraffins have been studied in experimental animals. Adequate information for humans is not available. Distribution of chlorinated paraffins occurs mainly in the liver, kidney, intestine, bone marrow, adipose tissue and ovary. Chlorinated paraffins or their metabolites are present in the central nervous system up to 30 days after administration. They may cross the blood-placental barrier. There is no adequate information on the pathways of metabolism of chlorinated paraffins, although in radiolabelling studies CO₂ has been identified as an end-product. Chlorinated paraffins may be excreted via the renal, biliary and the pulmonary routes (as CO₂). The total elimination of chlorinated paraffins decreases as the chlorine content increases, and compounds with high degrees of chlorination are mainly excreted (more than 50%) as CO₂. Chlorinated paraffins may be excreted in milk ([#IPCS](#)).

Health Effects

Acute Health Effects

Acute toxicity of SCCPs (C₁₀-13) is very low. SCCPs may cause skin and eye irritation upon repeated application, but do not appear to induce skin sensitization (UNEP, 2009).

Chronic Health Effects

Chlorinated paraffins (average chain length C₁₂; approx. 60% chlorine by weight) are listed on the [International Agency for Research on Cancer's](#) (IARC) Carcinogen List as "Possible

Carcinogens." On the U.S. [National Toxicology Program](#) (NTP) Carcinogen List they are listed as "Reasonably Anticipated to Be a Carcinogen."

There are no data on fertility or developmental effects for humans. No changes in reproductive organs were observed in a 13 week study with rats and mice dosed with 5000 and 2000 mg/kg/day of an SCCP. In addition, developmental effects were observed in rats at 2000 mg/kg/day but not at lower doses ([#UNEP 2009](#)).

Environmental Health Effects

Environmental releases of chlorinated paraffins can occur anywhere along the life-cycle chain from manufacture, transport, use, to disposal. However, it is widely agreed, because manufacture and transfer occur within closed systems, that the most likely source of releases comes from use and disposal in dispersive use applications such as metalworking.

The most ecologically significant impacts occur when CPs are released to water and sediment. Because of their low solubility in water, they are thought to be transported in water by adherence to particles and are strongly adsorbed to sediment. In air, CPs are thought to travel in a similar fashion by adhering to particles.

Chlorinated paraffins are considered to be relatively persistent. They have been shown to break down under the action of bacteria, but this biodegradation takes place relatively slowly and none of the grades tested was judged to be 'readily biodegradable'. The rate of biodegradation was found to be higher for grades with lower chlorine content and where bacteria had become acclimatised to chlorinated paraffins ([#Euro Chlor](#)).

Laboratory tests have been carried out to measure the levels present in fish exposed to chlorinated paraffins compared to those present in the water; this ratio is called the [bioconcentration factor](#) (BCF). In tests carried out with trout, the BCF was found to be approximately 8,000 for short-chain grades and approximately 1,000 for medium-chain grades, whilst for long-chain grades it was only about 50 ([#Euro Chlor](#)).

SCCPs are highly toxic to aquatic invertebrates following acute (48-hr EC50 = 0.043 to 11 mg/L) and chronic (NOEC = 0.005 to 2 mg/L) exposures. In fish high toxicity is associated with chronic exposures, but not for acute exposures (96-hr LC50 = 300 to 10,000 mg/L and NOEC = 0.0096 to 0.05 mg/L). For aquatic plants, there is high toxicity associated with both acute and chronic exposures to SCCPs (96-hr EC50s range from 0.043 to 0.39 mg/L and NOEC ranges from 0.012 to 0.39 mg/L) ([#UNEP, 2009](#)).

Regulation

On November 30, 1994, EPA expanded the list of chemicals subject to the Toxics Release Inventory (TRI) reporting requirements. Included on the expanded list was a category of "polychlorinated alkanes (C10-13)," the bulk of which are short-chain chlorinated paraffins ([#CPIA](#)).

US EPA included chlorinated paraffins and also chlorinated olefins on the 1990 High Production Volume (HPV) Chemical List. The purpose of the EPA HPV program list is to provide basic hazard information about chemicals that are produced or imported in quantities greater than one million pounds per year.

Chlorinated paraffins are not regulated hazardous wastes under the Federal Resource Conservation and Recovery Act (RCRA) system. Nonetheless, because many chlorinated compounds have been the focus of regulatory attention, questions are often raised about proper disposal practices for used CPs([#CPIA](#)).

Currently EPA is taking an action plan, under which regulations to restrict or even ban all short-chain paraffins (together with eight [phthalates](#), and two types of perfluorinated compounds: perfluorinated sulfonates and perfluoroalkyl carboxylates) are being considered ([#Environmental Health News, 2010](#)).

The EU has restricted SCCP use in metalworking fluids ([#Chlorinated Paraffins, 2009](#)).

The International Maritime Goods Code (IMDG) lists C10-13 grades as "severe marine pollutants." Other types are not listed in IMDG so long as the CPs does not contain more than 1 % of C10-13 products ([#Euro Chlor](#)).

Ways to Reduce Exposure

OSHA's (Occupational Safety and Health Administration) Safe Handling Practices for CPs ([#CPIA](#)):

Respiratory Protection	Normally not needed; For oil type mist, use NIOSH approved respirator
Ventilation	Special ventilation not required under normal conditions of use
Protective Gloves	Use impervious gloves
Eye Protection	Use chemical goggles or face shield

Other Protective Measures	Clean clothes; Use apron or chemical suit where splash can occur
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Source : <http://www.toxipedia.org/display/toxipedia/Chlorinated+Paraffins>