Canadian Environmental Protection Act, 1999

Follow-up Report on a PSL1 Substance for Which There Was Insufficient Information to Conclude Whether the Substance Constitutes a Danger to the Environment

Chlorinated Paraffins

April 2004

SYNOPSIS

Chlorinated paraffins (CPs) are chlorinated derivatives of n-alkanes, having carbon chain lengths ranging from 10 to 38 and a chlorine content ranging from 30 to 70% by weight. CPs, include short chain chlorinated paraffins (SCCPs) (CPs with 10–13 carbon atoms), medium chain chlorinated paraffins (MCCPs) (CPs with 14–17 carbon atoms) and long chain chlorinated paraffins (LCCPs) (CPs with ≥18 carbon atoms).

CPs that appeared on the first Priority Substances List (PSL1) were assessed to determine whether they should be considered “toxic” as defined under the *Canadian Environmental Protection Act* (CEPA). With the data available at that time, it was concluded in the PSL1 assessment that SCCPs were “toxic” because they were constituting or may constitute a danger in Canada to human life or health under paragraph 11(c) of CEPA 1988; however, there was insufficient information to conclude whether SCCPs, MCCPs or LCCPs could have immediate or long-term harmful effects on the environment under paragraph 11(a) or whether MCCPs or LCCPS could be considered “toxic” under paragraph 11(c). .

Subsequent to the completion of the PSL1 assessments, a revised CEPA, CEPA 1999, came into effect. Paragraph 64(a) of CEPA 1999 has a definition of “toxic” that is similar to that in paragraph 11(a) under the original CEPA, and addresses whether a substance has or may have an immediate or long-term harmful effect on the environment. However, in CEPA 1999 paragraph 64(a) has been expanded to include effects on biodiversity. Research to address data gaps relevant to the assessment of impacts on the environment was funded. Recent literature was reviewed for new data on concentrations in the environment, as well as for information on the effects on human and non-human organisms.

Total reported annual usage of CPs in Canada (production + imports – exports) was approximately 3000 tonnes in 2000 and 2001. MCCPs accounted for a large majority of CP usage in Canada, followed by smaller proportions of SCCPs and LCCPs. The major uses of CPs in Canada are in plastics, in lubricating additives and in metalworking. There is only one manufacturer of CPs in Canada, and only MCCPs and LCCPs are produced at this facility. In 2000, their production capacity was reported to be 8.5 kilotonnes.

There are no known natural sources of CPs. The major sources of release of CPs into the Canadian environment are likely the formulation and manufacturing of products containing CPs, such as polyvinyl chloride (PVC) plastics, and use in metalworking fluids. The possible sources of releases to water from manufacturing include spills, facility wash-down and drum rinsing/disposal. CPs in metalworking/metal cutting fluids may also be released to aquatic environments from drum disposal, carry-off and spent bath. These releases are collected in sewer systems and often ultimately end up in the effluents of sewage treatment plants. When released to the environment, CPs tend to partition primarily to sediment or soil.

In this assessment, the LCCPs were divided into two groups: (1) $C_{18–20}$ and $C_{>20}$ liquid LCCPs (together referred to as liquid LCCPs) and (2) $C_{>20}$ solid LCCPs. This division was made based on their different physical/chemical properties, which are related to the much higher chlorine content of $C_{>20}$ solid LCCPs relative to liquid LCCPs.

SCCPs have been detected in the following environmental samples from Canada: in Arctic air, in sediments from remote northern lakes, in sewage treatment plant effluents from southern Ontario, in surface water, sediments and fish from Lake Ontario and in marine mammals from the Canadian Arctic and the St. Lawrence River. MCCPs have been detected in effluent from a CPs manufacturing facility near Cornwall, Ontario, and also in sediments near this facility, in fish from Lake Ontario and in beluga from the St. Lawrence River. Internationally, MCCPs have been detected in sewage sludge, surface water near a CPs manufacturing plant, sediments, fish, aquatic invertebrates and earthworms. Maximum Canadian concentrations of SCCPs and MCCPs were observed in aquatic biota and sediments from the St. Lawrence River and also in sediments and fish from southwestern Ontario. No data on environmental concentrations in Canada exist for LCCPs. They have been detected in marine sediments, crabs and mussels near a CPs manufacturing facility in Australia.

Atmospheric half-lives for many CPs are estimated to be greater than 2 days. In addition, SCCPs have been detected in Arctic biota and lake sediments in the absence of significant sources of SCCPs in this region, which suggests that long-range atmospheric transport of SCCPs is occurring. SCCP and MCCP residues have been detected in Canadian lake sediments dating back over 25 years, suggesting that the half-lives of SCCPs and MCCPs in sediment are greater than 1 year. There are no data available for LCCPs in Canadian lake sediments; however, based on their physical/chemical properties, which are similar to those of MCCPs, LCCPs are expected to be persistent in sediments. It is therefore concluded that SCCPs, MCCPs and LCCPs are persistent as defined in the Persistence and Bioaccumulation Regulations of CEPA 1999.

Bioaccumulation factors (BAFs) of 16 440–25 650 wet weight (wet wt.) in trout from Lake Ontario indicate that SCCPs are bioaccumulating to a high degree in aquatic biota in Canada. This is supported by very high bioconcentration factors (BCFs) for SCCPs measured in mussels (5785–138 000 wet wt.). Despite the lack of valid laboratory studies of BCFs and BAFs, MCCPs and liquid LCCPs have been found to have significant potential to bioaccumulate in aquatic food webs: field BAFs for MCCPs in Lake Ontario fish are estimated to range from 7.77×10^5 to 5.45×10^6 wet wt.

Furthermore, MCCPs were found to have biomagnification factors (BMFs) greater than 1 in the Lake Ontario food web and in laboratory studies with rainbow trout and oligochaetes. The LCCP $C_{18}H_{30}Cl_7$ had BMF values greater than 1 in rainbow trout in laboratory studies, and its half-life in rainbow trout was found to be similar to those of recalcitrant compounds that are known to accumulate in organisms and magnify in food chains. In addition, MCCPs and LCCPs have octanol–water partition coefficient (log K_{OW}) values greater than 7, elevated concentrations of MCCPs have been measured in aquatic biota from the St. Lawrence estuary, the United States and Australia, and elevated concentrations of LCCPs have been found in marine benthic organisms in Australia. Therefore, based on these data, as well as the physical/chemical similarities of CP chain lengths, it is concluded that SCCPs, MCCPs and liquid LCCPs meet the bioaccumulation criteria as defined in the Persistence and Bioaccumulation Regulations of CEPA 1999.

In cases where appropriate Canadian environmental exposure data were not available, international concentration data were used for the risk quotients. Conservative risk quotients indicate that SCCPs, MCCPs and liquid LCCPs have the potential to harm pelagic and soil organisms, that SCCPs and MCCPs may harm benthic organisms and that SCCPs have the potential to harm fish-eating wildlife through food chain effects. Based on the limited toxicity data available and the use of environmental exposure data for liquid LCCPs, $C_{>20}$ solid LCCPs appear to have low potential to harm Canadian wildlife through food chain effects. However, no toxicity studies for $C_{>20}$ solid LCCPs were available with daphnids, which was the most sensitive organism for SCCPs, MCCPs and liquid LCCPs.

As CPs have been found to persist in the environment and to have the potential to bioaccumulate, risk assessments for these compounds were more conservative than for compounds not meeting the criteria defined in the Persistence and Bioaccumulation Regulations of CEPA 1999.

There are special concerns about persistent and bioaccumulative substances. Persistent substances can remain in the environment for long periods of time, increasing the probability and the duration of exposure. In addition, the long-range atmospheric transport of persistent substances may result in low-level, widespread contamination. Bioaccumulative substances have the potential to biomagnify; consequently, releases of extremely low concentrations of persistent and bioaccumulative substances may — either alone or in combination with similar substances — cause severe adverse effects.

Based on the information available, it is proposed that SCCPs, MCCPs and $C_{18–20}$ and $C_{>20}$ liquid LCCPs are entering the environment in quantities or concentrations or under conditions that have or may have an immediate or long-term harmful effect on the environment or its biological diversity. Therefore, it is proposed that SCCPs, MCCPs and $C_{18–20}$ and $C_{>20}$ liquid LCCPs be considered “toxic” as defined in paragraph 64(a) of CEPA 1999. SCCPs, MCCPs and $C_{18–20}$ and $C_{>20}$ liquid LCCPs are persistent, bioaccumulative and predominantly anthropogenic and thus they also meet the criteria for Track 1 substances under the Government of Canada Toxic Substances Management Policy, making them candidates for virtual elimination.