

Toxics Use Reduction Institute
Policy Analysis
PRELIMINARY DRAFT – FEBRUARY 2017

Halogenated Hydrocarbons: C1-C4 Not Otherwise Listed

This draft document provides preliminary information on the proposed category referred to as Halogenated Hydrocarbons: C1-C4 Not Otherwise Listed (C1-C4 NOL). This preliminary draft includes only a subset of the information that will be included in the full policy analysis. It has been prepared as an introductory draft for discussion at the February 2017 meeting of the TURA Advisory Committee.

Introduction

This document provides background information on a proposed category designated as Halogenated Hydrocarbons: C1-C4 Not Otherwise Listed (C1-C4 NOL). If this group of chemicals is added to the TURA list, companies in TURA-covered industry sectors with ten or more employees would be subject to TURA requirements if they manufacture or process 25,000 lb/year, or otherwise use 10,000 lb/year, of this group of chemicals. They would be required to file annual toxics use reports, pay annual toxics use fees, and develop a toxics use reduction plan every two years.

1. Category Overview

This document discusses a proposed new category referred to as Halogenated Hydrocarbons: C1 to C4 Not Otherwise Listed (C1-C4 NOL). This category is defined as chemicals with 4 or fewer carbons, at least one halogen, and only hydrogen as the other constituent, that are not already individually listed on the TURA chemical list.

Development of this category resulted from discussions surrounding the addition of n-propyl bromide (nPB) to the TURA list in 2009. During the Science Advisory Board (SAB) discussion of nPB, it was noted that regrettable substitutions can occur readily; small changes to chemicals currently on the market can result in the introduction of other, similarly toxic chemicals that are not regulated. The SAB has now evaluated a range of similar chemicals, in order to support an effort to avoid regrettable substitutions.

Number of chemicals. The TURA program has identified a few hundred possible chemicals that would be part of this category. However, only a fraction of those chemicals are in commerce in the US, and many fewer are expected to be used in reportable quantities in Massachusetts.

Chemical characteristics. The chemicals in the proposed category have similar chemical structures, health effects, and use profiles as other chemicals that are already listed. For context, it may be helpful to understand that a number of chemicals already identified as Higher Hazard Substances under TURA meet the criteria for this category. These include trichloroethylene (TCE), perchloroethylene (PCE or “perc”), and 1-bromopropane (n-propyl bromide, or nPB). Other chemicals that meet this description and are already listed under TURA, but not designated as HHS, include chloroform and Freon 113. Reporting on these and other listed substances would not change with the addition of this category; the category would cover only those chemicals that are not already listed individually.

Universe of chemicals. As shown in Appendix 1, “Theoretical Universe of Halogenated Hydrocarbons C1-C4,” the chemicals in this category would include halogenated unbranched alkanes with 1 to 4 carbons, halogenated branched alkanes with 4 carbons, halogenated cyclic alkanes with 3 or 4 carbons, halogenated alkenes with 2 to 4 carbons, and potentially halogenated alkynes (this last is theoretically possible, but not commercially available).

2. State of the science

Based on the SAB’s review, central nervous system (CNS) effects are found consistently across the chemicals in this proposed category. Additional hazards noted for many of these chemicals include target organ toxicity (cardiovascular, liver, kidney, gastrointestinal, blood); reproductive and developmental toxicity; carcinogenicity; and respiratory effects. In addition, many of them are ozone depleting chemicals and/or are greenhouse gases.

3. Use information

The chemicals in this proposed category may be used as solvents, propellants or refrigerants, among other uses.

Solvents. A number of chemicals in the C1-C4 category are likely to have functional properties similar to those of solvents currently on the market.

For example, during its evaluation of n-propyl bromide (1-bromopropane or nPB), the SAB observed that its isomer, 2-bromopropane, was present as a contaminant. 2-bromopropane is more toxic, but is not listed under TURA. The SAB was concerned that businesses could begin using unlisted short-chain halogenated hydrocarbons with similar functional properties, such as 2-bromopropane. This concern about substitution was the original impetus for the SAB to examine other halogenated hydrocarbons and propose creation of this category.

Refrigerants. A number of chemicals in the C1-C4 category are refrigerants. These include many hydrochlorofluorocarbons (HCFCs) as well as other compounds. The SAB included a number of these chemicals in its review. After the SAB's review, TURI obtained a more comprehensive list of refrigerants, and noted which are in commerce according to the TSCA Inventory. For those that had not already been reviewed by the SAB, TURI checked neurotoxicity data. TURI verified that nearly all have evidence of neurotoxicity, consistent with the findings of the SAB for the chemicals they had reviewed.

Massachusetts data available from Tier II. A preliminary review of the 2015 Tier II data shows approximately 135 records for chemicals in this category stored at Massachusetts facilities. The majority of these records are for refrigerants, and fewer refer to solvents. Table 1 shows the results of a preliminary review of these data.

As shown in Table 1, 9 chemicals in the C1-C4 category were reported under Tier II in 2015. Of these 8 are refrigerants and one is a solvent. Most are reported by only a handful of facilities, while others appear to be used more widely. The most commonly reported chemical in the category is 1;1;1;2-Tetrafluoroethane (R134a). These numbers are preliminary, as these data may include some reports from facilities in SIC codes that are not subject to TURA.

Table 1: Preliminary Tier II data review (2015)

	Chemical name	Preliminary number of users	Notes
Refrigerants	1,1,1-Trifluoroethane	1	
	1,1,1,2-Tetrafluoroethane (a.k.a. R134a)	21	Banned in the EU for use in specified automotive air conditioning systems. ¹
	1,1-difluoroethane	1	
	Fluoroform	2	
	Pentafluoroethane	1	
	Refrigerant (NOS)	35	
	R-410	2	
	Tetrafluoromethane	3	
Solvents	Solvent (NOS)	10	

Note: The user numbers shown here may include some SIC codes that are not subject to TURA. This table will be updated after further analysis has been conducted.

National trends in fluorocarbon use. Use trend information is available for fluorocarbons as a group. Fluorocarbons include all organic molecules that contain at least one fluorine. These include chlorofluorocarbons, hydrochlorofluorocarbons, and hydrofluorocarbons, among others. The broad category of fluorocarbons overlaps with the C1-C4 NOL category defined here, so it can be useful to consider these trends. Nationally, the largest use of fluorocarbons is in refrigeration and air conditioning, followed by polymer precursors. Other important uses are in foam blowing agents, aerosol propellants, and solvent cleaning.²

¹ Jebens A et al. 2014. *Chemical Economics Handbook: Fluorocarbons*. IHS Chemical, p. 26.

² Jebens A et al. 2014.

4. Regulatory context (preliminary)

A variety of regulations apply to the chemicals in the proposed C1-C4 NOL category. Selected regulations are noted here.

- A number of chemicals in the proposed C1-C4 NOL category are ozone depleters and are subject to the Montreal Protocol on Substances that Deplete the Ozone Layer. Under the Montreal Protocol, production and consumption of chlorofluorocarbons (CFCs) has been eliminated globally, and hydrochlorofluorocarbons (HCFCs) are being phased out. Economically developed countries, including the US, are committed to having achieved a 99% reduction in HCFC production and consumption by 2015; a 99.5% reduction by 2020; and a 100% reduction by 2030.³
- The US EPA regulates CFCs, halons, HCFCs and HFCs under the Clean Air Act and its amendments. EPA regulations include a market-based system for the phase-out of ozone depleters; controls on ozone depleters as used in refrigeration and automobile air conditioning; prohibitions on certain nonessential uses; labeling requirements; and procurement guidelines, among other elements.⁴
- Massachusetts requires reporting on greenhouse gas emissions that exceed 5000 CO₂ equivalents per year.

³ Jebens A et al. 2014, pp. 18-19.

⁴ Jebens A et al. 2014, p. 22.

Appendix 1: Theoretical Universe of Halogenated Hydrocarbons C1-C4

Halogens

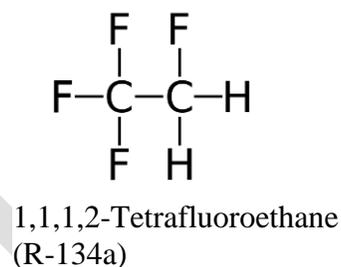
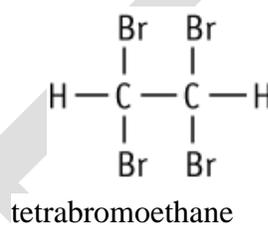
Any combination of Cl, Br, F, I, bonded to hydrocarbon

Hydrocarbon category

Examples of halogenated compounds

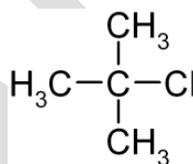
Simple unbranched alkanes (Single carbon bonds)

- C1: - methane
- C2: - ethane
- C3: - propane
- C4: - butane



Branched alkanes

Add methyl or ethyl groups



2-chloro-2-methyl propane

Cyclic alkanes (Single carbon bonds)

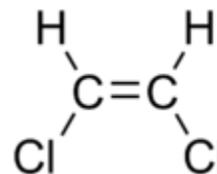
- C3: cyclopropane
- C4: cyclobutane



bromocyclobutane

Alkenes (Double C bonds)

- C2: Ethylene
- C3: propene or propylene (one double bond, 1 single bond)
- C4: butene or butylenes (with one double bond, 2 single bonds)
- C4: butadiene (2 double bonds, 1 single bond)



cis-1,2-dichloroethylene

Alkynes (triple C bond) (not commercially available)