European Chemicals Agency

Substance name: Lead sulfochromate yellow (C.I. Pigment Yellow 34)
EC number: 215-693-7
CAS number: 1344-37-2

MEMBER STATE COMMITTEE SUPPORT DOCUMENT FOR IDENTIFICATION OF LEAD SULFOCHROMATE YELLOW (C.I. Pigment Yellow 34) AS A SUBSTANCE OF VERY HIGH CONCERN BECAUSE OF ITS CMR PROPERTIES

Adopted on 27 November 2009

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Substance Name: Lead sulfochromate yellow (C.I. Pigment Yellow 34)

EC Number: 215-693-7

CAS number: 1344-37-2

The substance is identified as a CMR according to Article 57 (a) and (c) of Regulation (EC) No 1907/2006 (REACH).

Summary of the evaluation:

Pursuant to the first ATP to Regulation (EC) No 1272/2008 (Commission Regulation (EC) No 790/2009[1]) as of 1 December 2010 Lead Sulfochromate Yellow (C.I. pigment yellow 34) will be listed in Table 3.2 (the list of harmonised classification and labelling of hazardous substances from Annex I to Directive 67/548/EEC) of Annex VI, part 3, of Regulation (EC) No 1272/2008[2] as carcinogen category 2[3], R 45 (May cause cancer).

Therefore, this classification of the substance in Commission Regulation (EC) No 790/2009 shows that the substance meets the criteria for classification as carcinogen in accordance with Article 57 (a) of REACH.

Lead Sulfochromate Yellow (C.I. pigment yellow 34) is listed in Annex VI, part 3, Table 3.2 (the list of harmonised classification and labelling of hazardous substances from Annex I to Directive 67/548/EEC) of Regulation (EC) No 1272/2008 as toxic to reproduction category 1, R61 (May cause harm to the unborn child)[4].

Therefore, this classification of the substance in Regulation (EC) No 1272/2008 shows that the substance meets the criteria for classification as toxic for reproduction in accordance with Article 57 (c) of REACH[5].

Registration number(s) of the substance or of substances containing the substance:

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[1] Commission Regulation (EC) No 790/2009 of 10 August 2009 amending, for the purposes of its adaptation to technical and scientific progress, Regulation (EC) No 1272/2008 of the of the European Parliament and of the Council on classification, labelling and packaging of substances and mixtures (1st ATP)

[2] Regulation (EC) No 1272/2008 of the European Parliament and of the Council of 16 December 2008 on classification, labelling and packaging of substances and mixtures, amending and repealing Directives 67/548/EEC and 1999/45/EC, and amending Regulation (EC) No 1907/2006.

[3] This corresponds to a classification as carcinogen 1B, H350 in Annex VI, part 3, Table 3.1 of Regulation (EC) No 1272/2008 (list of harmonised classification and labelling of hazardous substances) as amended by the 1st ATP to (EC) No 1272/2008.

[4] This corresponds to a classification Repr. 1A; H360Df (May damage the unborn child. Suspected of damaging fertility.) in Annex VI, part 3, Table 3.1 of Regulation (EC) No 1272/2008 (list of harmonised classification and labelling of hazardous substances).

[5] This substance is also referred to in the 1st ATP but which does not change its classification as toxic for reproduction.

JUSTIFICATION

This report covers only the Pigment Yellow 34. However, results and information covering "lead chromate pigments" are used in some sections. This information refers to C.I. Pigment Yellow 34 and C.I. Pigment Red 104 and is used for results covering both substances. Individual justification is used for the identification as SVHC while grouping is proposed after their identifications as SVHC and their inclusion on the candidate list.

The yellow lead chromate pigments family is composed of the pure lead chromates, the mixed phase pigment of lead chromate and lead sulphate (lead sulfochromate pigment) and the mixed phase pigment of lead chromate, lead sulphate and lead molybdate (lead chromate molybdate sulphate pigment). The words "lead chromate" or "chrome yellow" are usually used in literature to describe this whole family and can thus mislead for the right substance identification according to their ESIS classification (three different substances).

1 IDENTITY OF THE SUBSTANCE AND PHYSICAL AND CHEMICAL PROPERTIES

1.1 Names and other identifier of the substance

Chemical Name:	lead sulfochromate yellow (C.I Pigment yellow 34)
EC Number:	215-693-7
CAS Number:	1344-37-2
Deleted CAS numbers[6]:	8012-76-8, 61513-05-1, 61513-06-2, 61513-07-3, 81209-53-2
IUPAC Name:	lead sulfochromate yellow

This substance is identified in the Colour Index by Colour Index Constitution Number, C.I. 77600 and 77603[7].

Inventory names[8]:

Pigment Yellow 34 (TSCA, AICS, PICCS, ASIA-PAC, NZIoC)*; Lead sulfochromate yellow;* (EINECS)*; Pigment Yellow 34* (ENCS)*; Pigment Yellow 034* (ECL)*; Mix-Crystal Lead Sulfochromate-Molybdate* (PICCS)*; Chrome Yellow* (PICCS)*; Chrome Yellow Lead Sulfochromate* (PICCS)

Other names[9]:

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[6] These CAS numbers have been deleted from the CA index, but may still be in use by some companies.

[7] 77603 C.I. Number refers to C.I. Pigment Yellow 34:1, which refers in turn to C.I. Pigment Yellow 34, with C.I. Constitution Number 77600, thus both colour index entries are covered by the proposal.

[8] Sources (Environment Canada 2008): National Chemical Inventories (NCI). 2007: AICS (Australian Inventory of Chemical Substances); ASIA-PAC (Combined Inventories from the Asia-Pacific Region); ECL (Korean Existing Chemicals List); EINECS (European Inventory of Existing Chemical Substances); ELINCS (European List of Notified Chemical Substances), ENCS (Japanese Existing and New Chemical Substances); NZIoC (New Zealand Inventory of Chemicals); PICCS (Philippine Inventory of Chemicals and Chemical Substances); and TSCA (Toxic Substances Control Act Chemical Substance Inventory)

C 103; C 103 (pigment); 77600; 77603; C.P. Chrome Yellow Light 1066; Chrome Yellow Light 1074; Chrome Yellow Medium 1074; Chrome Yellow Medium 1085; Chrome Yellow Medium 1298; Chromastral Green Y; Chrome orange; Chrome Yellow 10G; Chrome Yellow 4G; Chrome Yellow 4GL Light; Chrome Yellow 500LSG; Chrome Yellow 5G; Chrome Yellow 5GF; Chrome Yellow 62E; Chrome Yellow 6GL Primrose; Chrome Yellow A 241; Chrome Yellow G; Chrome Yellow GL Medium; Chrome Yellow Lemon; Chrome Yellow LF AA; Chrome yellow light; Chrome Yellow Light Y 434D; Chrome yellow medium; Chrome Yellow Medium Y 469D; Chrome yellow middle; Chrome Yellow NEO 5GS; Chrome Yellow Pigment GMN 35; Chrome Yellow Primrose; Chromium yellow; Dainichi Chrome Yellow 10G; Dainichi Chrome Yellow 5G; Dark chrome yellow; Horna Chrome Yellow dark GL 35; Horna Chrome Yellow GUH 41; Horna Chrome Yellow medium GU 25; Krolor Yellow KY 787D; Krolor Yellow KY 788D; KZh 2; KZh 3; KZh 3 (pigment); Lead sulphochromate; Lemon Chrome A 3G; Lemon Chrome C 4G; Lemon Chrome Yellow 325; Light chrome yellow; Medium chrome yellow; Middle chrome; Middle Chrome BHG; Middle chrome yellow; Perma Yellow 1650S; Perma Yellow 5G; Primrose chrome; Primrose yellow; Pure Lemon Chrome 24882; Pure Lemon Chrome 3GN; Pure Lemon Chrome HL 3G; Pure Lemon Chrome L 3G; Pure Lemon Chrome L 3GS; Pure Middle Chrome 24883; Pure Middle Chrome LG; Pure Primrose Chrome 24880; Pure Primrose Chrome 24881; Pure Primrose Chrome L 10G; Pure Primrose Chrome L 6G; Renol Chrome Yellow Y 2G; Renol Chrome Yellow Y 2RS; Resino Yellow NSR 107; Sicomin Yellow L 1122; Sicomin Yellow L 1630S; Sicomin Yellow L 1635 ; Supra Lemon Chrome 4Gl; Supra Lemon Chrome H 4G; Supra Middle Chrome G; Supra Primrose Chrome 6G

1.2 Composition of the substance

C.I. Pigment Yellow 34 (formula $Pb(Cr,S)O_4$) is a variable solid mixed phase crystal that contains **lead chromate** and **lead sulphate**. This substance is the result of a chemical co-precipitation reaction from other lead and chrome salts (see chapter on manufacturing and uses).

C.I. Pigment Yellow 34 can be considered borderline between a “well defined substance”[10] and an “UVCB substance”[11], with a variable concentration range of lead chromate and lead sulphate. Literature mainly identifies it as an UVCB substance.

For this reason the composition indicated below is given as example but may vary considerably. Tables 2 and 3 display possible compositions of C.I. Pigment Yellow 34.

Main constituent 1: Lead chromate:

Chemical Name:	Lead chromate
EC Number:	231-846-0
CAS Number:	7758-97-6
IUPAC Name:	lead(2+) chromate
Molecular Formula:	$PbCrO_4$ ($CrH_2O_4.Pb$)

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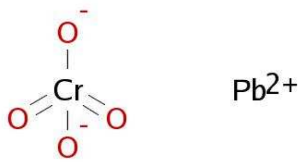
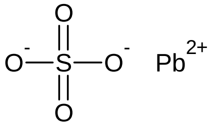
[9] Sources : IUCLID 2000 ; Environment Canada 2008

[10] According to the guidance for identification and naming of substances under Reach, a well defined substance is a “substance with a defined qualitative and quantitative composition that can be sufficiently identified based on the identification parameters of Reach Annex IV item 2”

[11] According to the guidance for identification and naming of substances under Reach, an UVCB substance is a “substance of Unknown or Variable composition, Complex reaction products or Biological materials -UVCB that cannot be sufficiently identified by the parameters of Reach Annex IV item 2”

Structural Formula:	
Molecular Weight:	323.2 g/mol
Typical proportion %	68% (Environment Canada, 2008)
Real proportion (range) in %	61-76% (Environment Canada, 2008) 50-80% (HSBD) 40-90% (Producers and suppliers web sources)

Main constituent 2: Lead sulphate:

Chemical Name:	Lead sulphate
EC Number:	231-198-9
CAS Number:	7446-14-2
IUPAC Name:	lead(2+) sulfate
Molecular Formula:	PbSO4 ($H_2O_4S.Pb$)
Structural Formula:	 $^{-}O-S(=O)_2-O^{-}\ Pb^{2+}$
Molecular Weight:	303.4 g/mol
Typical proportion %	29% (Environment Canada, 2008)
Real proportion (range) in %	20-38% (Environment Canada, 2008) 20 - 50% (HSDB)

1.3 Physico-Chemical properties

Table 1. Summary of available physico-chemical properties useful for this study

REACH ref Annex, §	**Property**	**Value**	**References**
VII, 7.1	Physical state at 20 C and 101.3 KPa	Solid Yellow powder (solid solution crystal)	Iuclid, 2000 Environment Canada, 2008
VII, 7.2	Melting / freezing point	844°C	Lide, 2006
VII, 7.3	Boiling point	unknown	
VII, 7.5	Vapour pressure	insignificant	
VII, 7.7	Water solubility of parent substance (lead sulfochromate yellow)	< 0.01 mg/L (at 20°C) Not soluble	Iuclid, 2000
	Water solubility of $PbCrO_4$ (major component)	0.058 mg/L (at 25°C) 0.17 mg/L (at 20°C)	Weast, 1965 Lide, 2006
	Water solubility of $PbSO_4$ (minor component)	42,5 mg/L (at 25°C)	Nicnas, 2007
	Experimental, total dissolved chromium[12]	0.012; 0.10; 0.179 mg/L	Environment Canada, 2008
	Experimental, total dissolved lead[13]	0.02; 0.36; 0.223 mg/L	Environment Canada, 2008
	Calculated, parent substance[14]	0.062; 0.693; 0.764 mg/L	Environment Canada, 2008
VII, 7.8	Partition coefficient n-octanol/water (log value)	Not applicable	
IX, 7.16	Dissociation constant	unknown	

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[12] Based upon dissolution of the parent substance C.I. Pigment Yellow 34 after 18 to 24 hours of stirring in dilution test water (pH 7.1 to 8.4, room temperature), 0.2 or 0.45 µm filtration and measurement of total dissolved metal in filtrate. The loading rate was 100 to 1000 mg of parent substance per liter.

[13] This is original data taken from C.I. Pigment Red 104 (CAS RN 12656-85-8); the particle size range for C.I. Pigment Yellow 34 is assumed to be similar.

[14] Solubility of the parent substance was back-calculated using the total dissolved concentrations of the metals (Cr, Pb) and information on the composition of that parent substance.

Table 2. Composition range and weight fractions for C.I. Pigment Yellow 34 (Environment Canada, 2008)

Constituent	Composition range (%)	Average composition (%)	Molecular weight (g/mol)		Weight fraction	
			Pb	Other	Pb	Other
$PbCrO_4$	61 - 76	68	207.2	116	44	24
$PbSO_4$	20 - 38	29	207.2	96	20	9
Other	1 - 8	--	--	--	--	--

Table 3. Weight fraction of specific moieties for C.I. Pigment Yellow 34 (Environment Canada, 2008)

Moiety	Composition (%)
Pb	64
CrO_4	24
SO_4	9

2 CLASSIFICATION AND LABELLING

2.1 Classification in Annex VI of Regulation (EC) No 1272/2008

According to Article 57 of the REACH Regulation, substances meeting the criteria for classification as carcinogenic (category 1 or 2) or as toxic for reproduction (category 1 or 2) in accordance with Directive 67/548/EEC may be included in Annex XIV.

Pursuant to the first ATP to Regulation (EC) No 1272/2008 (Commission Regulation (EC) No 790/2009) as of 1 December 2010, the classification of lead sulfochromate yellow in Annex VI, part 3, Table 3.2 of Regulation (EC) No 1272/2008 (list of harmonised classification and labelling of hazardous substances from Annex I to Directive 67/548/EEC) will be as follows:

Index Number: 082-009-00-X

Carc. Cat. 2; R45 (May cause cancer)

Repr. Cat. 1; R61 (May cause harm to the unborn child)

Repr. Cat. 3; R62 (Possible risk of impaired fertility)

R33 (Danger of cumulative effects)

N: R50-53 (Dangerous for the environment: Very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment).

According to the first ATP to Regulation (EC) No 1272/2008, the corresponding classification in Annex VI, part 3, Table 3.1 of this Regulation (EC) No 1272/2008 (list of harmonised classification and labelling of hazardous substances) will be as follows:

Index Number: 082-009-00-X
Carc. 1B; H350

Repr. 1A; H360Df

STOT RE 2; H373

Aquatic Acute 1; H400

Aquatic Chronic 1; H410

2.2 Self classification(s)

Not applicable.

3 ENVIRONMENTAL FATE PROPERTIES

This chapter is not relevant as C.I. Pigment Yellow 34 is identified as SVHC as a CMR substance and not as a PBT or vPvB substance. But since environmental fate properties may be useful to describe human exposure to C.I. Pigment Yellow 34 (Part II of Annex XV dossier on Pigment Yellow 34, Chapter 3: Information on exposure), the most relevant information is reported in annex 1.

4 HUMAN HEALTH HAZARD ASSESSMENT

This chapter is not relevant as C.I. Pigment Yellow 34 has already been classified as a CMR substance. However, some information is available in annex 2.

5 ENVIRONMENTAL HAZARD ASSESSMENT

Not relevant for this type of dossier.

6 PBT, VPVB AND EQUIVALENT LEVEL OF CONCERN ASSESSMENT

This chapter is not relevant as C.I. Pigment Yellow 34 is proposed to be identified as SVHC as a CMR substance and not as a PBT or vPvB substance.

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ANNEX 1: ENVIRONMENTAL FATE PROPERTIES

The most relevant information reported hereafter come from the environmental assessment[15] conducted in 2008 by the Canadian government under section 74 of the Canadian Environmental Protection Act, 1999 (Environment Canada, 2008). Please refer to the full study[16] for more available information

As this substance was not listed in a priority list under Regulation (EEC) 793/93, no risk assessment report (for environment and human health) is available for this substance.

According to the Canadian screening assessment, C.I. Pigment Yellow 34 meets the persistence criteria as set out in the *Persistence and Bioaccumulation Regulations* as it contains metal ions, lead (Pb^{2+}) and the chromate (CrO_4^{2-}) ions, which are themselves considered to be infinitely persistent. The current state of the science does not allow for the unambiguous interpretation of the bioaccumulation potential of metal containing inorganic substances such as C.I. Pigment Yellow 34. Experimental toxicity studies suggest that the substance is not hazardous to aquatic organisms at a loading rate (100 mg/L) that is considered to represent a reasonable environmental worst-case scenario. Additionally, considering its low solubility, it is unlikely that organisms associated with other compartments would be harmed by exposure to this substance.

On the basis of ecological hazard and reported releases of C.I. Pigment Yellow 34, it was concluded that this substance is not entering the environment in a quantity or concentration or under conditions that have or may have an immediate or long-term harmful effect on the environment or its biological diversity, or that constitute or may constitute a danger to the environment on which life depends.

Solubility and dissociation

The measured and estimated solubility in water of C.I. Pigment Yellow 34 is quite low ranging from < 0.01 to 0.764 mg/L with geometric and arithmetic means of 0.135 and 0.382 mg/L respectively. A relatively low proportion of the parent substance is thus expected to dissolve, dissociate and release the lead (Pb^{2+}) and chromate (CrO_4^{2-}) ions in typical aquatic media with a pH between 6 and 8 under conditions that are moderately oxic (~ 0.4-0.7 V, or dissolved oxygen > 4 mg/L). In addition to the low solubility of the parent substance itself, its encapsulation of the substance in paints, plastics and coatings that are made to last for long periods of time and resist harsh environments further restrains the dissolution of the parent substance and therefore further limits the bioavailability of the metals contained in the substance (Environment Canada 2007a; Lewis 1988). According to Pier (1991) silica encapsulated forms of C.I. Pigment Yellow 34 are leached to a substantially smaller extent than the identical pigment lacking silica encapsulation. However, recent literature showed that the particulate forms of Cr(VI) rather than the water soluble ones could be toxic (Xie et al., 2005).

Partitioning

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[15] This substance was identified in the categorization of the domestic substances list as a high priority for action because it was considered to pose greatest potential for exposure to individuals, because it had been classified of carcinogenicity, reproductive toxicity and developmental toxicity and because the substance also met the Canadian ecological categorization criteria for persistence and inherent toxicity to aquatic organisms.

[16] (http://www.chemicalsubstanceschimiques.gc.ca/challenge-defi/batch-lot_2_e.html)

As a metal-containing inorganic substance, a fate analysis based on log K_{ow} and K_{oc} is not applicable to C.I. Pigment Yellow 34. Since C.I. Pigment Yellow 34 is a solid and has a negligible vapour pressure, it is not expected to partition to air. Because of the strong tendency of these metals to sorb solid particles in aquatic media, a significant proportion of dissolved forms of these metals will end up in sediments, through the settling of suspended particles (Hamilton-Taylor et Willis 1984).

Therefore, the moieties of concern issued from the dissolution and dissociation of C.I. Pigment Yellow 34, Pb^{2+} and CrO_4^{2-}, are expected to be found in water, sediments and soils but not in air. Note that some non-dissolved C.I. Pigment Yellow 34 (as the parent substance) is also expected to be found in sediments and moist soils. When released to dry soils, C.I. Pigment Yellow 34 will mainly remain there with some of the substance leaching locally into ground and/or surface water ecosystems when the soil gets soaked by rain or melting snow/ice. The solid parent substance is not expected to be found in significant amounts in water, considering that its density is a few times greater than that of water.

Persistence and Bioaccumulation Potential

Environmental Persistence

The substance C.I. Pigment Yellow 34 is considered persistent according to criteria as set out in the Canadian *Persistence and Bioaccumulation Regulations* as both of its moieties of concern, the lead (Pb^{2+}) and the chromate (CrO_4^{2-}) ions are considered infinitely persistent.

Potential for Bioaccumulation

The current state of the science does not allow for the unambiguous interpretation of the significance of various measures of bioaccumulation (e.g., BCFs, BAFs) for metal-containing inorganic substances. Therefore, such substances are evaluated only on the basis of their properties relating to toxicity and persistence (Environment Canada 2003). It is anticipated that evolution of scientific understanding will eventually allow broader interpretation of the potential for bioaccumulation for such substances.

The PBT and vPvB criteria of Annex XIII to the REACH Regulation do not apply to inorganic substances, although they shall apply to organo-metals.

ANNEX 2: HUMAN HEALTH HAZARD ASSESMENT

The European Commission has concluded that C.I. Pigment Yellow 34, together with lead chromate and C.I. Pigment Red 104, "show(s) evidence for carcinogenicity in several studies with rats after subcutaneous and intramuscular administration. Lead chromate induced both benign and malignant tumours at the site of injection and, in one study, renal carcinomas. The animal studies are supported by epidemiological studies demonstrating an increased frequency of lung cancer among workers involved in production of chromate pigments. The animal studies are also supported by genotoxic(ity) studies as well as cell transformation studies. The substances show resemblance to known mutagens/carcinogens" (ECB 2003).

Whereas the toxicologic profile and properties of the substance may be useful to evaluate the human exposure, main conclusions from the screening assessment conducted by the Canadian government under section 74 of the Canadian Environmental Protection Act, 1999 are reported hereafter for information (Environment Canada 2008). See the full study for more available information.

Bioavailibility and absorption

The low solubility of C.I. Pigment Yellow 34 is indicative of limited bioavailability. The bioavailability of lead chromate and lead-chromate-derived pigments has been investigated in experimental animals. Administration of non-encapsulated or silica-encapsulated Chrome Yellow/lead chromate to rats by gavage (150 mg/kg-bw/day, five days per week, for four weeks) resulted in an increased level of lead in the blood and kidneys. No chromium could be detected in blood from exposed rats (detection limit = 10 µg/L). The kidney levels of chromium were increased significantly only in rats treated with non-encapsulated pigment. These results indicate that silica encapsulation reduces the gastrointestinal bioavailability of chromium from lead chromate pigments (Clapp et al. 1991; Pier et al. 1991). Administration of lead chromate to rats via whole body inhalation (5.3 ± 0.8 mg CrVI /m^3, 4 hours per day for 1 to 4 days) led to the accumulation of both chromium and lead chromate in the lungs. The chromium concentration in urine and feces were significantly increased following administration, whereas both chromium and lead concentrations in blood were only slightly elevated (above 5 µg/L for chromium) (Bragt et al. 1990). In addition, a short-term study in male rats showed that lead did not migrate from polypropylene plastic coloured with lead chromate-molybdate following oral administration (Gage and Litchfield 1967). Investigations employing other routes of administration, including intratracheal injection, instillation and infusion to the tracheal lobe bronchus, of lead chromate or lead paint resulted in increased lead and chromium levels in various tissues and retention in the lungs (Bragt and van Dura 1983; Perrault et al. 1995; Eaton et al. 1984). Finally, it was recently shown that the particulate forms of Cr(VI), rather than the water soluble ones, were the potent carcinogens (Xie et al, 2005).

Workers in a plastic production plant exposed to dust containing various chemicals, including lead and lead chromate, had significantly increased chromium levels in their urine samples. Their blood lead levels were also significantly increased, but not their serum chromium levels (Boscolo et al. 1997). Other occupational studies (McAughey et al. 1988; Wiegand et al. 1988) also showed that the urine and blood chromium levels in lead chromate pigment production workers were higher than those typically observed in non-occupationally exposed persons (Iyengar and Woittiez 1988). In two lead chromate-based paint factories in the UK, blood lead levels were detected in a range of 9-25 µg/L for warehouse men, a range of 10-36 µg/L for ball mill loaders, and a range of 9-15 µg/L for spray painters. The author stated that these levels were commonly found in non-lead workers (Cowley 1984).

In conclusion, there is uncertainty regarding the bioavailability of this substance; however, limited data from the bioavailability studies in experimental animals and observations in occupationally exposed humans suggest that lead chromate and its derived pigments have some level of bioavailability and absorption after exposure. In addition, although genotoxicity of the pigment or lead chromate is generally more pronounced after dissolution in acid or base, positive results were also obtained in aqueous media. However, encapsulation of the pigment has been shown to reduce bioavailability and genotoxicity in some studies.

Epidemiological surveys

Human epidemiological investigations have been conducted in occupational settings in various geographic locations with an attempt to identify the relationship between occupational engagement in lead chromate pigment production and cancer risk. Workers in this industry were exposed not only to the pigments themselves but also to the soluble hexavalent chromium compounds used as raw materials in the pigment production. The majority of the results showed an increased risk of lung cancer among the workers in the plants where both lead and zinc chromate pigments were produced (Sheffet et al. 1982; Hayes et al. 1989; EEH 1976; EEH 1983; Davies 1979; Davies 1984; Haguenoer et al. 1981; Deschamps et al. 1995; Fentzel-Beyme 1983; Korallus et al. 1993). The only exception is the study conducted in five chromate pigment production plants in Japan where no significantly increased mortality due to lung cancer was observed (Kano et al. 1993). The authors stated this might be because the amount of hexavalent chromium compounds in the work environment has been lowered as a result of engineering hygiene considerations such as improved ventilation, the wearing of masks, attention to work clothes and bathing after work. Two epidemiological studies conduced in the plants where only lead chromate pigments were produced reported a slightly elevated risk in respiratory tract tumour, but no statistical significance has been reached (Davies 1979; EEH 1983). The authors speculated that the numbers of observed and expected deaths were too small in these studies for definitive conclusions. With respect to lead chromate pigment use, the only available epidemiological investigation did not indicate a statistically significant association between spray painting and respiratory-cancer-caused mortality (Chiazze et al. 1980).

Based on the above, the Canadian screening assessment concluded that several epidemiological investigations conducted in occupational settings in various geographic locations have shown an increased risk of lung cancer among the workers in the plants where both lead and zinc chromate pigments were produced. But it is underlined that there is uncertainty concerning the actual exposure levels of the workers in some of the epidemiological investigations as workplace exposure monitoring data were not available and protective measures were sometimes implemented during the time period of studies (Environment canada 2008).

According to producers (DCC, 2009), any lung cancer has been attributed over 60 years to exposure to C.I. Pigment Yellow 34 and the observed excess of cancer deaths is more linked to a mixed exposure to soluble zinc, strontium or calcium chromate, which are known carcinogens, than to C.I. Pigment Yellow 34.