

Controlling Lead Chromate Pigments *The Case for a Rotterdam Convention Listing*

The IPEN Lead Paint Elimination Campaign May 1, 2023



CONTROLLING LEAD CHROMATE PIGMENTS The Case for a Rotterdam Listing

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Chapter 1: Introduction

<u>IPEN</u> is campaigning to promote a decision by the <u>Rotterdam</u> <u>Convention</u> to list lead chromates in its Annex III and make them subject to the Convention's Prior Informed Consent (PIC) procedure.

This paper presents information about lead chromates that may be of interest and use to campaign participants; to others in the IPEN network; and to anyone who supports <u>IPEN's *Toxics Free Future*</u> <u>goal.</u>

The objective of <u>IPEN's Lead</u> <u>Chromates Listing Campaign</u> is a decision by the Rotterdam Convention's Conference of the Parties (COP) to list lead chromates at its 2025 meeting.

What Happens When Lead Chromates are Listed By the Rotterdam Convention.

When the Rotterdam COP lists lead chromates they will become subject to the Convention's PIC procedure. This means that any company that exports lead chromates and/or paints, or any other product that contains lead chromates as an intentional ingredient, will be required to get the consent of the receiving country before shipping it.

If lead chromates are listed, all 165 country Parties to the Rotterdam Convention will be expected to decide, within nine months, whether or not to give their consent to imports of lead chromates and to imports of mixtures, such as paints, that contain lead chromates as intentional ingredients.



A Party can decide to consent to no imports; consent to all imports; or consent to imports only under specified and well-defined conditions. A Party can later revise its initial decision and make it stronger (or weaker).

A Convention decision to list lead chromates will help many of the governments that recently enacted legally binding controls on the lead content of paints better enforce them.

It will also make it easier and more likely that governments, which

have not yet enacted legally binding controls on the lead content of paints, will do so.

Why Lead Chromates?

IPEN is focusing on lead chromates because they are the predominant source of lead in paints.

If the Convention decides to list lead chromates, IPEN expects this will speed up the global phase-out and elimination of all lead paints in all countries.

In addition to their primary use as ingredients in paints, lead chromates are also used to color plastics and have some additional minor uses.¹

All the uses of lead chromates are potential sources of lead exposures that can harm human health. Less harmful, cost-effective substitutes are readily available for every use.

If the Rotterdam Convention lists lead chromates and makes them subject to its PIC procedure, governments and others – around the world – will begin to closely scrutinize all the uses of lead chromates. IPEN expects that this scrutiny will result in eventual decisions to phase out and eliminate all remaining uses of lead chromates.

For more information on how a Rotterdam Convention listing will accelerate global lead paint elimination, see Chapter 5.

¹ See Chapter below on Uses of Lead Chromates

Chapter 2: What are Lead Chromates?

Lead chromates are a family² of bright yellow, orange, and red pigments that are commonly used as ingredients in paints (mainly in solvent-based decorative paints and in industrial coatings). Lead chromate pigments give the paint its hue and color. They also help protect underlying surfaces from wear and corrosion.

The Lead Chromate Family

The family of lead chromate pigments has three members.

Lead chromate (CAS number

7758-97-6) Lead chromate is a yellow crystalline pigment whose chemical



formula is PbCrO₄. It is sometimes used as a paint ingredient, but its primary use is for manufacturing the two other lead chromate pigments: lead sulfochromate yellow and lead chromate molybdate sulphate red.

Lead sulfochromate yellow (CAS

1344-37-2; called Lead Sulfate

Chromate in some jurisdictions) Lead sulfochromate yellow is a



yellow crystalline pigment commonly used as an ingredient in paints. It is a mixed-phase pigment each of whose crystals typically contain 61% to 76% lead chromate; 20% to 38% lead sulphate (PbSO₄); and possibly 1% to 8% other substances.³

Lead chromate molybdate sulphate red (CAS 12656-85-8)

Lead chromate molybdate sulphate red is an orange or red crystalline pigment that is



commonly used as an ingredient in paints. It is a mixed-phase pigment. Each crystal is typically 69% to 80% lead chromate; 9% to

² According to an EU document: "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 (emphasis added).

See the European Chemical Agency's SVHC support document for lead sulfochromate yellow, adopted November 2009, on page 3.

https://echa.europa.eu/documents/10162/cd44c55f -3473-4c73-a356-ce732b2f3d87

³ Source: European Chemical Agency's *SVHC support document for lead sulfochromate yellow;*

https://echa.europa.eu/documents/10162/cd44c55f -3473-4c73-a356-ce732b2f3d87

15% lead sulphate; 3% to 7% lead molybdate (PbMoO₄); and possibly 3% to 13% other substances.⁴

Common Names for Lead Chromates

Lead chromate pigments have many common names.

Yellow-colored lead chromate pigments are often called *Chrome Yellow; Middle Chrome; Lemon Chrome; Primrose Chrome; Medium Chrome Yellow; Pigment Yellow 34;* and many other common and/or commercial names.

Orange- and red-colored lead

chromate pigments are often called Molybdate Orange; Molybdate Red; Chrome Vermilion; Vynamon Scarlet; Pigment Red 104; and many other common and/or commercial names.

More information on lead chromates

Appendix 2: lead chromates' common names and identifiers.

Appendix 3: factors that influence the colors and properties of lead chromate pigments.

https://echa.europa.eu/documents/10162/624c215 1-d7f2-47d7-ab26-7f4996e81e36

⁴ Source: European Chemical Agency's *SVHC support document for lead chromate molybdate sulphate red*;

Chapter 3: The Lead Chromate Hazard

Lead chromates exhibit toxicity from both their lead and their hexavalent chromium content.

Lead Toxicity. Lead chromates are approximately 65% lead (Pb), by weight. A person who ingests or inhales lead chromate is exposed to lead and will suffer the harmful health effects of lead toxicity.

Hexavalent Chromium Toxicity.

Lead chromates are approximately 16% chromium (Cr), by weight. The chromium is in a form called <u>hexavalent chromium</u>,⁵ which is highly toxic and is carcinogenic by nature.

Although the hexavalent chromium toxicity of lead chromates is of serious public health concern, IPEN's efforts to list lead chromates in Annex III of the Rotterdam Convention will be primarily based on recent regulatory decisions by low- and middle-income countries to control the lead content of paints. In these countries, the campaign will focus, almost entirely, on lead chromates' lead toxicity.

Lead Toxicity

Whenever lead chromate is used as an ingredient in paint or in another product, it becomes a source of human lead exposure.

According to the European Commission:

The central nervous system is the main target organ for lead toxicity. The developing brain is more vulnerable to the neurotoxicity of lead than the mature brain. Apart from developmental neurotoxicity in young children, lead can also cause cardiovascular effects and nephrotoxicity in adults.⁶

The World Health Organization says that lead "*is particularly harmful to young children," and that* "*there is no level of exposure to lead that is known to be without harmful effects.*"⁷

Lead exposure in young

children. A young child who is exposed to lead in even very small amounts can suffer lead-induced neurological impairments or

⁵ The term *Hexavalent Chromium* is a name for the element chromium whenever it occurs in the valance state +6. This includes all chromates and numerous other chromium compounds.

⁶ Lead in Food, The European Commission, <u>https://food.ec.europa.eu/safety/chemical-</u> <u>safety/contaminants/catalogue/lead_en</u>

⁷ Lead poisoning: Key facts; World Health Organization; October 2021; <u>https://www.who.int/news-room/fact-sheets/detail/lead-poisoning-and-health</u>

deficits. These deficits are lifelong and irreversible. In many cases, they cannot be clinically diagnosed (because the child's IQ and/or behavior patterns may remain within what is considered a *normal range*).

The health effects of low-dose lead poisoning in young children are very real, and they can negatively affect the child's life prospects.

Population studies have shown that lead-induced neurological impairments and deficits can reduce a child's intelligence (as



measured by IQ tests); make a child less successful in school

(as measured in grades and graduation rates); decrease attention span; increase impulses toward violent behavior; increase a child's likelihood of incarceration later in life; and reduce the child's lifelong earnings.

Lead exposure pathways. Paints that contain lead chromate pigments are probably the most

widespread source of lead exposure in young children. These paints often are used in and around homes, schools, and other places where young children live and play. Painted surfaces always weather, wear, and deteriorate over time.

There is no known safe threshold for lead exposure in young children:⁸ Exposure to any amount of lead has the potential to cause neurological deficits. For this reason, lead chromates should be controlled and regulated as a nonthreshold toxicant in young children.

They are also often scraped or sanded prior to repainting. If the paint contains a lead chromate pigment, leaded paint fragments enter indoor dust and outdoor soil. Young children at play will dirty their hands with lead-contaminated dust and soil. They will, typically, put their hands in their mouths and suck on their fingers. When they do this, they ingest lead.

Ingesting fragments of deteriorated lead paint is a well-documented,

⁸ This was first clearly stated in a 2011 monograph on Lead Exposure approved by the Joint FAO/WHO Expert Committee on Food Additives (JECFA). The monograph exhaustively reviews relevant medical and scientific literature on human lead exposure and states in its concluding section: "the dose–response

analyses do not provide any indication of a threshold for the key effects of lead ..." See: *Safety evaluation of certain food additives and contaminants; LEAD* (*addendum*); page 481,

https://inchem.org/documents/jecfa/jecmono/v64je 01.pdf.

major lead exposure pathway for young children. Other uses of lead chromates are also potential sources of lead exposure.

Occupational lead exposure. In addition to harming the health of young children, lead exposure is also harmful to adults. It causes hypertension and is a risk factor for heart disease, stroke, and chronic kidney disease.⁹

A report from the Australian Government describes occupational exposures to lead chromates (and other lead compounds) that are used in industrial surface coatings:¹⁰

Occupational exposure can occur from accidental spillage during import, transport and warehousing. During manufacture of industrial surface coatings and inks, workers can be exposed to the chemicals from loading mixing vats, packing finished product and in the event of accidents. Use of the products can lead to dermal and inhalation exposure to dusts and aerosols. Exposure is likely to be particularly high during surface preparation by sanding, prior to use of the industrial surface coatings, where old coatings containing lead (e.g. automotive panels and bridge repair) are removed. Exposure during sanding is mainly through inhalation of lead containing dust while spray painting could result in high exposure to aerosols and mists.

It is also reported that workers who come home with lead (from lead chromates or other sources) on their hands or clothes can become a source of lead exposures in their children.

Hexavalent Chromium Toxicity

The chromium that is present in lead chromates is in a form that toxicologists refer to as *hexavalent chromium.*¹¹ According to most

⁹ Lead and the heart: an ancient metal's contribution to modern disease, by Philip J Landrigan, in The Lancet, March 12,2008,

https://www.thelancet.com/journals/lanpub/article/ PIIS2468-2667(18)30043-

^{4/}fulltext#:~:text=Lead%20has%20long%20been%20 recognised,stroke%2C%20and%20chronic%20kidney %20disease.&text=The%20relationship%20between %20blood%20lead,and%20its%20cardiovascular%20 risk%20implications

¹⁰ Lead Compounds In Industrial Surface Coatings & Inks, a report from the Australian Government Department of Health and Ageing, September 2007, page v,

https://www.industrialchemicals.gov.au/sites/defaul t/files/PEC29-Lead-compounds-in-industrial-surfacecoatings-and-inks.pdf

¹¹ More precisely, the term *Hexavalent Chromium* refers the element chromium whenever it occurs in the valance state +6. This includes all chromates and numerous other chromium compounds including chromic acid (which is used in electroplating). Hexavalent chromium can also be emitted when steel that contains chromium alloys is welded. For more information about hexavalent chromium; see: Hexavalent Chromium; U.S. Occupational Safety and Health Administration, 2009,

expert sources, human exposures to hexavalent chromium occurs mainly in the workplace.

Primary routes of hexavalent chromium exposure include breathing air that contains suspended particles; ingesting hexavalent chromium compounds in food or water; or direct contact with the skin.¹²

The United States National Toxicology Program states, with no qualifications, that hexavalent chromium compounds "are known to be human carcinogens based on sufficient evidence of carcinogenicity from studies in humans."¹³

The European Chemicals Agency, whose Infocard for lead chromate focuses on its hexavalent chromium toxicity, states that lead chromate:

...may cause cancer, may damage the unborn child and is suspected of damaging fertility, ... and may cause damage to organs through prolonged or repeated exposure.¹⁴

https://www.osha.gov/sites/default/files/publications/OSHA-3373-hexavalent-chromium.pdf

¹² *Hexavalent Chromium*; U.S. National Institute of Environmental Health Sciences;

https://www.niehs.nih.gov/health/topics/agents/he x-chromium/index.cfm

¹³ *Chromium Hexavalent Compounds*; from Report on Carcinogens, Fifteenth Edition; U.S. National

Toxicology Program, December 2021: https://ntp.niehs.nih.gov/ntp/roc/content/profiles/c hromiumhexavalentcompounds.pdf ¹⁴ ECHA Substance InfoCard https://echa.europa.eu/substance-information/-/substanceinfo/100.028.951

Chapter 4: Uses of Lead Chromates

Lead chromates have mainly been used as pigments in paints. They are also often used as colorants in plastics and other synthetic polymer-based materials. There are other lead chromate uses, but they all appear to be relatively minor, or obsolete.

Lead Paint

Lead chromates are used as pigments in the manufacture of yellow-, orange-, red-, and greencolored¹⁵ solvent-based paints¹⁶ and industrial coatings. Some countries have established regulatory controls that effectively prohibit the manufacture, import, sales, and use of all paints and coatings that contain a lead chromate pigment as an intentional ingredient.

Some others have adopted regulations that control the lead content of decorative (architectural) paints, but do not address the lead content of some or all industrial paints and coatings.

Most of the world's countries, however, have still not adopted any regulatory controls on the lead content of paints. And in these countries, paints that contain lead chromate pigments are still widely available for sale and use.

Paint and coating products are sometimes divided into two broad categories: **decorative paints** and **industrial paints and coatings**. It should be noted, however, that these distinctions are imprecise, and that so-called "*industrial paints*" are often sold for home use.

Decorative

paints. Decorative paints are paints used to coat indoor and outdoor walls, and other surfaces, of homes, schools, offices, and



other commercial buildings. Some are water-based and some are solvent-based. The decorative paint category also includes wood finishes, enamels, and sometimes primers, putties, and the like. These paints are typically purchased for use by consumers, by painters, and by painting

¹⁵ Green paints are often produced using a mixture of a lead sulfochromate pigment and a blue pigment.
¹⁶ Replacement of lead pigments in solvent based decorative paints, IPEN, 2015,

https://ipen.org/sites/default/files/documents/Repl acement%20of%20lead%20pigments%20in%20solve nt%20based%20decorative%20paints.pdf

contractors. In 2021, the decorative paint segment accounted for 52.7% of the global paints and coatings market.¹⁷

Most of the larger transnational paint companies have stated they no longer use leaded pigments in any of their decorative paints. Lead chromate pigments, however, are still used in decorative paints produced by smaller transnational, national, and local paint companies that service countries that have not yet adopted regulatory controls on the lead content of paints.

Industrial Paints and Coatings.

Industrial coatings are used to protect surfaces and enhance their appearance. Although the use of industrial paints that contain lead chromate pigments has declined in recent years, they are still commonly used in many countries by both large and small manufacturers.

Industrial paints and coatings have many uses including the manufacture of toys, school supplies, sporting goods, and other consumer products used by children. There are numerous, specific categories of industrial paints and coatings including:

- Vehicle Original Equipment (OE) Coatings are used to paint new cars, trucks, and other vehicles. This sector was previously a large user of lead chromate pigments. It appears this sector has now mostly (or completely) discontinued this use, although this is not yet fully confirmed.
- *Road Marking Paints* (sometimes called traffic paints) are high-

visibility paints that are applied to roads, highways, runways, and other vehicle and pedestrian pathways to



communicate important information.

Yellow road marking paints often contain lead chromate pigments. Although the European Union no longer allows the use of lead chromate pigments in road marking paints, other countries still allow this use even though good alternatives are available.

¹⁷ Paints & Coatings. *Global Market Analysis, Insights and Forecast, 2022-2029*; Fortune Business Insights (Sample) from <u>www.fortunebusinessinsights.com</u>

 Vehicle Refinish Coatings are used to touch up or repaint cars, trucks, and other vehicles. Some of the larger transnational paint companies no longer sell refinish coatings that contain lead chromates. But others still produce and sell them. These products can expose the painter to lead.

Auto refinish spraying facilities are sometimes located in urban areas where they can expose nearby residents and passersby. And when a worker comes home with leaded paint on their hands and clothing, they can expose their children.

 Protective and Marine Coatings are used to protect metal surfaces from corrosion by limiting the exposure of the metal to a corrosive environment. Lead chromates are often used as pigments in these applications.¹⁸ Red lead oxide (lead tetroxide) is also commonly used. These paints and coatings typically have very high lead content. They can cause occupational lead exposures. They also create hazardous lead dust when the coated surface is scraped, sanded, or sand blasted prior to repainting.

Although protective (anticorrosive; anti-rust) paints are formally classified as being "industrial," they are often sold for home and school uses (for

playground equipment; fencing; shutters; windows; bicycle and toy refinish;



and others) and are important sources of lead exposures in young children.

 Powder Coatings are dry powders that are sprayed onto metal surfaces. An electric charge can be used to make the coating powder fuse with the surface. And the coated product may be baked in a curing oven to harden the coating. Some powder coatings contain lead chromate pigments.¹⁹

¹⁸ For example, the Canadian lead chromate producer, DCL (formerly Dominion Color Corporation) produces several different lead sulfochromate (PY34) and lead chromate molybdate sulfate (PR 104) pigments specifically marketed for use in the manufacture of industrial paints and powder coatings. See its list of the pigments for industrial paints and coatings that it sells to "the rest of the world" at:

https://www.pigments.com/productsapplications/coatings/rest-of-world/coatingapplications-rest-of-world/industrial-coatingapplications-rest-of-world/

¹⁹ Product specification sheets for the lead chromate pigments manufactured and sold by the Canadian company DCL (formerly Dominion Color Corporation) identify powder coatings as a *recommended* use. See, for example, its specification sheet for its lead

These can expose the factory and transport workers to lead. And lead can be released from the coated product by migration, weathering, wearing, and/or chipping.

 Coil Coatings are used in processes where a coil of sheet metal (steel, aluminum, or other) is unwound; its surface is cleaned and pre-treated; the coil coating is applied in a continuous process; and the sheet is then heat cured.

After the sheet has cooled, it is rewound back into a coil to be shipped for uses such as appliances, office furniture, building products (roofs, sidewall, gutters, etc.), furnaces, hot water heaters, air conditioners, automotive parts, and others. Lead chromate pigments are sometimes used as coil coating ingredients.²⁰

Plastics and Other Synthetic Polymers

In addition to the use of lead chromates as pigments for paints and coatings, they have one additional major use. Lead chromates are widely used as

chromate pigment *DCC Yellow 1002*: <u>https://www.pigments.com/wp-</u> <u>content/uploads/DCC YELLOW 1002 EN TDS.pdf</u> ²⁰ A fact sheet from the U.S. based National Coil

Coating Association lists the pigments commonly used in coil coatings which include pigment yellow coloring agents in plastics, and in other polymer-based materials such as synthetic rubbers, leathers, and textiles.

The use of lead chromates to colorize plastics and synthetic polymers can result in human ingestion of lead. For this and other

reasons, some countries restrict the total lead content of plastic



(or other polymer-based materials) in children's products, in food contact materials, and in other plastic products.

If plastic products that contain lead chromates are recycled, lead spreads uncontrollably into downstream products. Lead is released into leachate if these plastic products are landfilled. And lead is dispersed into the environment (through various pathways) if they are dumped.

Nontoxic and/or significantly lesstoxic colorants are available for every application in which lead

³⁴ and pigment red 104. See: *Pigments for the Coil Coating Industry*, a publication of the National Coil Coating Association,

https://uploads.prod01.oregon.platformos.com/instances/1799/assets/documents/pdfs/Too IKit-7.pdf?updated=1595250503

chromate colorants are currently used. These substitutes are as good or better than lead chromates; they are cost effective; and they are readily available.

Products made from plastic (or from another polymer-based material) that have been colorized using lead chromates cannot be safely or properly recycled. They release lead into the air, into ash, and into other environmental media when burned, incinerated, or otherwise processed.

European Union Directives and the EU REACH legislation have removed almost all products from the European market that contain a plastic (or another polymer-based material) that was colorized with lead chromates.²¹

In the United States, a combination of regulatory controls, international standards, and market forces have greatly diminished the sale and use of products that contain plastic (or another polymer-based material) colorized with lead chromates.²²

On the other hand, lead chromates are still commonly used as colorants in the plastics and other polymer-based materials that go into products destined for sale in low- and middle-income countries. Unless it is constrained (by regulatory controls and/or by market forces) this use of lead chromates is likely to grow.

One reason is the projected, rapid growth of global plastics production (unless a global plastics treaty is able to reverse these projections).

Another reason is that as the sale of lead chromates to paint manufacturers declines (in response to increasing regulatory and other pressures), companies that manufacture and distribute lead chromates have an incentive to replace their lost paint industry sales by actively promoting increased sales for use in plastics (and other polymer-based materials) destined for sale in low-

²¹ Lead in plastics – Recycling of legacy material and appropriateness of current regulations, by Andrew Turner and Montserrat Filella, Journal of Hazardous Materials, 15 February 2021.

https://www.sciencedirect.com/science/article/pii/S 030438942032121X

<u>Section 1. Introduction</u> identifies the EU Directives that have largely eliminated the use of lead chromates as intentional ingredients in polymerbased products for sale on the European market.

²² Lead in plastics – Recycling of legacy material and appropriateness of current regulations, by Andrew Turner and Montserrat Filella, Journal of Hazardous Materials, 15 February 2021. (cited above) <u>Section 1. Introduction</u> identifies the regulatory actions and standards that prevent or discourage the use of lead chromates as ingredients in plastic products destined for use in the US.

and middle-income countries with weak consumer protections.

Other Uses of Lead Chromates

Lead chromates have some additional uses, but they are relatively minor, and some may be

obsolete.

Printing

ink. Lead chromates were once widely used as ingredients



in printing inks to produce yellow, green, orange, and red printed materials. They were once commonly used to print colored pages of newspapers, and more recently, they were widely used to produce the vivid colors on product packaging.²³ IPEN does not have enough information to know the extent to which lead chromates are still commonly used as pigments in printing inks, but suspects this

https://www.nytimes.com/1990/05/13/business/tec hnology-farewell-to-those-old-printing-ink-bluesand-a-few-reds-and-yellows.html practice is no longer as common as it once was. IPEN will continue to investigate this.²⁴

Pyrotechnics. Lead chromate can be used in pyrotechnics for what is called a "*delay composition*:" an ingredient that introduces a delay into the explosive firing train.²⁵ Good alternative ingredients are available, and this appears to be a minor and/or obsolete use. However, more investigation is needed to be certain.

Applications that have employed lead chromates for use as a delay composition include:

- Detonators. Lead chromates have been used in making detonators for the mining and demolition sectors.²⁶
- Fireworks. Lead chromates have been used to make a firework fire in sequences.²⁷
- Model Rockets. In model rockets, lead chromates have

²³ See, for example, *Farewell to Those Old Printing Ink Blues, and a Few Reds and Yellows*, New York Times, May 13, 1990.

²⁴ See Appendix 2 for more information about the use of lead chromates in printer's inks

²⁵ For more information about *Delay Composition* see Wikipedia entry:

https://en.wikipedia.org/wiki/Delay composition ²⁶ See more on the use of lead chromates in detonators in Appendix 2 below

²⁷ Some studies have found high lead particle emissions from some fireworks. For example, one study found that the lead content of the particulate matter released from the explosion of a *Black Cuckoo* firework was 40,000 ppm. See *Toxicity of particles emitted by fireworks*, in Particle and Fibre Toxicology, by Hickey et al. 2020, <u>https://particleandfibretoxicology.biomedcentral.co</u> <u>m/counter/pdf/10.1186/s12989-020-00360-4.pdf</u>. It appears, however, that most of the lead in fireworks comes from the use of lead oxides, not lead chromates. And the use of lead chromates in fireworks appears to be minor.

been used to delay the firing of ejection charges.

 Hand Grenades. Lead chromates have been used to introduce a few seconds of time between triggering a hand grenade and its explosion.

Artists' paints. Lead chromatebased paints and pigments were commonly used by 19th and early 20th century artists. A small number of artists and art students are still willing to risk their health for their art, and some art-supply vendors still supply lead chromatebased art paints.

Art restorationists, on the other hand, have little choice but to carefully use lead chromates and other original artists' materials to do their job. The amount of lead chromates sold and used for artists' paints and for restoring old paintings, however, is quite small.

Ceramic glazes. Some sources indicate that lead chromates are used in ceramic glazes. This may once have been true, but it no longer appears to be common.

There is a misperception that traditional pottery commonly produced and used in Mexico, Morocco, and elsewhere has lead chromates in their glazes. Lead in traditional pottery glazes is a serious public health concern. But the lead in these glazes comes from naturally occurring lead oxides (and possibly other lead compounds). It does not come from lead chromates,²⁸ which are industrially synthesized chemicals.

Industrially manufactured ceramic tiles sometimes use glazes or frits²⁹ that contains lead. It appears that their lead content usually comes from the use of lead oxides, although some may use lead chromates.

In the past, some industrially mass-produced kitchen ceramics used lead chromate in their glazes. IPEN sees no evidence that this practice is still common.

Some "artistic" artisan potters do use lead chromates in their ceramic glazes for its artistic effects.³⁰ This use, however, appears to be small.

²⁸ See: *Lead Levels in a Potters Population*; Frontiers in Toxicology, March 2022, by Netzy Peralta et al, <u>https://www.frontiersin.org/articles/10.3389/ftox.2</u> 022.799633/full.

²⁹ A frit is a type of ceramic glass. It is a combination of materials that, when melted together, are rendered insoluble and resistant to acid attack. They

are a means of introducing certain materials into a glaze which would otherwise be toxic.

³⁰ See, for example, *Lead Glaze Recipes (No Safety Lectures Please)*; In Clay and Glaze Chemistry, August 25, 2015,

https://community.ceramicartsdaily.org/topic/1253 1-lead-glaze-recipes-no-safety-lectures-please

Reagents. Lead chromate is sometimes used as a reagent for the absorption of sulfur dioxide in commercial CHNS analyzers³¹ (used to analyze the ratio of total nitrogen, carbon, and sulfur in organic matter).

At least one reagent supply company has discontinued selling lead chromate for this application and sells an alternative. The company states that the reason it decided to do so was "*safety considerations for customers and employees.*"³²

³¹ See, for example, the manual for the Elementar brand, Aario EL III, CHNOS Elemental Analyzer at <u>https://studylib.net/doc/18608820/manual_vario-</u> <u>el_e</u>.

³² See Technical Bulletin: Lead Chromate and Alternative: Elemental Microanalysis introduces a

less hazardous alternative to Lead Chromate: <u>https://www.elementalmicroanalysis.com/elementa</u> <u>l blog.php?title=technical-bulletin:-lead-chromate-</u> <u>and-alternative&bid=16</u>

Chapter 5: The Impact of a Rotterdam Listing

Lead is a **non-threshold toxicant** in young children. No level of lead exposure is known to be safe. Therefore, all preventable sources of lead exposure in young children should be prevented.

There is a strong body of evidence demonstrating that all lead exposures are harmful to children's health. Despite the evidence, however, too many children – all over the world – continue having their life prospects diminished because of lead exposure.

IPEN's Campaign

IPEN has been <u>campaigning</u> for the elimination of all production and use of all lead paints in all countries for fifteen years.

IPEN's 2007-9 research on the widespread availability of lead paints in low- and middle-income countries (LMICs) helped stimulate the decision of the United Nations

Environment Programme and the World Health Organization to establish a global partnership to encourage all countries to adopt regulatory controls on the lead content of paints.^{33,34}

IPEN – an active participant in this partnership – supports NGO efforts

in countries in all regions to build awareness about harms to children's health from exposure to lead from lead paints, and to promote national



regulatory controls on the lead content of paints.

IPEN and other participants in the Global Alliance to Eliminate Lead Paint (GAELP) have made important progress in reducing global lead paint sales and use. Most countries, however, have still

https://www.who.int/publications/m/item/sixthsession-of-the-intergovernmental-forum-onchemical-safety---final-report. And see: Global Study to Determine Lead in New Decorative Paints in 10 Countries, https://ipen.org/projects/leadelimination-2009 ³⁴ The Global Alliance to Eliminate Lead Paint, https://www.unep.org/explore-topics/chemicalswaste/what-we-do/emerging-issues/global-allianceeliminate-lead-paint

³³ In 2008, IPEN brought findings about the lead content of paints in LMICs to the Sixth session of the Intergovernmental Forum on Chemical Safety in Dakar, Senegal which then adopted the *Dakar Resolution for Eliminating Lead in Paints*. The resolution called for the formation of partnership to promote "*phasing out of lead in lead-based paints*." And in 2009, IPEN released more extensive findings on lead in paints in LMICs at the 2nd International Conference on Chemicals Management (ICCM2). The ICCM built on the Dakar Resolution and unanimously called upon WHO and UNEP to establish a global partnership to eliminate lead in paints. See: IFCS

Forum 6 Final Report,

not imposed **any** controls on lead in paints. And some countries that adopted lead paint controls have been unable to fully enforce them.

For these reasons, IPEN began looking for new and additional strategies that can advance and accelerate the achievement of its global lead paint elimination goal.

A New Focus on Lead Chromates

IPEN investigated the supply chain of lead-containing ingredients commonly used in paints and concluded that lead chromate pigments should receive focused attention:

- They are the predominant source of the lead in leaded paints.
- Good, cost-effective substitutes are available for **all their uses**.
- They are a well-defined family of hazardous chemicals that can meet all the requirements and criteria for a Rotterdam Convention listing.

A Convention Listing Decision

Because lead chromate pigments are the predominant source of lead in lead paints, countries that recently adopted controls on the lead content of paints can submit documents that formally nominate lead chromates for a Rotterdam Convention listing.³⁵

IPEN and several of its Participating Organizations (POs) have been working to encourage some of the countries that recently adopted lead paint controls to prepare and submit documents that nominate lead chromates.

If the nominations are submitted, and if the Convention's Conference of the Parties decides to list lead chromates in its Annex III, then international trade in lead chromates and in paints (and other products) that contain lead chromates as intentional ingredients will become subject to the Rotterdam Convention's Prior Informed Consent (PIC) procedure.

A decision to list lead chromates will not, by itself, require any country to stop importing lead chromates and/or importing paints (or other products) that contain lead chromates. It will, however,

³⁵ There is a good precedent for this. After countries adopted regulatory controls on the lead content of automotive fuels, they submitted documents that

successfully nominated the predominant leaded ingredient in leaded fuels – tetraethyl lead (TEL) – for a Rotterdam Convention listing.

give countries a tool they can use to control such imports if they choose to use it.

A Convention listing will also send a clear signal that there is international agreement that lead chromates are hazardous chemicals that are harmful to human health.

This, in turn, will encourage governments and others to begin scrutinizing both the benefits and the health risks associated with the continued import and use of lead chromates and of paints (and other products) that contain lead chromates as ingredients.

Using the PIC Procedure to Control Lead in Paints

In most LMICs, the vast majority of lead paints available for sale are either imported or are domestically manufactured using imported lead chromates.^{36, 37}

If lead chromates are listed by the Convention, a government can use the Convention's Prior Informed Consent procedure to deny consent to imports of:

- Lead chromates destined for use as ingredients in the domestic production of paints.
- Paints that contain lead chromate pigments as intentional ingredients.

By using the PIC procedure to deny consent, a government can easily remove most lead paints from its national market.

Every government, of course, will also have the right to give its consent to imports of lead chromates and/or of paints (and other products) that contain lead chromates as intentional ingredients.

For this to happen, however, some government official or agency will need to take responsibility for making the consent decision – a decision that will have clear public health consequences, and that might, additionally, have political consequences.

Final Thoughts

In IPEN's experience, there are few LMICs where knowledgeable government officials support the

³⁶ Paint producers in India, China, and possibly a few other LMICs manufacture lead paints using domestically produced lead chromate pigments. The vast majority of LMICs, however, import all or almost all of the lead chromates they use for domestic paint manufacture.

³⁷ Not all lead paints contain lead chromates. Some anti-corrosive primers contain red lead (lead tetroxide) and some solvent-based paints contain leaded driers. The vast majority of the lead in the paints that are produced and/or used in LMICs, however, comes from the lead in lead chromates.

continued sales and use of lead paints. $^{\rm 38}$

In countries that do not yet regulate the lead content of paints, the main obstacles to taking regulatory action include institutional inertia; weak regulatory capabilities; and covert lobbying (especially by some smaller paint producers and importers).

IPEN expects that a Rotterdam Convention decision to list lead chromates will help:

Overcome institutional inertia.

Governments will have a Convention obligation to decide – within a nine-month time frame – whether or not the country gives its consent to continued imports of lead chromates and of paints that contain lead chromates as ingredients. And if so, under what conditions.

Address resource concerns.

In most countries that have not yet regulated the lead content of paints, the government officials with regulatory responsibilities are highly overburdened and underresourced. Once lead chromates are listed, however, the Convention's PIC procedure will place major enforcement responsibilities on exporting countries. And this will greatly reduce the enforcement burden of imposing regulatory controls on lead paints.

Weaken the influence of prolead paint lobbying. In LMICs,

most of the lobbying against taking regulatory action to control the lead content of paints is done on the quiet, and it mostly focuses on getting officials to avoid or delay taking a regulatory decision.

When lead chromates are listed and governments become obligated to decide within nine months whether or not to impose import controls on lead chromates (and on paints that contain them), continuing to avoid and delay taking a decision becomes burdensome.

Once the Rotterdam Convention decides to list lead chromates, relevant high-level government officials in numerous additional countries will have good reason to begin giving more serious consideration to the human health effects of lead in paint.

³⁸ This is especially the case for leaded decorative paints. But there is also broad support for eliminating lead in all paints. Several resolutions that call upon governments to control the lead content of all paints have been unanimously adopted (by

government delegates from more than 100 countries) at meetings of the International Conference on Chemicals Management (ICCM) and the United Nations Environment Assembly (UNEA).

And because the Convention's PIC procedure will make it much easier for a country to enforce controls on lead paints, IPEN expects many will decide to impose restrictions on imports of lead chromates and on paints that contain lead chromates as ingredients.

Once this happens, it will then become only a small additional step to impose more general controls on lead in paints.

In addition, and by extension, IPEN expects a Rotterdam Convention decision to list lead chromates will also impel governments and others to begin giving closer scrutiny to all the uses of lead chromates.

And once this happens, these other uses of lead chromates will also become vulnerable to demands that they be phased out and eliminated.

Appendix 1: Lead Chromate Names and Designations

Lead chromates are identified in many different ways.

Chemical Abstract Service.

The Chemical Abstracts Service (CAS) is a division of the American Chemical Society and is an internationally recognized source of chemical information. It maintains a registry with information on more than 130 million organic and inorganic substances. It identifies each with its own, unique CAS registry number.

The CAS numbers for the lead chromates are:

- Lead Chromate: CAS # 7758-97-6
- Lead Sulfochromate: CAS # 1344-37-2
- Lead Chromate Molybdate Sulfate: CAS # 12656-85-8.

European Community Number.

The European Community number (EC number) is a unique sevendigit identifier that is assigned to substances for regulatory purposes within the European Union by the European Commission.

The EC numbers for lead chromates are:

• Lead Chromate: 231-846-0

- Lead Sulfochromate: 215-693-7
- Lead Chromate Molybdate Sulfate: 235-759-9

Color Index Constitution Number.

Color Index is a reference database that is jointly maintained by the Society of Dyers and Colourists and the American Association of Textile Chemists and Colorists.

It uses an internationally recognized dual classification system that assigns each dye and pigment a Color Index Generic Name (CIGN) and a Color Index Constitution Number (CICN)

- Lead Chromate
 - The CIGN is Pigment Yellow 34 (PY34)
 - \circ The CICN is CI 77600
- Lead Sulfochromate
 - The CIGN is Pigment Yellow 34 (PY34)
 - $\circ~$ The CICN is CI 77603
- Lead Chromate Molybdate
 Sulfate
 - The CIGN is Pigment Red 104 (PR104)
 - $\circ~$ The CICN is CI 77605

International Union of Pure and Applied Chemistry.

The International Union of Pure and Applied Chemistry (IUPAC) is an international federation of National Adhering Organizations working for the advancement of the chemical sciences, especially by developing nomenclature and terminology.

An IUPAC preferred name is a unique name that is assigned to a chemical substance and is preferred among the possible names generated by IUPAC nomenclature. IUPAC, however, has only – so far – established preferred names for organic compounds. It is still working on nomenclature rules for inorganic compounds such as lead chromates.

Nonetheless, both U.S. regulators and the European Chemical Agency assign IUPAC names to lead chromates. Unfortunately, they assign different names.

Lead Chromate

 In U.S. regulatory documents the IUPAC name for Lead Chromate is given as "dioxido(dioxo)chromium;lead (2+)."³⁹

³⁹ For the IUPAC name as given by PubChem, see <u>https://pubchem.ncbi.nlm.nih.gov/compound/Lead-chromate#section=3D-Status</u>

⁴⁰ For the IUPAC name as given in an ECHA document see

 In ECHA documents the IUPAC name is given as "lead(2+) chromate."⁴⁰

Lead Sulfochromate

- In U.S. regulatory documents the IUPAC name for Lead Sulfochromate is given as "dioxido(dioxo)chromium;lead (2+);tetrasulfate."⁴¹
- In ECHA documents the IUPAC name is Lead Sulfochromate is given as "lead sulfochromate yellow."⁴²

Lead Chromate Molybdate Sulfate

- In U.S. regulatory documents the IUPAC name for Lead Chromate Molybdate Sulfate is given as "dioxido(dioxo)chromium;diox ido(dioxo)molybdenum;lead(2 +);sulfate."43
- In ECHA documents the IUPAC name is given as Lead "chromate molybdate sulfate red."44

https://echa.europa.eu/documents/10162/cd44c55f -3473-4c73-a356-ce732b2f3d87

https://echa.europa.eu/documents/10162/25e3a7a 4-41a4-4f72-8d0f-2ab06a6bf51a

⁴¹ For the IUPAC name as given by PubChem, see <u>https://pubchem.ncbi.nlm.nih.gov/compound/7687</u> 1857.

⁴² For the IUPAC name as given in ECHA documents see

⁴³ For the IUPAC name as given by PubChem, see <u>https://pubchem.ncbi.nlm.nih.gov/compound/Lead-</u> <u>Chromate-Molybdate-Sulfate-Red</u>

⁴⁴ For the IUPAC name as given In ECHA documents, see

https://echa.europa.eu/documents/10162/624c215 1-d7f2-47d7-ab26-7f4996e81e36

Other Names

Some common names for lead chromates are identified in section 2 of the main document. A more extensive list would include:

Names for Lead Sulfochromate

- Chromium Yellow
- Primrose Yellow
- Primrose Chrome
- Middle Chrome
- Chrome Yellow
- Lead Sulfochromate Yellow
- Chromium orange
- Light chrome yellow
- Chromastral Green
- Chrome Yellow Lemon
- Chrome Yellow Light
- Vynamon Yellow
- Chrome Yellow Medium
- Chrome Yellow Middle
- Chrome Yellow Primrose
- Supra Middle Chrome
- Pure Middle Chrome
- Supra Lemon Chrome
- Pure Lemon Chrome
- Krolor Yellow
- Dainichi Chrome Yellow
- Renol Chrome Yellow.⁴⁵

<u>Names for Lead Chromate</u> <u>Molybdate Sulfate</u>

- Molybdate Orange
- Moly Orange
- Molybdenum Red
- Chromate Molybdate Sulfate Red
- Chrome Vermilion
- Molybdate Red
- Molybden Red
- Molybdenum Orange
- Vynamon Scarlet
- Molybdate Chrome Orange
- Mineral Fire Red
- Renol Molybdate Red
- Krolor Orange.⁴⁶

⁴⁵ From *Lead Sulfochromate Yellow*; PubChem, U.S. National Library of Medicine, <u>https://pubchem.ncbi.nlm.nih.gov/compound/1383</u> 94846#section=Synonyms

⁴⁶ Lead Chromate Molybdate Sulfate Red; PubChem, U.S. National Library of Medicine, <u>https://pubchem.ncbi.nlm.nih.gov/compound/1383</u> <u>94069#section=Depositor-Supplied-Synonyms</u>

Appendix 2: Printing Inks and Pyrotechnics

Section 4 of the main paper identifies several uses of lead chromates. It notes that more information is needed for two of these uses: printing inks and pyrotechnics.

Printing Inks. A 1974 study investigated the lead content of leading New York City newspapers. It analyzed the lead content of black and white pages as compared to pages with colored print. The study found that there was a big difference. Black and white pages contained only trace levels of lead. However, the pages that had colored print – especially those with green, yellow, and/or red print – had lead content as high as 2,000 parts per million.⁴⁷

The practice of using lead chromates in printing inks remained common in the U.S. at least into the 1990s, long after the adoption of regulatory controls on the lead content of paints. A 1990 New York Times article, for example, discusses an effort to remove lead chromates and other heavy metal pigments from the inks used to produce brightly colored packaging. According to the article: "Packaging and printing industry officials complain[ed] they may lose some of their most striking colors as a result."⁴⁸

It appears that until at least 2007, Australia still permitted the use of lead chromates in commercial printing inks with restrictions only for "toy materials." According to a government assessment report: "Lead-based inks used in commercial printing processes are not available for consumer use. However, items printed with these inks <u>are used as products or as</u> <u>packaging for products</u>, which are used by consumers."⁴⁹

A 2010 Report prepared for the European Chemicals Agency (ECHA) identifying the uses of lead chromates on the European Market still lists the manufacture of *printing inks* as one of its uses.⁵⁰

⁴⁷ Lead Content of Printed Media (Warning: Spitballs May Be Hazardous to Your Health), by Morris Joselow, American Journal of Public Health, March 1974,

https://ajph.aphapublications.org/doi/pdf/10.2105/ AJPH.64.3.238

⁴⁸ See *Technology; Farewell to Those Old Printing Ink Blues, and a Few Reds and Yellows,* New York Times, May 13, 1990.

https://www.nytimes.com/1990/05/13/business/tec

hnology-farewell-to-those-old-printing-ink-bluesand-a-few-reds-and-yellows.html

⁴⁹ Lead Compounds In Industrial Surface Coatings & Inks, an assessment carried out under Australia's National Industrial Chemicals Notification and Assessment Scheme, September 2007, Page 26, https://www.industrialchemicals.gov.au/sites/defaul t/files/PEC29-Lead-compounds-in-industrial-surfacecoatings-and-inks.pdf

⁵⁰ Service Request on Providing Actual Data on the European Market, Uses and Releases/Exposures for

Pyrotechnics. Most uses of lead chromates in pyrotechnics are likely to be minor or obsolete. The one possible exception is their use in making explosive detonators for mining and demolition.

A 2010 European Union report stated that three companies in two EU countries reported using lead chromates in detonators. It also stated that the European Federation of Explosive Manufacturers claims explosive detonators no longer contain lead.⁵¹ If lead chromates were still used for this purpose within the EU as recently as 2010, this suggests more work may be needed to determine whether this use continues in some other countries.

There is a possible indication that lead chromate may still be commonly used in detonators in India. The Bureau of Indian Standards maintains a Specification for lead chromate for explosive and pyrotechnic: <u>IS</u> <u>7602</u>.⁵² The Foreword to the standard states: "Lead chromate is a synthetic inorganic chemical widely used in the manufacture of delay detonators and in pyrotechnic formulations." It further states that the standard was established to help "lead chromate manufacturers and users to make and procure standard quality of lead chromate" for this use.

The Indian standard for lead chromates in detonators is almost fifty years old: it was established in 1975. There are indications, however, that the standard may still be in active use. A Bureau of Indian Standards website states that that the standard, IS 7602, was reviewed in 2021.⁵³

https://echa.europa.eu/documents/10162/d5d34d4 d-bf57-4fd8-af61-87742f0ff5d8 for Lead Chromate, Final Report, 2010, page 2, https://echa.europa.eu/documents/10162/d5d34d4 d-bf57-4fd8-af61-87742f0ff5d8 ⁵² Indian Standard: Specification for Lead Chromate for Explosive and Pyrotechnic Compositions, https://law.resource.org/pub/in/bis/S02/is.7602.197 <u>5.pdf</u> ⁵³ See: IS 7602 : 1975, Reviewed In : 2021, https://www.services.bis.gov.in/php/BIS_2.0/bis connect/standard_review/Standard_review/Isd

etails?ID=MTQ10DU%3D

Lead Chromate, Final Report, prepared for the European Chemicals Agency (ECHA), July 2010, Table 4.4: Overview of Uses of Lead Chromate in the EU, page 28.

First Entry

[&]quot;Manufacture of paints, varnishes and similar coatings, printing ink and mastics" Page 28

⁵¹ See Service Request on Providing Actual Data on the European Market, Uses and Releases/Exposures

Appendix 3: Factors that Influence the Colors and Properties of Lead Chromate Pigments

Lead chromate pigments come in many different shades and hues of yellow, orange, and red. These differences are partly determined by the ratio of lead chromate (PbCrO₄) to lead sulphate (PbSO₄) to lead molybdate (PbMoO₄) in the pigment's crystal lattice.

Other factors, however, also influence the pigment's color, its quality, and its other properties. These include:

Impurities. Various other substances may be present in the pigment's crystals.

Crystal polymorphisms.

The molecules in a pigment's crystal lattice can have different arrangements, and these can influence the pigment's color and other properties.⁵⁴

Particle size distribution and particle shape distribution.

Pigment crystals are ground into a very fine powder. The way they are ground influences the size distribution and the shape distribution of the pigment particles.⁵⁵

Encapsulation. Lead chromate pigments are sometimes encapsulated in silica, and this can influence the pigment's properties.⁵⁶

⁵⁴ See *Pigment Processing: Physico-Chemical Principles*, by Juan M. Oyarzún, 2015. Section 1.2 Crystal structure, Page 15. <u>https://www.european-</u> coatings.com/-

[/]media/LA/Produkte/Buecher/EC_Leseproben/EC_pi
gment-

processing_15127.pdf?bc=White&as=0&hash=8E25 D29CC8AF2BC2AE5864F856DC1A0E

⁵⁵ See *Pigment Processing* by Oyarzún referenced above.

⁵⁶ Vendors and end users sometimes make claims that when lead chromate pigments are encapsulated in silica, this prevents or reduces their bioavailability, and therefore, their toxicity. Some studies have found that the mutagenicity of encapsulated lead chromates (from exposure to hexavalent chromium) may be reduced under some, well-controlled conditions. However, under conditions such as those by which children ingest deteriorated lead paint, there is no evidence that encapsulation prevents human exposure to lead.

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