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Toxic Lead Paint Pigment Exports from Rich to Poor Countries

RORY TODD · LEE CRAWFURD · RACHEL BONNIFIELD

Abstract

Lead poisoning affects one in three children globally, with large but neglected impacts on health and education. One important source of exposure is lead in paint, of which one key additive is the pigment lead chromate. Lead chromate is toxic and safe alternatives exist: its use is effectively prohibited in the European Union and the UK, and is highly restricted in other high-income countries. In this paper we present new data documenting the global trade in lead chromate. Exports of lead chromate are dominated by companies based in India, but we also show significant ongoing exports from high-income countries including the United States, Canada, and Spain, despite these countries placing bans or strong restrictions on its use in their own territories. Many of these exports go to countries with potentially low capacity to regulate its end-use and prevent highly hazardous applications. While the harm posed by any particular shipment or actor depends on the end-use of the exported lead chromate, which is not possible to determine, the volume of exports from rich to poor countries could be sufficient to poison hundreds of thousands of children, harming health and holding back educational progress. We conclude with recommendations to policymakers to end the detrimental and unnecessary use of lead chromate, including to support its regulation through the Rotterdam Convention, the primary international agreement for the regulation of hazardous chemicals.

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Disclaimer: While it is demonstrably true that lead chromate exports as a whole pose an unnecessary exposure risk, the existence and degree of risk posed by any particular shipment depends on its end-use. As we cannot determine the end-use of any individual shipment, or shipments from a particular company or country, we cannot specifically attribute harm to any individual actor.

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1. Introduction

Lead is a highly toxic metal and lead exposure represents a huge but mostly neglected challenge to public health in the developing world. One in three children are estimated to have elevated blood lead levels (BLLs), with the issue strongly concentrated in low- and middle-income countries. Through its impacts on cognitive ability, we have estimated that lead exposure accounts for a fifth of the learning gap between rich and poor countries.[i]

Since the global phase-out of leaded petrol beginning in the 1970s there has been no single dominant source of lead exposure, and new sources continue to be identified. Lead paint is often recognized as one key source. Lead compounds are added to paint either as a pigment, in order to provide color and prevent corrosion, or alternatively as a drying agent. The most common lead-based pigments are lead oxides and lead chromates—specifically in the form of lead sulfochromate yellow and lead chromate molybdate sulfate red.

Non-toxic alternatives to lead additives have been used for decades and are widely available.[ii] These substitutes generally bring some compromise in performance, particularly in terms of durability, and further innovation in this area would be beneficial.[iii] However, countries such as Sweden have not used lead chromate for several decades, demonstrating that even for applications such as road marking, the use of lead chromate is not necessary.[iv] Alternative pigments are also marginally costlier; however, the additional costs of alternatives have been shown to be manageable for paint manufacturers in all world regions.[v] For manufacturers, the primary barrier to removing lead paint is the fixed cost of the reformulation process. As a result, companies will likely continue to produce lead paint unless legal restrictions are placed on its sale or use.

Advocacy and awareness-raising led by the Global Alliance to Eliminate Lead Paint,[vi] which is administered by the United Nations Environment Programme and the US Environmental Protection Agency, has increased the number of countries with legal controls on lead paint, to just under half of all countries at present. However, existing regulations commonly include exemptions for 'industrial' uses, which are often poorly defined.[vii] In many countries—including those which have introduced *de jure* regulations on lead in paint—studies have found that paints with high lead levels continue to be sold over the counter and online, without warning of lead content or toxicity.[viii]

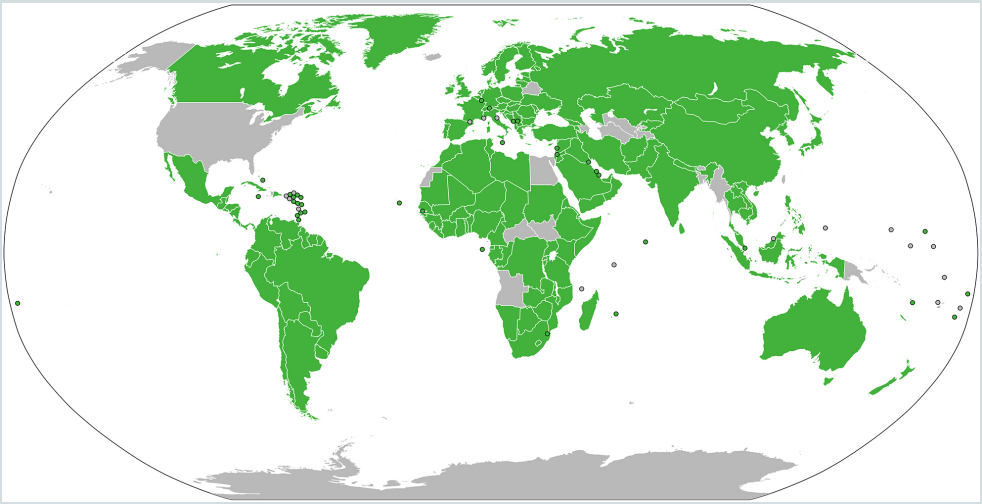
Recently, research has also documented lead chromate additives in food, specifically turmeric in Bangladesh,[ix] India, Pakistan, Sri Lanka, and Nepal,[x] and several regional spices in the Republic of Georgia.[xi] In Bangladesh, polishers added lead chromate to satisfy consumer demand for brightly coloured roots, generally without awareness of its toxicity.[xii] A nationwide campaign against lead chromate adulteration in Bangladesh resulted in the complete elimination of detected lead in turmeric between 2017 and 2021.[xiii]

Continued demand for lead chromate in turn drives a persistent market for its manufacture and global trade. This trade is largely invisible and uncontrolled, as lead chromate is not yet regulated by the Rotterdam Convention, the international agreement policing the trade of hazardous chemicals (Box 1).

BOX 1. The Rotterdam Convention

The key international agreement for trade in hazardous chemicals is the Rotterdam Convention. For each chemical listed in Annex III of the convention, party countries (Figure 1) must provide an 'import decision' on whether they will allow future imports.[xiv] Exporting parties are required to ensure that flows comply with these import decisions. Additionally, if a country has banned or severely restricted usage of a chemical domestically, they are obliged to notify importing countries of these flows before the first shipment is made, and annually thereafter, as well as label shipments with key health and safety information—even if this chemical has not yet been listed in Annex III.[xv]

FIGURE 1. Parties to the Rotterdam Convention[xvi]



Chemicals are selected to be listed in Annex III via a multi-stage process. Parties to the convention which have taken a 'Final Regulatory Action' (FRA) to ban or severely restrict domestic usage of a chemical are obliged to notify the convention secretariat. Once two FRA notifications for a chemical from countries in different specified regions have been received, they are reviewed by the Convention's Chemical Review Committee, which makes a recommendation regarding whether the chemical should be listed in Annex III at the subsequent Conference of Parties (COP). The next COP for the Rotterdam Convention takes place in April to May 2025.

Presently, FRA notifications for lead chromate have been submitted by Cameroon and Morocco.[xvii] No European country has submitted a notification, despite lead chromate being effectively banned for sale or use within the EU and the UK after a Court of Justice decision in 2019.[xviii] In our recommendations, we strongly urge countries in Europe to submit a notification to the convention secretariat, to support its listing in Annex III.

Evidence suggests that ratification of the Rotterdam Convention and addition of new chemicals to Annex III can lead to reductions in trade of covered chemicals.[xix]

This note builds on recent work by the International Pollutants Elimination Network (IPEN), which connects more than 600 NGOs working to promote better chemical and waste management. In a groundbreaking report, they document a thriving global trade in lead chromate.[xx] They found that India exported lead chromate to 78 countries between 2020 and 2022, 44 of which have banned or restricted lead paint. They also showed that Germany, Italy, and likely France and Portugal continue to export lead chromate, despite its use being effectively prohibited within the EU.

We expand on IPEN's work through an analysis of new data on export volumes from a wider set of countries, including from the United States, the United Kingdom, and Canada, to low- and middle-income countries with potentially poor capacity to monitor its use. In many cases these countries act as a trading intermediary—for example, with pigments routed through them—for the companies in India which dominate this trade. But companies based in Canada, the United States, and other countries also export pigments directly.

In section 2 we outline our approach to assess flows of lead chromate. In section 3 we share our results. In section 4 we discuss the implications of these estimated flows for human health in importing countries. In section 5, we put forward several policy recommendations targeted at exporting countries, importing countries, and the international community, to help end this toxic trade.

2. Methods

2.1 Bills of Lading

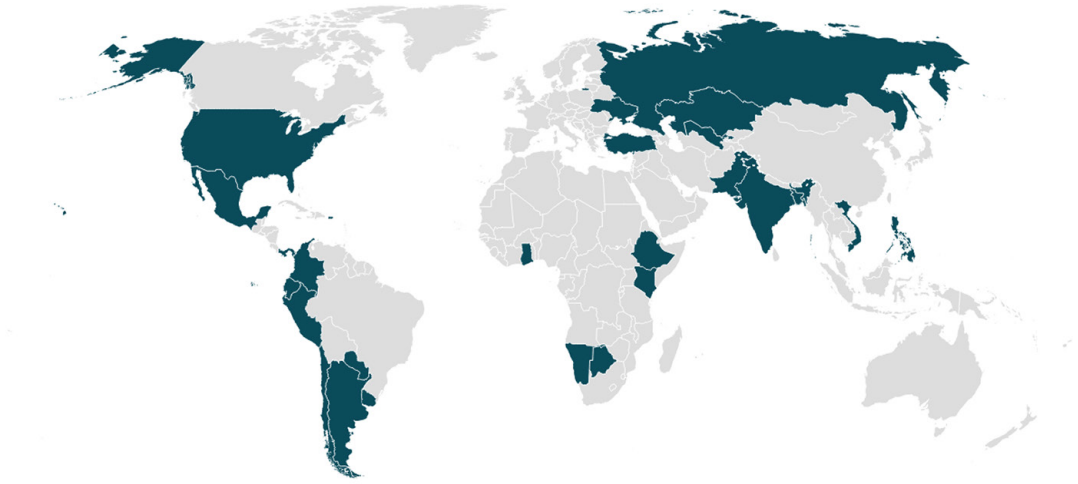
Standard trade data, available through UN COMTRADE and national customs authorities, classifies cargo according to internationally standardized Harmonized System (HS) codes. Lead chromate should be coded within HS code 320620 ("Pigments and preparations based on chromium compounds"), but this category also includes zinc chromate and chrome oxide, and most countries do not require traders to further specify the product type. This does not allow us to ascertain import and export flows of lead chromate specifically. In the absence of a full ban, lead chromate should be assigned its own HS code, to allow governments and researchers to better and more easily

understand the full extent of this trade. Preliminary work in Pakistan, however, indicates that shipments of lead chromate imported from Dubai are intentionally miscoded as non-hazardous to avoid duties; this means that even a distinct HS code would likely underestimate flows of lead chromate in practice.[xxi]

In lieu of adequate standard trade data, our analysis draws on data extracted from 'Bills of Lading' (B/L), which are documents acknowledging receipt of cargo by carriers. An example is shown in Appendix Figure A1. These generally contain information on the supplying and customer companies and the countries in which they are registered; the country of export and import (explained in more detail below); the net and/or gross weight of the cargo; its value; its HS code, frequently given at a more detailed level than in standard trade data; and, critically, a description of the cargo. By inspecting the description of shipments, it is possible to identify a large share of shipments of lead chromate.

Bills of Lading are only available for a select group of countries, whose customs authorities sell data to vendors. Figure 2 highlights countries which reported B/L for the period we analyze (January 2022 to June 2024), although some countries will only report shipments which come by particular transport modes, or will be only 'half-open', meaning that they do not report the business details of the other partner in the transaction. Table 1 provides further detail on the reporting status for each country. Despite these limitations, B/L provide the best means of ascertaining international flows of lead chromate specifically, offering valuable insight into this trade.

FIGURE 2. Countries reporting Bills of Lading



Created with Datawrapper

Note: This figure shows in blue the 25 countries that report detailed Bill of Lading data via Abrams world trade wiki.

TABLE 1. Reporting status for countries reporting Bills of Lading

Country	Transport mode for which shipments are reported	Business details for trade partner given
Argentina	All	No
Bangladesh	All	Yes
Botswana	All	Yes
Chile	All	No
Colombia	All	No
Ecuador	All	Yes
Ethiopia	All	Yes
Ghana	All	Yes
India	All	Yes
Kazakhstan	All	Yes
Kenya (imports only)*	All	Yes
Mexico	Sea	No
Namibia	All	Yes
Pakistan	All	Yes
Panama	All	Yes
Paraguay	All	No
Peru	All	No
Philippines (imports only)	All	Yes
Russia	All	Yes
Turkey	All	Yes
Ukraine	All	Yes
United States	Sea	Yes (imports), no (exports)
Uruguay	All	No
Uzbekistan	All	Yes
Vietnam	All	Yes

Note: *Only data up to May 2022 available for Kenya.

Prior analysis by IPEN examined exports from India of shipments with HS code 320620, as India is known to be the largest exporter of lead chromate, and is also a fully B/L reporting country. Our analysis expands on this by considering all available B/L data, which we accessed through ABRAMS world trade wiki. This allows us to analyze exports not only from reporting countries such as India, but also exports *to* reporting countries. We are primarily interested in exports from high-income countries, including Canada and European countries, which are generally non-reporting. While we cannot draw a comprehensive picture of exports from these countries, we do have access to a large portion of their exports to reporting countries, which includes several large low- and middle-income countries.

2.2 Search strategy

We began by following IPEN's approach of downloading data for shipments with HS code 320620. We focus on the period from January 1 2022 to June 30 2024. We narrowed these shipments down to those carrying lead chromate specifically using their product description. We included all shipments where the product description contained at least one synonym for the two lead chromates used as pigments. We began with the list of synonyms used by IPEN in their analysis of India's export data.[xxii] We then manually validated a sample of shipments, in order to refine this list, with the aim of minimizing exclusion errors while ensuring that all included shipments were lead chromate. Our final list of synonyms after this manual validation process is given in Table 2. We also translated these terms into 12 other languages using Google Translate: nine which are national languages for reporting countries (Spanish, Portuguese, Indonesian, Kazakh, Russian, Ukrainian, Uzbek, Vietnamese, and Turkish); and three which are national languages for key countries of interest to us (French, Italian, and German). We also used an English language spell checker for descriptions to correct misspellings, allowing us to include shipments which were slightly misspelled in English.

TABLE 2. Synonyms for lead chromate used as search terms

lead chromate	heucotron	light chrome
lead sulfochromate yellow	primrose chrome	yellow a y034
yellow-34	lemon chrome	molybdate orange
yellow 34	cr yellow a2-y034	scarlet chrome
red 104	middle chrome	red a104

Note: We also used translations of all English terms into 12 other languages, as well as misspellings in English (eg "Primerose"), and descriptions containing commercial names for lead chromate pigments.

Upon inspecting the wider database, we found that some shipments of lead chromate were listed under different HS codes. We therefore also downloaded data for shipments with three other related HS codes (28, 3204, and 3207)[1] where the product description contained one of the synonyms for lead chromate in any of the languages.[2] We also conservatively excluded several shipments where the cargo was a mixture of lead chromate and other products, and after another manual validation process, excluded several shipments where the description was not clearly lead chromate.

1 These refer to: 28 ("Inorganic chemicals; organic or inorganic compounds of precious metals, of rare-earth metals, of radioactive elements or of isotopes"); 3204 ("Synthetic Organic Colouring Matter"); 3207 ("Pigments for ceramic, glass industry").

2 As this step came before the process of manually validating the list of synonyms, we only downloaded data from shipments where the product description contained a synonym from the original list used in the IPEN report (or a translation of one of these terms). This means we may miss out on certain shipments containing synonyms which we added afterwards, although this is likely to be a small number.

2.3 Analytical choices

In calculating the weight of the cargo for each shipment, we preferred the net weight over the gross weight (which includes the weight of the packaging). If only gross weight was given, we imputed a figure for net weight by dividing by 1.04, the mean for the ratio between gross and net weight across shipments which reported both. Where the value but not weight of a shipment was given, we imputed a figure for weight by assuming that the price per kilo of the cargo was $4.65. This was the average (mean) price per kilo across all shipments, and values were quite consistent around this mean (standard deviation $2.10). We used the same assumption to impute a figure for weight, in cases where value but not weight was available. We excluded shipments where the price was below $1 per kilo or above $20 per kilo, assuming these to be miscoded.

We analyzed the data by both 'Country of Supplier' and 'Country of Export'. In general terms, the Country of Supplier refers to the country where the supplying company is registered. Notably, this is not necessarily where the product is manufactured: for example, cargo technically sold by a subsidiary of a holding company based in a different country will be listed under the country of the subsidiary. Confusingly, while the 'Country of Export' is often where the goods are exported from, in other cases it is simply where the routing was organized. Generally speaking, however, the Country of Supplier can be thought of as the country of the manufacturer, while the Country of Export can be thought of as the country from which the goods were physically transported.

A reciprocal relationship exists with the 'Country of Customer' and 'Country of Import'. However, these align in almost all cases, and in cases where either is not identified, we therefore impute the value given for the other variable.

2.4 Limitations

Overall, our results are likely to show only an absolute minimum value for the flows we analyze. There are three reasons why our results are likely to be under-estimates, even just for flows to reporting countries. First, for some reporting countries, import data is only 'half-open', meaning that we do not have access to the business details of the exporter. Second, our inclusion criteria are necessarily conservative, only accounting for shipments with one of the four HS codes we specified, and with a product description which included one of the known synonyms for lead chromate. Shipments with vague descriptions—such as 'pigments'—were excluded, but may in fact be lead chromate. Third, some shipments did not provide a figure for either weight or value, meaning they could not be included in our analysis.

There is one opposing reason why we may overestimate the volume of certain shipments. In most cases, the cargo is the pigment itself and therefore its weight can be equated to the weight of pigment; however, in some cases, the cargo is a solvent containing the lead chromate. In these cases, the weight of the lead chromate within the solvent will be less than the total weight of the product.

These cases are relatively infrequent, and we treat the given weight as the lead chromate weight for parsimony.

We also only manually validated a sample of the shipments marked as lead chromate. It is possible a few shipments were misidentified as lead chromate, although these are likely to be a very small proportion of the shipments we analyze.

The limited coverage of our data means, for example, that we have no information on shipments of lead chromate from Germany and Italy, which were identified by IPEN from European Prior Informed Consent (PIC) notification data.[xxiii] This also makes comparing volumes for countries directly potentially problematic, as volumes may reflect differences in reporting coverage rather than actual flows. In particular, exporters which are themselves reporting countries—such as India—may be more highly ranked than non-reporting countries which actually export more. Our comparisons between exporting countries should therefore be viewed as only indicative.

2.5 Extrapolating to global data

How much of the total global trade in lead chromate does our detailed B/L microdata cover? Recall that B/L data measures lead chromate shipments in a subset of countries. The alternative global data for all countries (from UN COMTRADE) measures a broader category of chrome-based pigments (HS code 320620), including non-lead chrome-based pigments such as "chrome oxide green" and "zinc chromate." The share of lead chromates in all chrome-based pigments is unknown. What we can do is use the overlap between the two data sources to estimate this share. That is, we compare each exporter-importer-yearly flow of lead chromate (for example, the flow from Canada to Paraguay in 2022) reported in the B/L data, with the equivalent flow of chrome-based pigments in the UN COMTRADE data.[3,4]

We find that for the median exporter-importer-yearly flow, lead chromate exports make up 82 percent of total chrome-based pigments exports, but this varies significantly by country and country income group. We disaggregate by income group, finding that for flows where the exporter is a high-income country, the share of chrome-based pigments which are lead chromate is 44 percent for the median flow (Table 3).

3 We in fact use BACI-reconciled COMTRADE data, which is produced by the Centre d'Etudes Prospectives et d'Informations Internationales (CEPII) (https://www.cepii.fr/CEPII/en/bdd_modele/bdd_modele_item.asp?id=37). This reconciles conflicting reported import and export data by harmonizing data on export values, and assigning differential weights to data reported by each countries, based on the reliability of the reporting country; this reliability is determined by how often its reported flows align with those of other countries.

4 We only compare flows which exist in both the COMTRADE and B/L data, and only compare flows for the years 2022 and 2023, as we don't have access to 2024 data for COMTRADE.

TABLE 3. Ratio of exports estimated to be lead chromate, by income group of exporter

Income group of exporting country	Number of flows with overlap between B/L and COMTRADE	Median share identified as lead chromate
High income	15	0.44
Upper middle income	71	0.56
Lower middle income	124	0.92

For exporter-importer yearly flows which exist in our COMTRADE data but not in our B/L data, we impute a proportion of the COMTRADE flow equivalent to the median ratio for the exporter country income group, as an estimate of the flow of lead chromate. For example, for export flows from the United States which don't exist in the B/L data, we impute 44 percent of the COMTRADE chrome-based pigment volume, while for export flows from China—an upper middle-income country—we impute 56 percent of the COMTRADE volume. Figure A2 in the Annex demonstrates how this imputation process affects our estimates for different exporting countries: for several high-income country exporters, only a small proportion of the estimated volume of exports is confirmed in our B/L data.

We don't include these imputed flows in our main analysis due to the high level of uncertainty around the true relationship between the two datasets, but they do allow us to provide a rough estimate of total global lead chromate trade, and to estimate impacts from this trade (section 4). Based on this approach, global trade included in our microdata amounts to 60 percent of the total global trade in lead chromate, which we estimate at 23,900 tons annually between 2022 and 2023, including 15,600 tons to low- and middle-income countries.

3. Results

Table 4 shows some descriptive statistics for the 8,397 shipments which met our criteria to be classified as lead chromate, within our time frame of January 2022 to June 2024. 94 percent of shipments had 6-digit HS code 320620. Shipments came from suppliers based in 26 different countries, and were physically exported from 36 different countries, but 76 percent of shipments were from companies based in India and 81 percent were exported from there. On average, shipments weighed 4,500kg (median 2,500kg, with a maximum of 80,000kg) and had a value of $20,086 (median $11,644, with a maximum of $250,204). At least 76 percent of shipments were transported by sea, with 2.7 percent by road and 1.5 percent by air (for 19.5 percent of shipments the transport mode was unknown).

TABLE 4. Descriptive statistics for shipments of lead chromate

Observations			8,397
			Percentage of shipments
HS code			
28 (Inorganic chemicals)			0.7
3204 (Synthetic Organic Colouring Matter)			3.2
3206 (Inorganic colouring matter)			95.0
3207 (Pigments for ceramic, glass industry)			0.9
Transport mode			
Sea			76
Road			2.7
Air			1.5
Unknown			19.5
Country of Supplier (top 3)			
India			76
Mexico			2.7
Colombia			2.2
Country of Export (top 3)			
India			80
China			2.8
Mexico			2.4
Volume	**Mean**	**Median**	**Range**
Weight (kg)	4,506	2,500	0–80000
Value (US$)	20,086	11,644	0–250,204

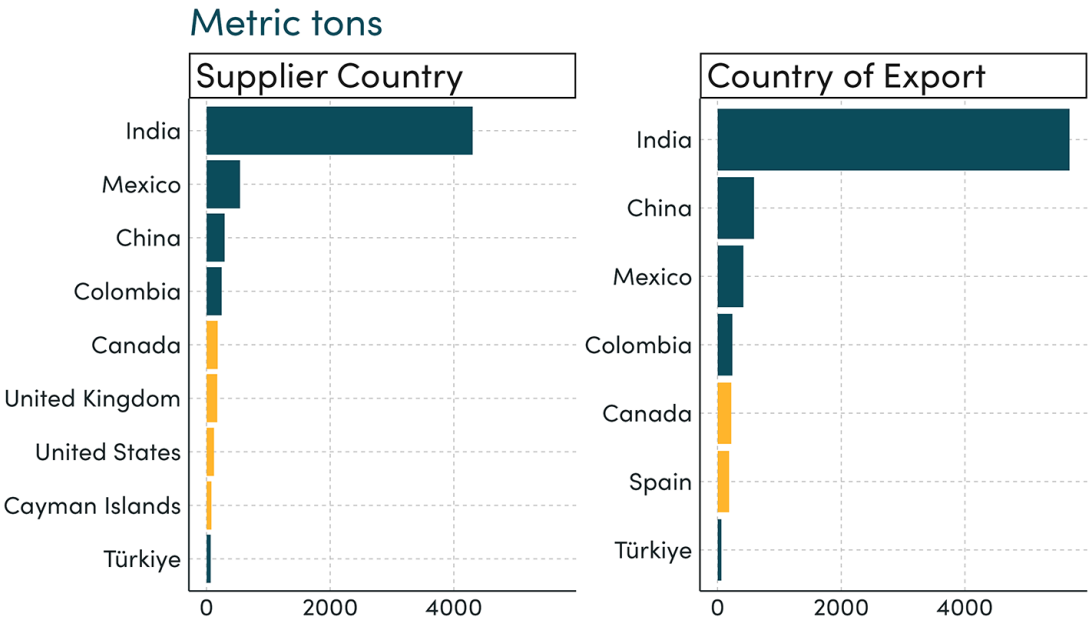
Notes: Labels for HS codes have been abbreviated. Only the largest three countries by percentage of shipments shown.

3.1 Exports from all countries

Exports to reporting countries are dominated by Indian companies, which account for at least 51 percent of export volumes by weight (see Figure 3).[5] Mexico, Colombia, and China are also leading contributors. As discussed above, the partial nature of our data means that country rankings here may not reflect true volumes. In particular, exports from China—a non-reporting country—are likely to be significantly greater than the flows we are able to identify. Overall, only 6–7% percent of exports are from high-income countries, whether as the country of supplier or country of export. Russia, Vietnam, and Mexico were the largest importers in our data (Figure 4), although it is likely that there are non-reporting countries which import more.

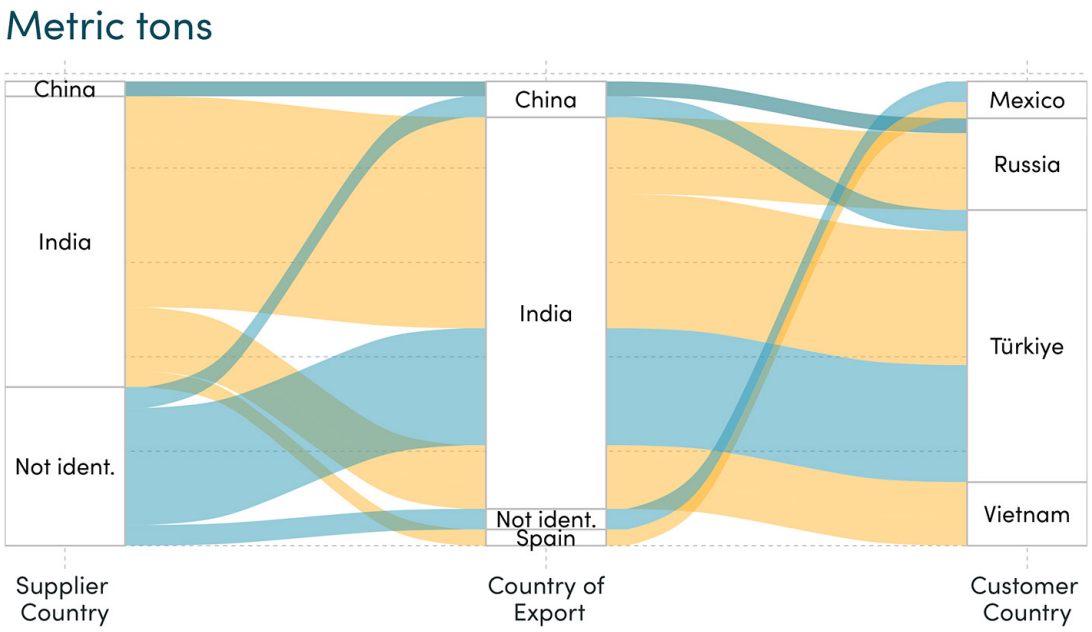
5 We restrict shipments to import by reporting countries specifically, to reduce reporting bias. When including shipment to all countries, then B/L-reporting countries are grossly over-ranked, as all of their exports may be included, compared to only a small subset from non-B/L reporting countries (specifically, exports to reporting countries).

FIGURE 3. Annual lead chromate exports from all countries, by weight



Notes: High-income countries are coloured in gold, and middle-income countries in teal. This figure shows exports to the 25 reporting countries listed in Table 1 for whom we have detailed Bill of Lading import data.

FIGURE 4. Alluvial plot showing lead chromate exports from all countries, by weight

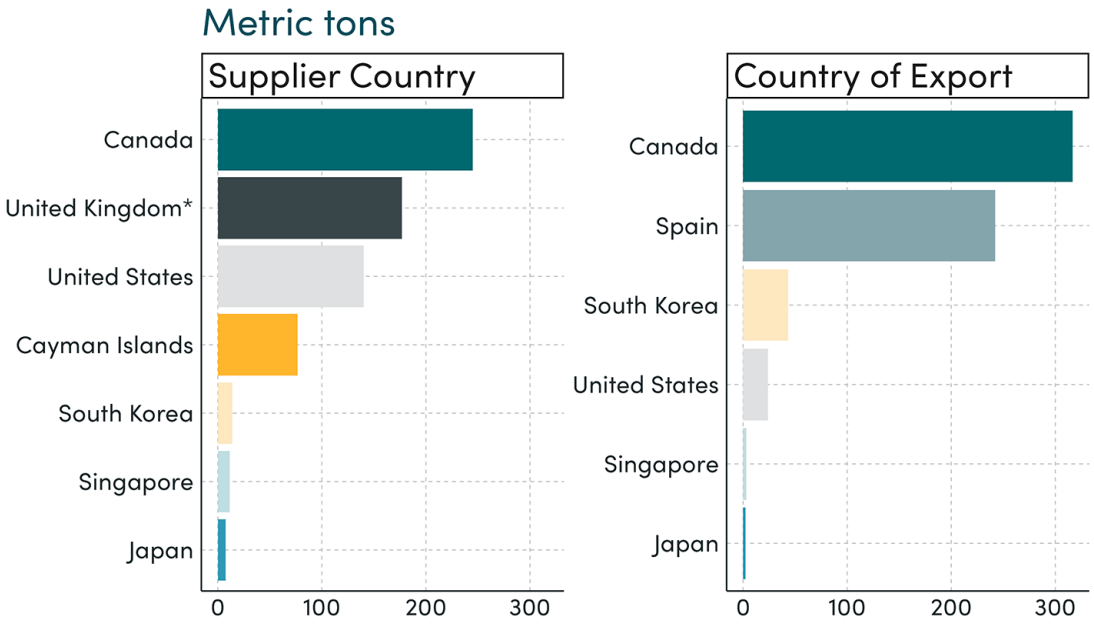


Notes: Where the customer country was not identified, the country of import was imputed instead. Only the 12 largest flows are shown here. This figure shows exports to the 25 reporting countries listed in Table 1 for whom we have detailed Bill of Lading import data.

3.2 Exports from high-income countries

We have a particular focus on high-income countries, which have strict regulations—or a complete ban in the case of EU countries—on lead chromate. These countries also spend significant international aid on work to improve health and education outcomes in low- and middle-income countries, which risks being undermined by these hazardous exports. In our time frame from January 2022 to June 2024, there were still sizable annual exports of over 200 tons from Canadian firms, and over 100 tons from UK[6] and US firms (Figure 5). US exports that we identify flow almost exclusively to Mexico (Figure 6). A large share of identified exports from UK and Canadian-owned firms were to Türkiye, with another large share to unidentifiable destinations. Another major trade route (167 tons annually) is from Indian firms via Spain to Mexico. A large number of identified exports from Cayman Islands-registered firms are actually physically exported from India to Peru and other unidentified countries.

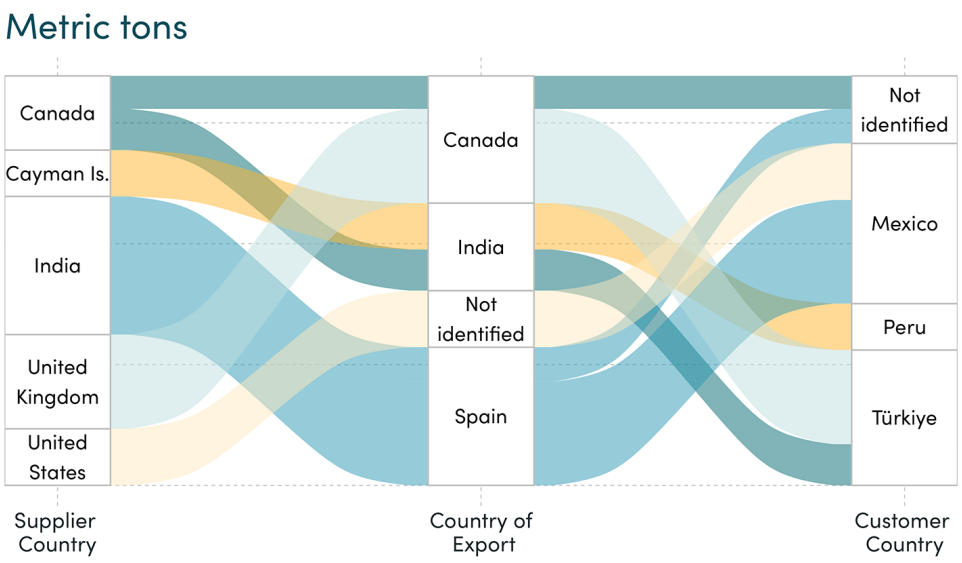
FIGURE 5. Annual lead chromate exports from rich countries, by weight



Notes: "Supplier country" is the country registration of the exporting company, whereas "country of export" is the country from which goods were physically exported. So, for example, a large quantity of exports were made by firms registered in the Cayman Islands but with few actual goods travelling via the Cayman Islands, and a large quantity of goods were physically exported from Spain, but not by Spanish-registered firms. This figure shows exports to the 25 reporting countries listed in Table 1 for whom we have detailed Bill of Lading import data. *Note that there have been no exports from the United Kingdom since 2022.

6 We identify no UK exports after December 2022.

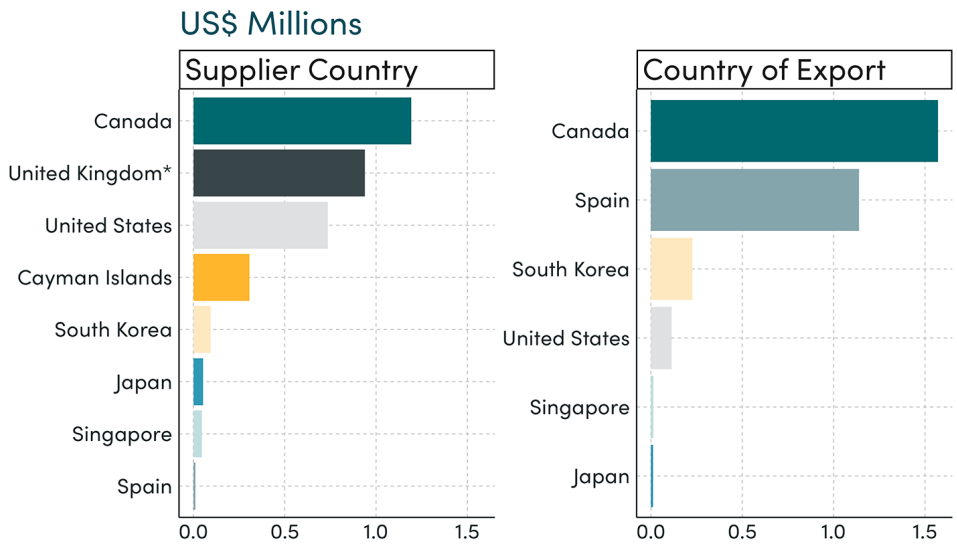
FIGURE 6. Alluvial plot showing largest export flows from rich countries, by weight



Notes: This figure shows the eight largest flows where either the supplier country or country of export was a high-income country. "Supplier country" is the country registration of the exporting company, whereas "country of export" is the country from which goods were physically exported. Where the customer country was not identified, the country of import was imputed instead. This figure shows exports to the 25 reporting countries listed in Table 1 for whom we have detailed Bill of Lading import data.

The dollar value of these shipments is relatively small, at around USD $1 million annually from Canada (Figure 7), the largest rich country exporter. Regardless, the quantity of lead chromate traded is potentially sufficient to cause significant damage to health, as we discuss in section 4.

FIGURE 7. Annual lead chromate exports from high-income countries, by value



Notes: *The United Kingdom has no identifiable exports since 2023. This figure shows exports to the 25 reporting countries listed in Table 1 for whom we have detailed Bill of Lading import data. "Supplier country" is the country registration of the exporting company, whereas "country of export" is the country from which goods were physically exported.

4. Implications of global trade for human health

Following the extrapolation approach using COMTRADE data which we describe in section 2.5, we estimate annual exports of lead chromate from high-income to low- and middle-income countries of around 3,000 metric tons per year.[7] What should we expect the health impact of this to be?

The exposure risk posed by lead chromate depends on its usage. In the United States and Canada, lead chromate is restricted to uses such as road marking. This is still an unnecessary application, as demonstrated by the use of alternatives in European countries, and evidence suggests even these industrial uses can contribute significantly to atmospheric dust.[xxiv] Nevertheless, the degree of risk from this use is likely to be relatively low compared to its use in applications such as household paints. In contrast, in low- and middle-income countries, there are consistent findings that lead chromate pigments are used for more hazardous end uses, e.g., domestic paints with dangerously high levels of lead.[xxv,xxvi] A recent study by Pure Earth showed that around 40 percent of paints tested across 25 low- and middle-income countries had levels of lead above 90 parts per million: this included 93 percent of paints for large surfaces in Mexico, and 70 percent in Turkey, the largest importers from high-income countries in our data.[xxvii] As others have argued, in practice it is challenging to restrict the use of paint with high levels of lead to 'industrial' uses.[xxviii]

Unfortunately, our data lacks information on the end-use of exports, meaning that we cannot determine the existence or degree of harm caused by any individual shipment, or shipments from a particular company or country. With awareness of this fundamental limitation, below, we adopt a conservative approach to model the potential harm posed by these exports.

To estimate the potential effect on international trade in lead chromate on children, first consider that a child is considered to be harmfully exposed with a blood lead concentration of 5 mcg/dl, that the average child has 2.7 litres[xxix] or 27 decilitres of blood, and lead has a half-life of one month. Multiplying through these terms comes to a total of 1,620mcg of lead per child per year. Not all ingested lead is absorbed into the bloodstream. In standard approaches to modeling lead uptake, the default fraction of ingested lead from soil which is absorbed into the bloodstream is 30 percent.[xxx] Thus if we assume that lead chromate breaks down into soil or dust, 5,400mcg of soil would be sufficient to poison a child for a year (alternatively, 0.0054 grams).

How much lead from pigments should we expect to be ingested? Here we have no real empirical basis for making an estimate, but for the sake of illustration we use one part per million; we suspect this is conservatively low. This proportion of 3,000 metric tons is therefore 3,000 grams. Lead chromates

7 Amounts are in fact likely to be somewhat higher than this. COMTRADE data reports only on the country of export and not the country of registration of the supplier firm, so would miss exports from lower income countries that are made by companies registered in high-income countries. Examples of this include large exports from India by companies registered in Canada and the Cayman Islands.

are not pure lead but typically in the range of 50–60 percent lead. If we take the lower estimate of 50 percent lead, then 3,000 grams of lead chromate is equivalent to 1,500 grams of pure lead.

We can then calculate that annual exports of lead chromate from high-income countries may be sufficient to poison 1,500 / 0.0054 = 277,000 children annually. This figure is highly approximate, however, and dependent upon the end-use of the lead chromate, which is unknowable for exports from any individual actor.

Exports of lead chromate to low- and middle-income countries as a whole are equivalent to around 15,606 tons annually. Following our approach here, this would be sufficient to poison 1.45 million children annually.

5. Discussion and recommendations

Lead chromate and lead-based paint are an unnecessary hazard to human health. Whilst global exports of lead chromate are dominated by emerging markets (principally India, Mexico, Colombia, and China), high-income countries also play a role.

In this report we focus on this role played by high-income countries for three main reasons. First, high-income countries spend large sums of foreign assistance on global health and education programs that are being actively undermined by their own trade policy. Second, high-income countries can play a global leadership role, encouraging other producers to also increase regulation.

Thirdly and most importantly, they typically have higher domestic standards on lead paint regulation, so they should not be exporting hazardous chemicals to countries with weaker regulation. While the United States and Canada—unlike European countries—do allow the use of lead chromate for certain industrial applications, they also have stringent standards to prevent high lead levels in domestic paints. For example the limit for lead content in paint in the United States (90 parts per million [ppm]) is much lower than the limit in Mexico (600ppm).[xxxi] High-income countries accompany these standards with strong monitoring systems, which are not always present in the low- and middle-income countries to which they export: a study in 2018 found that 28 percent of solvent-based decorative paints in Mexico had lead levels above 10,000ppm, more than an order of magnitude higher than the already lax 600ppm standard.[xxxii]

Nevertheless, there is also a clear role to be played by governments in low- and middle-income countries which import lead chromate. These countries should improve their regulations on lead chromate production and use, aligning with standards in the United States and Canada, if not the complete ban on its use already established in the European Union.

Importantly, this paper focuses only on the countries and companies responsible for *exports* of lead chromate; in so doing, it effectively neglects the demand side of this issue. As we have highlighted,

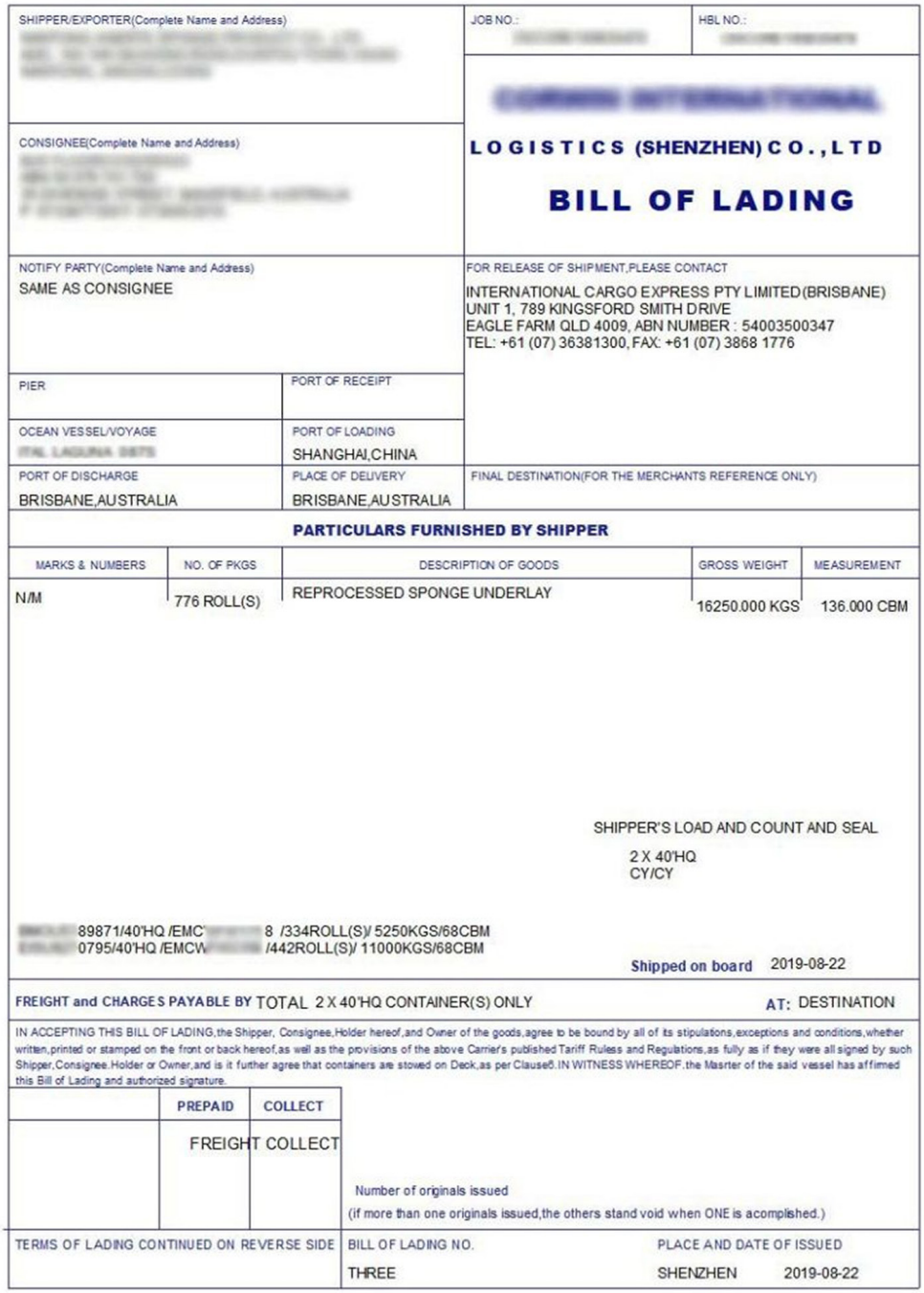
the manufacture of lead chromate is already dominated by producers in low- and middle-income countries, suggesting that a cessation of imports from high-income countries would not necessarily reduce overall use, and in all likelihood would simply drive a substitution to alternative suppliers. Low- and middle-income country governments must improve public health communication on this issue, helping their publics to understand lead's toxicity, and thereby permanently reduce demand for its use.

Underlining the insights we have already discussed, below we list several recommendations for governments in all countries to stem the global trade in lead chromate, end its use, and thereby improve human health and welfare:

1. In the long term, all countries should move towards a complete ban on the manufacture and use of lead chromate, including for export. High-income countries should prioritize ending the export of lead chromate to low- and middle-income countries with poor capacity to regulate its end use, to stop actively supporting an industry which is leading to children and adults being poisoned by lead.
2. Countries should ban shippers from using their territories as a pass-through for lead chromates en route to other countries. This is a particular concern for the route from India via Spain to Mexico.
3. Low- and middle-income countries should raise awareness of the toxicity of lead and lead paint among their own public, to reduce demand in the long-term.
4. The United States, Canada, and European countries should support adding lead chromates to the Rotterdam Convention. They should submit a notification to the convention that they have severely restricted the use of the chemical domestically, to allow for its consideration as a hazardous chemical to be listed in Annex III of the convention. The next Conference of Parties for the Rotterdam Convention takes place in April–May 2025, and lead chromate should be approved for listing then.
5. The United States and Canada should use their own policy reforms to promote broader restrictions on global production and trade in lead chromate pigments, recognizing their relatively minor contribution to trade globally.
6. The World Customs Organization (WCO) should assign lead chromate its own HS code in the Harmonized Commodity Description and Coding System. This would allow for the straightforward tracking of all global trade in lead chromate through the UN COMTRADE data system. The WCO Harmonized System is revised every five years, with the next update due in 2027.

Appendix

FIGURE A1. Example of Bill of Lading[xxxiii]



SHIPPER/EXPORTER(Complete Name and Address)

JOB NO.:

HBL NO.:

CONSIGNEE(Complete Name and Address)

LOGISTICS (SHENZHEN) CO.,LTD

BILL OF LADING

NOTIFY PARTY(Complete Name and Address)

SAME AS CONSIGNEE

FOR RELEASE OF SHIPMENT,PLEASE CONTACT

INTERNATIONAL CARGO EXPRESS PTY LIMITED(BRISBANE)
UNIT 1, 789 KINGSFORD SMITH DRIVE
EAGLE FARM QLD 4009, ABN NUMBER : 54003500347
TEL: +61 (07) 36381300, FAX: +61 (07) 3868 1776

PIER	PORT OF RECEIPT
OCEAN VESSEL/VOYAGE	PORT OF LOADING
	SHANGHAI,CHINA
PORT OF DISCHARGE	PLACE OF DELIVERY
BRISBANE,AUSTRALIA	BRISBANE,AUSTRALIA

FINAL DESTINATION(FOR THE MERCHANTS REFERENCE ONLY)

PARTICULARS FURNISHED BY SHIPPER

MARKS & NUMBERS	NO. OF PKGS	DESCRIPTION OF GOODS	GROSS WEIGHT	MEASUREMENT
N/M	776 ROLL(S)	REPROCESSED SPONGE UNDERLAY	16250.000 KGS	136.000 CBM

SHIPPER'S LOAD AND COUNT AND SEAL

2 X 40'HQ
CY/CY

89871/40'HQ /EMC 8 /334ROLL(S)/ 5250KGS/68CBM
0795/40'HQ /EMCW /442ROLL(S)/ 11000KGS/68CBM

Shipped on board 2019-08-22

FREIGHT and CHARGES PAYABLE BY TOTAL 2 X 40'HQ CONTAINER(S) ONLY AT: DESTINATION

IN ACCEPTING THIS BILL OF LADING,the Shipper, Consignee,Holder hereof,and Owner of the goods,agree to be bound by all of its stipulations,exceptions and conditions,whether written,printed or stamped on the front or back hereof,as well as the provisions of the above Carrier's published Tariff Rulesa and Regulations,as fully as if they were all signed by such Shipper,Consignee.Holder or Owner,and is it further agree that containers are stowed on Deck,as per Clause6.IN WITNESS WHEREOF,the Masrter of the said vessel has affirmed this Bill of Lading and authorized signature.

	PREPAID	COLLECT
	FREIGHT	COLLECT

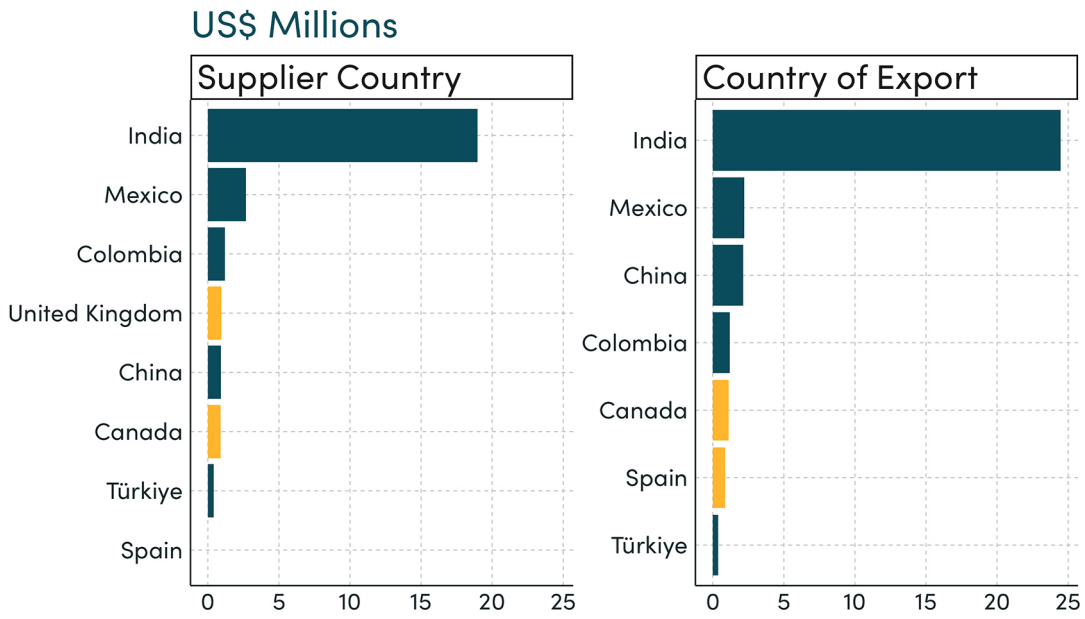
Number of originals issued
(if more than one originals issued,the others stand void when ONE is acomplished.)

TERMS OF LADING CONTINUED ON REVERSE SIDE	BILL OF LADING NO.	PLACE AND DATE OF ISSUED
	THREE	SHENZHEN 2019-08-22

FIGURE A2. Confirmed and imputed exports

Notes: This figure shows volumes of lead chromate exported from various countries, for the period 2022 to 2023. Confirmed volumes include only those flows which we identify in our Bill of Lading data source. Imputed volumes are calculated by also including a share of the volume of chrome-based pigments from COMTRADE data, for flows which we don't identify through our Bill of Lading data. The imputed share depends on the income group of the exporter.

FIGURE A3. Dollar ($) value of annual exports from all countries to reporting countries



Notes: This figure shows exports to the 25 reporting countries listed in Table 1 for whom we have detailed Bill of Lading import data. "Supplier country" is the country registration of the exporting company, whereas "country of export" is the country from which goods were physically exported.

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