Lead in Solvent-Based Paints in Indonesia

October 2021

NEXUS3 FOUNDATION

IPEN
for a toxics-free future

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Established in 1998, IPEN is currently comprised of over 500 Participating Organizations in 126 countries, primarily developing and transition countries. IPEN brings together leading environmental and public health groups around the world to establish and implement safe chemicals policies and practices that protect human health and the environment. IPEN's mission is a toxics-free future for all.

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List of Abbreviations

APCI	*Asosiasi Produsen Cat Indonesia*
BSN	*Badan Standarisasi Nasional*
ELPAT	Environmental Lead Proficiency Analytical Testing
EU	European Union
GAELP	Global Alliance to Eliminate Lead Paint
ICCM	International Conference on Chemicals Management
IDR	Indonesian Rupiah
IPEN	International POPs Elimination Network
NGO	Non-Governmental Organization
ppm	part per million
SAICM	Strategic Approach to International Chemicals Management
SNI	*Standar Nasional Indonesia*
UNEP	United Nation Environmental Programme
WHO	World Health Organization

Lead paint terminology

As used in this report:

- "Paint" includes varnishes, lacquers, stains, enamels, glazes, primers, or coatings used for any purpose. Paint is typically a mixture of resins, pigments, fillers, solvents, and other additives.
- "Lead paint" is paint to which one or more lead compounds have been added.
- "Lead pigments" are lead compounds used to give a paint product its color.
- "Lead anti-corrosive agents" are lead compounds used to protect a metal surface from rusting or other forms of corrosion.
- "Lead driers" are lead compounds used to make paint dry more quickly and evenly.
- "Decorative paint" refers to paints that are produced for use on inside or outside walls, and surfaces of homes, schools, commercial buildings, and similar structures. Decorative paints are frequently used on doors, gates, and windows, and to repaint household furniture such as cribs, playpens, tables, and chairs.
- "Solvent-based, enamel decorative paint" or "enamel decorative paint" refers to oil-based paints.
- "ppm" means parts per million total lead content by weight in a dried paint sample. All lead concentrations in the report are total lead levels, unless otherwise specified.

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Preface

Lead paints for home use continue to be widely produced, sold, and used in developing countries despite the fact that most highly industrial countries banned lead paints for household use more than 40 years ago. IPEN and Participating Organizations are part of the global movement to eliminate lead paint by 2020 to protect children´s health.

In 2007 and 2008, NGOs in the IPEN network collected and analyzed decorative (home use) paints on the market in 11 developing countries, and in countries with economies in transition. The results were startling. In every one of these countries, many of the paints contained extremely high lead levels.

In response, IPEN launched its Global Lead Paint Elimination Campaign, which seeks to eliminate lead in paint and raise widespread awareness among business entrepreneurs and consumers about the adverse human health impacts of lead paint, particularly on the health of children. Since then, IPEN-affiliated NGOs and others have sampled and analyzed paints on the market in more than 50 low- and middle-income countries.

This report presents new data on the total lead content of solvent-based paints for home use available on the market in Indonesia. It also presents background information on why the use of lead paint is a source of serious concern, especially to children's health; a review of national policy frameworks that are in place to ban or restrict the manufacture, import, export, distribution, sale and use of lead paint, and provides a strong justification to adopt and enforce further regulatory controls in Indonesia. Finally, it proposes action steps by different stakeholders to protect children and others from lead paint.

This study was conducted in Indonesia by Nexus3 Foundation in partnership with IPEN.

IPEN is an international NGO network of health and environmental organizations from all regions of the world of which Nexus3 is a member. IPEN is a leading global organization working to establish and implement safe chemicals policies and practices to protect human health and the environment. Its mission is a toxics-free future for all. IPEN helps build the capacity of its member organizations to implement on-the-ground activities, learn from each other's work, and work at the international level to set priorities and achieve new policies.

The Nexus Foundation for Environmental Health and Development, or Nexus3 Foundation (previously known as BaliFokus Foundation), works to safeguard the public, especially vulnerable populations, from the impacts of development to their health and the environment, and works towards a toxics-free, just, and sustainable future.

Executive Summary

Background

Lead is a toxic metal that causes adverse effects on both human health and the environment. While lead exposure is also harmful to adults, lead exposure harms children at much lower levels, and the health effects are generally irreversible and can have a lifelong impact.

The younger the child, the more harmful lead can be, and children with nutritional deficiencies absorb ingested lead at an increased rate. The human fetus is the most vulnerable, and a pregnant woman can transfer lead that has accumulated in her body to her developing child. Lead is also transferred through breast milk when lead is present in a nursing mother.

Evidence of reduced intelligence caused by childhood exposure to lead has led the World Health Organization (WHO) to list "lead-caused mental retardation" as a recognized disease. WHO also lists it as one of the top ten diseases whose health burden among children is due to modifiable environmental factors.

Lead paint is a major source of childhood lead exposure. The term lead paint is used in this report to describe any paint to which one or more lead compounds have been added. The cut-off concentration for lead paint used in the report is 90 parts per million (ppm, dry weight of paint), the strictest legal limit enacted in the world today. All lead concentrations in the report are total lead levels, unless otherwise specified.

Most highly industrial countries adopted laws or regulations to control the lead content of decorative paints—the paints used on the interiors and exteriors of homes, schools, and other child-occupied facilities—beginning in the 1970s and 1980s. In Indonesia, there is currently no regulation limiting the amount of lead in paint for all uses. When this report is being prepared, the National Standardisation Agency of Indonesia (*Badan Standarisasi Nasional*/BSN) is in the process of approving a stricter voluntary national standard, RSNI3 8011:2021, that limits the content of lead in enamel decorative paints produced in Indonesia to 90 ppm—a revision of SNI 8011:2014 which set a 600 ppm limit on lead in enamel decorative paints in 2014.

Sampling method

This study was conducted from March 2020 to March 2021 during the COVID-19 pandemic lockdowns and restrictions. The Nexus3 team purchased 115 cans of solvent-based paint sold for home use from stores in 10 cities in Indonesia—Jakarta, Bogor, Depok, Tangerang, Bekasi, Bandung, Yogyakarta, Surabaya, Sidoarjo, and Denpasar.

The paints represented 64 different brands produced by 47 manufacturers. An accredited laboratory analyzed all samples in the United States of America for their lead content based on the dry weight of the paint. The laboratory participates in the Environmental Lead Proficiency Analytical Testing (ELPAT) program operated by the American Industrial Hygiene Association (AIHA), assuring the reliability of the analytical results.

Results

88 out of 120 analyzed paints for home use and industrial purposes (73 percent of paints) were lead paints, i.e., they contained lead concentrations above 90 parts per million (ppm, of dry weight paint). The concentration of 90 ppm is the regulatory limit for lead in decorative paint in many countries, e.g., India, the Philippines, and the United States of America.

Moreover, 47 paints (39 percent of paints) contained extremely high lead concentrations above 10,000 ppm. The highest lead concentrations detected were **250,000 ppm in a yellow road-line industrial paint**, and **150,000 ppm in a yellow decorative paint** sold for home use. Both paints were manufactured by Japan-based companies.

On the other hand, 23 out of 101 solvent-based paints for home use (23 percent of paints) contained lead concentrations at or below 90 ppm, suggesting that the technology to produce paint without lead ingredients exists in Indonesia.

Fifty-four out of 66 analyzed brands (82 percent of paint brands) sold at least one lead paint, i.e., paint with a lead concentration above 90 ppm.

Thirty-eight out of 66 analyzed brands (58 percent of paint brands) sold at least one lead paint with extremely high lead concentrations above 10,000 ppm.

This study shows that orange paints most frequently contained extremely high lead concentrations above 10,000 ppm. Ten out of 11 orange paints (91 percent of orange paints) contained lead levels above 10,000 ppm; 24 out of 41 yellow paints (59 percent of yellow paints) contained lead levels above 10,000 ppm; four out of seven green paints (57 percent of green paints) contained lead levels above 10,000 ppm; and nine out of 45 red paints (20 percent of red paints) contained lead levels above 10,000 ppm.

In general, paint can labels did not carry meaningful information about lead content or lead paint hazards. Only 23 out of 101 solvent-based paints (23 percent of paints) provided information about lead content on their labels.

Two paints from Primatan brand contained 12,000 ppm and 8,900 ppm lead levels despite having a “no added lead” claim on its labels. Most warning symbols on the paint cans indicated the flammability of the paints.

There were no further warnings about the dangers of lead and the effect of lead dust on children and pregnant women. Most paints carried little information about any ingredients on paint can labels.

Most paints were merely labelled as “solvents, pigments, and resin,” with no further details on the type of solvents and pigments (organic or inorganic) provided on paint can labels.

Manufacturing dates or batch numbers were included on the labels of 94 out of 120 paints (78 percent of paints).

Lead levels in this study are consistent with the results of a similar paint study conducted by Nexus3 in 2015. In that study, 121 solvent-based paints from 63 brands were purchased and analyzed. In the 2015 study, 101 of 121 paints (83 percent of paints) contained lead levels above 90 ppm, and 50 of 121 paints (41 percent of paints) contained lead levels above 10,000 ppm.

In the 2021 and 2015 studies, 34 out of 64 brands were the same. Out of 120 paints in 2021 study, 67 paints were from the same brands and colors as in the 2015 study.

One similarity found in the 2021 and 2015 studies is that the top five largest companies still use significant amounts of lead in their products.

The percentage of paints with lead levels below 90 ppm were slightly higher in the current study (27 percent in 2021) as compared to the previous study (17 percent in 2015). In terms of decorative paints, the highest lead concentration in the 2021 study (150,000 ppm) is 1.5 times higher than the 2015 study (102,000 ppm).

Compared to the 2015 study, the 2021 study included eight water-based paints, three spray paints, three anti-corrosive paints, and five industrial paints. In the current study, all three spray paints, two out of three anticorrosive paints, and three out of five industrial paints contained lead levels above 10,000 ppm. The highest lead level in this study—250,000 ppm—was from a road-marking industrial paint.

Conclusions

This study demonstrates that solvent-based paints with high lead concentrations are sold for home use and are available in Indonesia. The paints included in this study are brands commonly sold in retail and online stores all over Indonesia. However, the fact that 23 out of 101 solvent-based paints for home use (23 percent of paints) contained lead concentrations below 90 ppm indicates that the technology to produce paints without added lead exists in Indonesia.

The study results provide a solid justification to adopt and enforce a regulation that will ban the manufacture, import, export, distribution, sale and use of all paints with total lead concentrations greater than 90 ppm.

Recommendations

To address the problem of lead in paint, the Nexus3 Foundation and IPEN propose the following recommendations:

For Government and Government Agencies

Since the Global Alliance to Eliminate Lead Paint (GAELP) aimed a global goal to eliminate lead in paint by 2020,[1] the Ministry of Industry, Ministry of Trade, and Ministry of Environment and Forestry should immediately draft a regulation that will ban the manufacture, import, export, distribution, sale and use of all paints that contain total lead concentrations exceeding 90 ppm, the standard recommended in the Model Law and Guidance for Regulating Lead Paint,[2] developed by GAELP and published by the UN Environment Programme.

The Ministry of Environment and Forestry, Ministry of Trade, and Ministry of Health should also require paint companies to display sufficient information indicating harmful content, such as solvents, on paint can labels. To protect consumers from lead hazards, paint companies must also provide easily readable and visible labels on possible lead dust hazards when disturbing painted surfaces.

The Ministry of Trade should prohibit the importation, trade and use of lead-based pigment for paint manufatured in Indonesia. Also, prohibit the importation of lead-based paint for use and trade in Indonesia.

The Ministry of Public Works and Housings (PUPR) should include technical specifications of non-lead-based road marking paints and spray paints in all biddings. The Ministry of Public Works and Housings should also develop the guidance document for construction companies to strip off lead-based paints safely.

For Paint Industry

Paint companies that still produce lead paints should expeditiously stop using leaded paint ingredients in paint formulations. Paint companies that have shifted to non-lead paint production should get their products certified through independent, third-party verification procedures to increase the customer's ability to choose paints with no added lead.

For Individual, Household and Institutional Consumers

Paint consumers should demand paints with no added lead from paint manufacturers and retailers, and full disclosure of a paint product's content. Household and institutional consumers should ask for, consciously buy, and apply only paints with no added lead in places frequently used by children such as homes, schools, daycare centres, parks, and playgrounds.

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[1] *https://sdg.iisd.org/news/global-alliance-to-eliminate-lead-paint-announces-2020-elimination-goal/*

[2] *https://www.unenvironment.org/resources/publication/model-law-and-guidance-regulating-lead-paint*

Consumers' rights are protected by Law No. 8 year 1999 concerning consumer protection.[3] Article 7 of Law No. 8/1999 stipulates one of the obligations of producers "to provide the correct, accurate, and honest information about the condition and assurance of products or services and provide explanations on how to use, repair and maintain them."

Furthermore, Article 9 of the law stipulates that business actors are "prohibited from offering, promoting, advertising goods and/or services incorrectly, and/or as if the goods do not contain hidden defects."

For Organizations and Professional Groups

Public health groups, consumer organizations and other concerned entities should support the elimination of lead paint and conduct activities to inform the public and protect children from lead exposure through lead paint, lead in dust and soil, and other sources of lead.

All Stakeholders

All stakeholders should unite to promote a strong policy that will eliminate lead paint in Indonesia.

[3] *Undang-undang Nomor 8 tahun 1999 tentang Perlindungan Konsumen. Accessed by 20 July 2021, https://peraturan.bpk.go.id/Home/Details/45288/uu-no-8-tahun-1999*

Lead in Solvent-Based Paints in Indonesia

1. Background

1.1. Health and Economic Impacts of Lead Exposure

Children are exposed to lead from paint when lead-containing paint on walls, windows, doors or other painted surfaces begins to chip or deteriorate since this causes lead to be released to dust and soil. When a surface previously painted with lead paint is sanded or scraped in preparation for repainting, vast amounts of lead-contaminated dust is produced, which, when spread, can constitute a severe health hazard. [1]

Children playing indoors or outdoors get house dust or soil on their hands and then ingest it through normal hand-to-mouth behavior. If the dust or the dirt is contaminated with lead, the children will ingest lead. Hand-to-mouth behavior is especially prevalent in children aged six years and under, the age group most easily harmed by exposure to lead. A typical one- to six-year-old child ingests between 100 and 400 milligrams of house dust and soil each day. [2]

In the United States today, deteriorating lead-based paint in older homes and buildings is the most highly concentrated and significant source of lead exposure among children, accounting for up to 70% of elevated childhood blood lead levels (BLLs).[3]

Lead dust and paint chip hazards arise through the following: friction between interior surfaces, such as doorframes or windowsills, home renovations that disturb lead paint, and transport from outdoor sources, such as soil and exterior paint. Lead can then be transferred from surfaces to hands and ingested by young children via regular hand-to-mouth activity.[4] This can be especially harmful because the lead content of paint chips is typically much higher than what is found in dust and soils. When toys, household furniture, or other articles are painted with lead paint, children may directly ingest the lead-contaminated, dried paint when chewing on them. Nonetheless, the most common way children ingest lead is through lead-contaminated dust and soil that gets onto their hands.[5]

While lead exposure is also harmful to adults, lead exposure harms children at much lower levels. In addition, children absorb up to five times as much ingested lead as adults. Children with nutritional deficiencies absorb ingested lead at an even increased rate.[2]

The younger the child, the more harmful lead can be, and the health effects are generally irreversible and can have a lifelong impact. The human fetus is the most vulnerable, and a pregnant woman can transfer lead accumulated in her body to her developing child.[6] Lead is also transferred through breast milk when lead is present in a nursing mother.[7]

Once lead enters a child's body through ingestion, inhalation, or across the placenta, it has the potential to damage several biological systems and pathways. The primary target is the central nervous system and the brain, but lead can also affect the blood system, the kidneys, and the skeleton.[8] Lead is also categorized as an endocrine-disrupting chemical (EDC).[9]

Lead poisoning has also been found to be the cause of anaemia. Lead is also known to be quickly absorbed in the bloodstream, and researchers believed it to have adverse effects on specific organ systems like the central nervous system, the cardiovascular system, kidneys, and the immune system even in low concentration.[6, 10]

It is generally agreed that one key element in lead toxicity is its capacity to replace calcium in neurotransmitter systems, proteins, and bone structure, altering function and structure and thereby leading to severe health impacts. Lead is also known to affect and damage cell structure.[11]

According to the World Health Organization (WHO): "Lead has no essential role in the human body, and lead poisoning accounts for about 0.6 per cent of the global burden of disease."[2] Evidence of reduced intelligence caused by childhood exposure to lead has led WHO to list "lead-caused mental retardation" as a recognized disease. WHO also lists it as one of the top ten diseases whose health burden among children is modifiable environmental factors.[12, 13]

In recent years, medical researchers have documented significant health impacts in children from lower and lower levels of lead exposure.[2, 8] According to the factsheet on Lead Poisoning and Health from WHO: "There is no known level of lead exposure that is considered safe."[14]

When a young child is exposed to lead, the harm to their nervous system makes them more likely to have difficulties in school and engage in impulsive and violent behavior.[14] Lead exposure in young children is also linked to increased rates of hyperactivity, inattentiveness, failure to graduate from high school, conduct disorder, juvenile delinquency, drug use, and incarceration.[2] Lead exposure impacts on children continue throughout life and have a long-term effect on a child's work performance and—on average—are related to decreased economic success.

A recent study investigating the economic impact of childhood lead exposure on national economies in low- and middle-income countries estimated a total cumulative cost burden of $977 billion international dollars per year.[15] The study considered the neurodevelopment effects on lead-exposed children, as measured by reduced IQ points. It correlated lead exposure-related reductions in children's IQ scores to reductions in lifetime economic productivity, as expressed in lifelong earning power.

The study identified many different sources of lead exposure in children, with lead paint as one primary source. Broken down by region, the economic burden of childhood lead exposure as estimated by this study was:

- Africa: $134.7 billion of economic loss, or 4.03 per cent of Gross Domestic Product (GDP);
- Latin America and the Caribbean: $142.3 billion of economic loss, or 2.04 per cent of GDP; and
- Asia: $699.9 billion of economic loss, or 1.88 per cent of GDP.

Country estimates used in this study can be accessed at a publicly available website[4] and shows that economic loss in Indonesia is estimated at $37.9 billion,[5] or 3 per cent of Indonesia's Gross Domestic Product (GDP).[6]

Further, the study also revealed the average blood lead level (from available studies) is 7.27 µg/dL,[7] presumed IQ Loss due to lead poisoning about 16 million points,[8] Lost Lifetime Economic Productivity per IQ Point about $2,355.[9] The number of population under 5 years of age (2013) was 4 million children.[10]

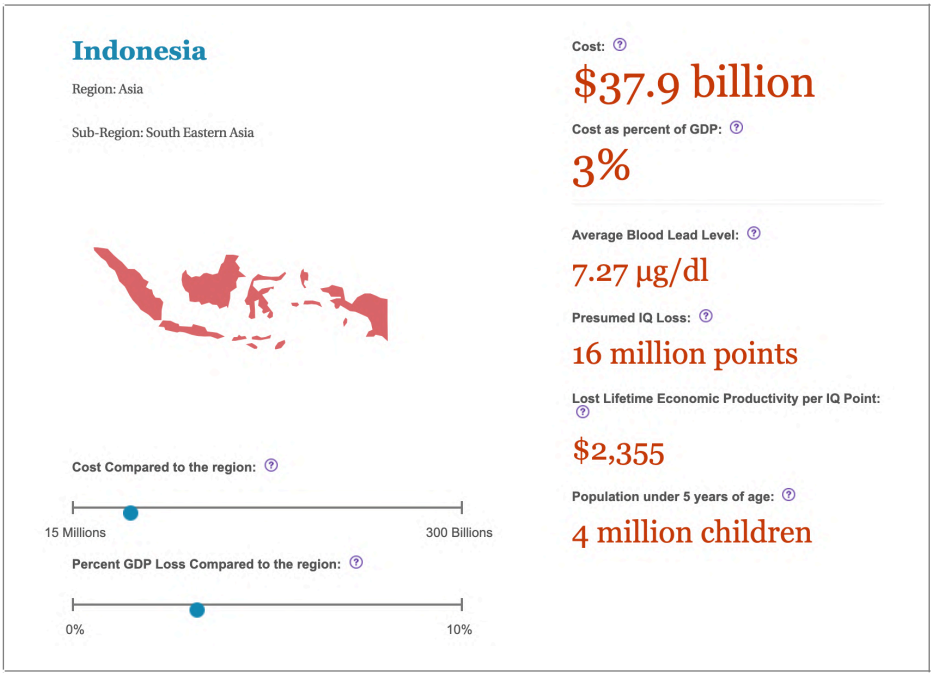

Figure 1. Economic Costs of Childhood Lead Exposure in Indonesia.

Source: Attina, et al. (2013)

[4] http://www.med.nyu.edu/pediatrics/research/environmentalpediatrics/leadexposure,

[5] *Cost: Total economic loss at country level related to loss of IQ points and consequent decreased earning power attributable to preventable lead exposure in childhood (international dollars). This economic loss is repeated each year as new children are born.*

[6] *Cost as per cent of GDP: Total economic loss reported as per centage of country gross domestic product (GDP). This economic loss is repeated each year as new children are born.*

[7] *Average Blood Lead Level: Estimated blood lead levels in children for the year 2008. Derived from country studies or, if not available, calculated using our regression model (see "Our Research" for further details).*

[8] *Presumed IQ Loss: Average IQ point loss estimated over a range of blood lead levels.*

[9] *Lost Lifetime Economic Productivity per IQ Point: Lost economic productivity (in international dollars) per each IQ point decrement attributable to lead exposure. Based on the association between decrements in total IQ score and decreased lifetime earning power.*

[10] *Population under 5 years of age: Population at risk, represented by each 1-year cohort of children under five years of age (UN population estimates).*

1.2. The Use of Lead in Paint

Paints contain high lead levels when the paint manufacturer intentionally adds one or more leaded compounds to the paint for some purpose. A paint product may also contain some lead when paint ingredients contaminated with lead are used or cross-contaminated from other product lines in the same factory. Leaded paint ingredients are most commonly used in solvent-based paint due to their chemical properties, and solvent-based paints have high lead content in many countries.[16-18]

The leaded compounds most commonly added to paints are pigments. Pigments are used to give the color, make the paint opaque (so it covers well), and protect the paint and the underlying surface from degradation caused by exposure to sunlight. Lead-based pigments are sometimes used alone and sometimes used in combination with other pigments.

Leaded compounds may also be added to enamel paints as driers (sometimes called drying agents or drying catalysts). Leaded compounds are also periodically added to paints used on metal surfaces to inhibit rust or corrosion. The most common of these is lead tetroxide, sometimes called red lead or minium.

Non-leaded pigments, driers, and anti-corrosive agents have been widely available for decades and are used by manufacturers producing the highest quality paints. When a paint manufacturer does not intentionally add lead compounds in the formulation of its paints and takes care to avoid the use of paint ingredients that are contaminated with lead, the lead content of the paint will be very low—less than 90 parts per million (ppm) lead by dry weight, and frequently down to 10 ppm or less.

The use of lead in decorative paint production is prohibited in the European Union through regulations related to the safety of consumer products and specific prohibitions for most leaded raw materials. In the U.S., Canada, Australia, and other countries with rules restricting leaded ingredients in decorative paint, standards specifying a maximum lead limit are in place.

The current standard for decorative household paints in, e.g., the U.S., the Philippines, and India is a total maximum lead content of 90 ppm. These countries' adherence to this standard ensures that a manufacturer can sell its paint anywhere in the world. This standard is also recommended in the *Model Law and Guidance for Regulating Lead Paint*, developed by the Global Alliance to Eliminate Lead Paint (GAELP) and published by the UN Environment Programme.[11]

[11] *https://www.unenvironment.org/resources/publication/model-law-and-guidance-regulating-lead-paint*

1.3. Paint Market in Indonesia

1.3.1. Distribution of Indonesia's Paint Manufacturers

Paint industries are spread out around seven provinces in Indonesia—Banten, DKI Jakarta, West Java, Central Java, East Java, Riau Islands, and North Sumatera.[19] Table 1 below shows the distribution of paint manufacturers in Indonesia.

Table 1. Paint manufacturers distribution in Indonesia

No.	Province	Number of Medium-Sized to Large Companies
1	Banten	37
2	DKI Jakarta	23
3	West Java	46
4	Central Java	11
5	East Java	28
6	Riau Islands	2
7	North Sumatera	2
	Total	**149**

Based on the size, companies are classified into three categories—multinational manufacturing company, domestic manufacturing company, and small-medium enterprises with details as follows:

- PMA (*Penanaman Modal Asing*/Foreign Investment Company): 34 companies
- PMDN (*Perusahaan Manufaktur Dalam Negeri*/Domestic Manufacturing Company): 92 companies
- UKM (*Usaha Kecil–Menengah*/Small–Medium Enterprises): 23 companies

The country's coating and paint sector currently comprise more than 150 companies—consisting of small, medium and large enterprises—with a total production capacity of 1.5 million tons per year, with production per factory varying from 4,000 to 75,000 tons per year.

Four paint companies—PT. Propan Raya, PT. Avia Avian, PT. ICI Paints Indonesia (subsidiary of Dutch multinational AkzoNobel), and Japan's Nippon Paint Holdings—comprise 65 to 75 percent of the Indonesian market share. Other international players and smaller local manufacturers constitute the remainder of the paint market.

The country has a relatively low level of imports—83,140 tons (worth US$354M) in 2019, up from 74,700 tons (worth US$283.57M) in 2015—according to Indonesia's Trade Ministry data.

Indonesia's paint and coatings industry still have ample room for growth amid booming infrastructure development albeit struggling with the ongoing COVID-19 pandemic.

1.3.2. Market Leaders

The Indonesia Paint Manufacturers Association (*Asosiasi Produsen Cat Indonesia* or APCI) has 31 members, mostly paint manufacturers with legal licenses, and medium- to large-sized companies including multi-national corporations.[12] The current head of APCI is Kris Rianto Adidarma, CEO of PT Propan Raya.[13]

The top ten paint manufacturers in Indonesia are as follows:[14]

- PT Propan Raya Industrial Coating Chemicals;
- PT Avia Avian Tbk;
- PT Asian Paint Indonesia;
- PT ICI Paints Indonesia (AkzoNobel Decorative Paints Indonesia);
- PT Mowilex Indonesia;
- Nippon Paint Holdings Co (NIPSEA Paints and Chemicals);
- Jotun;
- Kansai;
- TOA Indonesia; and
- PT Mataram Paint;

The new Propan factory was built in 2017 with an installed capacity of 100,000 tons per year and cost about IDR250 billion. This new facility complements the Propan group's capacity.[15] Currently, Propan has three plants with a total production capacity of 200,000 tons per year.

The prospect of the domestic paint industry is still quite bright in line with the government's constant property development. The paint industry also plays an essential role in supporting other sectors such as furniture, wooden toy, and other creative industries.

PT Propan Raya's CEO admitted that water-based paints are more environmentally friendly than solvent-based paints. In addition to being ecologically unfriendly, solvent-based paints also contain volatile organic compounds (VOCs), which are harmful to both the body and the environment. By switching to water-based paints, the Propan group aims to reduce solvent emissions and lead-based pigment use.[16]

Propan's new factories applied the latest technology called Rapid Production System (RPS) originating from Germany. The technology used is the only technology available in Asia-Pacific. With this technology, Propan's entire production process will be more environmentally friendly. The advantages of this RPS technology include quick production rate of 25 tons per batch in four hours. Then, the resulting product is consistent and stable, flexible and space-saving.

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[12] *https://www.apci.info/*

[13] *https://www.propanraya.com/en/*

[14] *https://marketeers.com/ibarat-membeli-cat-dalam-karung/*

[15] *https://news.propanraya.com/news-event/propan-resmikan-pabrik-berteknologi-rps-pertama-di-asia-pasifik-yang-ramah-lingkungan*

[16] *https://kemenperin.go.id/artikel/18109/Industri-Cat-Ekspansi-Rp-250-Miliar-Hasilkan-Produk-Ramah-Lingkungan*

PT Propan Raya is a market leader in wood paint (wood finish), even becoming a supplier of wood paint for export-oriented national companies. Propan Raya also began to develop products in wall paint, iron paint, natural stone paint, car paint, and ship paint.

The Indonesian government encourages industries to adopt the "Industrial Revolution 4.0" commitment to compete with industries abroad. Therefore, factory modernization is a necessity for business actors.

PT Mowilex Indonesia, a subsidiary of Asia Coating Enterprise (ACE), has adopted the Industrial Revolution 4.0 during the pandemic by continuing the construction of their newest factory in Cikande, Serang, Banten.

PT Mowilex Indonesia is the first water-based paint company since the beginning of its operations and the first manufacturing company to have a carbon-neutral certification.[17] The new factory is equipped with HMI (human-machine interface) and other automation technology that combines automation and human composition. This environmentally friendly factory also uses a lot of technology, including the latest waste treatment plant.

Mataram Paint produced various paints from 1950 to 1960, ranging from ship paint, wall paint, Duco paint, varnish, iron paint, and wood paint. EMCO brand, which initially marketed its products only in Surabaya, has spread throughout East Java, Central Java, West Java, and Bali-Lombok with more than 10,000 outlets.[18] The management of PT Mataram Paint is now entering the second generation of sons of the first founders of the company and made it as a national paint industry.[19]

1.3.3. Pigment Suppliers

In January 2016, Clariant, a global leader of organic pigment and speciality chemicals, has received the Halal certification in Indonesia. In May 2019, Clariant's Masterbatches plant in Tangerang, Indonesia, has been certified by the Indonesian Council of Ulama (*Majelis Ulama Indonesia*) to meet the government Halal Product Assurance requirements.

Indonesia is the largest moslem country globally, with a population of nearly 263 million people, of whom some 87 percent or 223 million are moslem. To serve the significant populations, the Indonesian government has issued Law No. 33/2014 on Halal Product Assurance, which covers not only food and beverages but also drugs, cosmetics and "any goods that can be used and applied by humans." The law extends to manufacturing processes and requires that packaging, including Clariant color or additive masterbatches, comply.

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[17] *https://tekno.sindonews.com/read/248808/207/adopsi-industri-40-pabrik-cat-mowilex-dilengkapi-human-machine-interface-1606529463*

[18] *https://swa.co.id/swa/trends/pigmentasi-cat-emco-untuk-tiga-segmen-pasa*

[19] *https://www.matarampaint.com/about.php*

Objects with the Halal certification are permissible to use according to Islamic law. Halal awareness has evolved from being concerned with meat-based products a decade ago to encompass food, drink, and daily necessities such as personal care products today.

In countries such as Indonesia and Malaysia, where there is a large and growing Muslim population, much of the cosmetics and home care industries are shifting raw materials to vegetable-based or even aiming for Halal-certified ingredients, which are perceived as safer and milder.

In September 2020, BASF introduced the new lead-free Pacific Orange EH 3963—a new powder coating under the Colors & Effects® brand. With the campaign "Color our Future Lead-Free," BASF's Colors & Effects® brand supports the industry with a designated lead-free portfolio and provides paint manufacturers with reformulation guidance.[20]

For several years, lead chromate has been suspected to impact human health negatively and appears toxic to aquatic life with long-lasting effects. Last year, the new launched product filled the chromatic orange shades gap for lead-free coatings applications. The hybrid technology of the new pigment offers the performance of the coating required by their customers without the use of lead chromate.

In June 2021, DIC Corp (formerly known as Dainippon Ink and Chemicals) acquired BASF's global pigments business through subsidiary Sun Chemical, known as BASF Colors & Effects (BCE).[20] The acquisition brings together the complementary portfolio of technologies, products, manufacturing assets, supply chain, and customer service of the two companies to serve customers globally.

The acquisition broadened Sun Chemical's portfolio as a global manufacturer of pigments, including electronic displays, cosmetics, coatings, inks, plastics, and speciality applications. With over 30 pigment production facilities worldwide between DIC and BCE, the company's pigment portfolio will offer broader product categories related to effect pigments, inorganic pigments, organic pigments, speciality dyes, and pigment preparations.[21]

1.3.4. New Investments

From January to October 2020 amidst the pandemic, imports slowed to 62,270 tons (worth US$236.25M), reports said. Exports had been stable over the past five years, from 41,000 tons (US$74.8M) in 2015 to 36,000 tons (US$86.92M) in 2019. From January to October 2020, exports were 28,000 tons (US$63.27M). The Ministry of Industry stated that Singapore is the leading export destination.

The pandemic has increased the demand for antimicrobial paint. Like other countries, Indonesia is also moving ahead with antimicrobial products. Nippon Paint Indonesia has been applying silver-ion technology to Nippon Vinilex Fresh since 2005, which is used in hospitals.

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[20] *https://www.sunchemical.com/sun-chemical-and-dic-corporation-finalizes-acquisition-of-basfs-global-pigments-business/*

In 2018, Nippon Paint Indonesia introduced this technology to the retail business through Nippon Spot-Less Plus—a premium segment interior paint with anti-stain and anti-germ functions. In April 2020, Nippon Paint Indonesia integrated its silver-ion antimicrobial technology into Vinilex *Anti-Kuman*, a medium segment interior wall paint.[21] Despite the pandemic, Mowilex Indonesia, a subsidiary of Asia Coatings Enterprises Pte Ltd, is set to open a new IDR500 billions (US$34 millions) plant this year.[22]

Innovations in the Indonesian coatings sector have proliferated. The major Norwegian company, Jotun, is recently launching its Global 2021 Color Trends in Indonesia and its ColorDesign app. The company is developing coatings that work as insulators to withstand heat and electricity. However, they admitted that ensuring such high-tech coatings, which follow international standards, remains a problem in Indonesia.

PT ICI Paints Indonesia (AkzoNobel Decorative Paints), a paint manufacturer from the Netherlands, also had the opportunity to increase their production capacity in 2016 by building a new factory in Cikarang, which cost up to IDR37.6 billion.
The factory, which uses robotics technology, is allegedly able to increase 40 percent of AkzoNobel's paint production capacity, which at that time had a total capacity of 100,000 tons.

Other players prefer to carry out an exit strategy by listing their initial shares on the stock exchange. PT Avia Avian Tbk, for example, last year released an IPO with an eye on Rp 3 trillion in funds. The funds will be used for company expansion purposes.[23]

PT Asian Paints Indonesia is committed to investing 100 million US dollars in 5 to 10 years. While the first factory is worth an investment of 40 million US dollars.[24] The Indian investors had boosted its paint production to 20,000 tons by 2018 and plan to capture at least 12 percent of its national market share in the next 5 to 10 years.

The Asian Paints factory in Karawang produces mostly water-based paint, making it environmentally friendly. In the early stages, the company pegged the production rate at 15,000 tons per year. After that, the production capacity will be increased to 25,000 tons per year, targeting 50,000 tons per year.[25]

Thailand's largest paint and coating producer, TOA Group, has built a new plant in Indonesia. PT TOA Coating Indonesia operates the new plant with an installed capacity of 7.7 million gallons per annum. Located about 50 kilometers away from Jakarta with an investment of approximately USD20 million, this plant has been operated since May 2019.[22]

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[21] *https://translate.google.com/translate?sl=id&tl=en&u=https://www.beritasatu.com/digital/792309/teknologi-silverion-nippon-paint-disebut-ampuh-basmi-covid19*

[22] *https://investor.id/business/mowilex-indonesia-gandakan-kapasitas-produksi-pada-2021*

[23] *Avia Avian (Avian Brands) berencana gelar IPO. 16 November 2020. Kontan. Accessed by 6 June 2021 https://investasi.kontan.co.id/news/avia-avian-avian-brands-berencana-gelar-ipo*

[24] *https://www.tribunnews.com/bisnis/2017/09/05/asian-paints-indonesia-targetkan-enter-three-besar-di-pasar-cat-indonesia*

[25] *https://www.tribunnews.com/bisnis/2017/09/05/asian-paints-indonesia-targetkan-enter-three-besar-di-pasar-cat-indonesia*

1.3.5. Market Drivers

Construction and Property Sectors

Growing urbanisation and the significant importance placed by the Government on infrastructure are two key reasons behind this likely growth. Indonesia's urbanisation rate is expected to increase from 55 percent in 2019 to 62 percent in 2030. This growth in urbanisation will lead to a greater demand for housing and offices, retail spaces, and other services catering to the new consumers.[23]

The greater demand for construction services come from the middle and upper class and the urban poor. President Jokowi launched the "One Million Houses" programme to decrease the urban housing backlog for the poor from 7.6 million houses in 2015 to 5.4 million housing units in 2019. So far, three million housing units have been built under this programme.[26]

The Indonesian government has also planned to spend over IDR5,957 trillion (USD$412 billion) between 2020 and 2024 to build airports, power plants, and other infrastructure to decentralise Indonesia's growth beyond Java. The Indonesian government is also planning to spend nearly US$40 billons on new metro railway lines for the Jakarta region, which will boost paint and coating demand. Additionally, the plans to build a new national capital in East Kalimantan, costing US$400 billions, will also create a new market.[24]

The property sector is still considered the primary growth driver of Indonesian paint and coating sales in the last ten years. Market experts stated that the high demand for new housing and the repainting cycle assures a steady demand for paint and coating products.

Before the pandemic, the construction sector was currently the main engine of Indonesia's economic growth, contributing more than 10 percent of Indonesia's GDP. During the Covid-19 pandemic, for the first time, Indonesia recorded negative economic growth rate since 1998 when it contracted due to the monetary crisis. In 2020, it contracted minus 2.07 percent due to the pandemic. Of the 17 economic sectors, 10 of them experienced negative performance due to the impact of the pandemic.

The construction sector growth rate in 2019 was within the range of 5.65 to 5.91 percent per year. The construction services sector is the fourth-highest employment sector in the country. Meanwhile, the first rank is the agricultural sector, followed by the trade and manufacturing sectors.[27]

Before the pandemic, the property development and construction tagline in Indonesia was 'prioritizing domestic production'. In 2021, the slogan changed to 'property development and construction must not import construction materials' following the President's directive to use local products not only for housing projects but all kinds of construction under the Ministry of

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[26] *The Jakarta Post (2019), "Government doubles down on building more, better-quality homes". Available at: https://www.thejakartapost.com/news/2019/01/24/government-doubles-down-to-build-more-better-quality-homes.html*

[27] *https://www.kompas.com/properti/read/2021/02/06/200000021/tak-kebal-pandemi-pertumbuhan-sektor-konstruksi-minus-5-67-persen?page=all*

Public Works and Public Housing (PUPR).[28] This is an opportunity that has to be seized by the Indonesian paint manufacturers.

Furniture Sector

Exports of furniture products in 2020 increased by US$1.91 billion, an increase of 7.6 percent from 2019, which was US$1.77 billion.[29] Because of this number, Indonesia ranked among the leading exporters of significant furniture products which included China, Germany, Poland, Italy, and Vietnam. The most prominent export destinations for Indonesian furniture in 2020 were the US, Japan, the Netherlands, Belgium, and Germany.

In 2019, Indonesia was on the list of the world's largest exporters of woodworking products such as doors. In 2020, Indonesia ranked among the top six exporters of doors, with export destination countries included the UK, the United States, the Netherlands, Australia, and South Africa.

During the start of the COVID-19 pandemic in the first quarter of 2020, the growth rate of the furniture industry experienced a relatively large contraction of 7.28 percent, but grew positively to 8.04 percent in the first quarter of 2021. In addition, the woodworking industry in 2020 experienced a contraction of 5.85 percent compared to the previous year.

1.4. Regulatory Framework in Indonesia

As of 30 September 2020, 77 countries (40 percent of all countries) have legally binding controls to ban the manufacture, import and sale of lead paint.[25] Such crucial laws are necessary to help achieve the sound management of chemicals and secure a healthier future and planet. Despite efforts to eliminate lead paint globally, too many countries still lack regulations for lead paint. However, more countries are passing new laws every year.[26]

The paint industry is regulated under the Ministry of Industry's Directorate of General, Chemical, Pharmacy, and Textile Industries; and Directorate of Downstream Chemical and Pharmacy Industries. Despite having been targeted to have mandatory national standard since 2015, there are no mandatory policy for paint industry on lead concentrations in paint.

There are several voluntary national standards relevant to coating and paints as follows:

- SNI 8011-2014: Organic Solvent-based Decorative Paint (sets a maximum lead content of 600 ppm for paint manufactured in Indonesia, voluntary standard). This SNI is in the process of review to change the standard limit to 90 ppm by the end of 2021.
- SNI 2407:2008 on Code of conduct for wood painting for houses and buildings (not containing mercury and lead, mandatory for public buildings).
- SNI 0465-2014: Paint Sampling Protocol.
- SNI 3564-2014: Emulsion Wall Paint.

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[28] *https://www.kompas.com/properti/read/2020/12/29/150746221/mulai-2021-gunakan-barang-import-dilarang-for-properti-dan*

[29] *https://www.antaranews.com/berita/2174598/menperin-industri-furnitur-terus-menggeliat-ekspor-naik*

- SNI 8069-2014: Test Protocol for Trace Concentration of Lead, Cadmium, and Cobalt in Paint using Atomic Absorber Spectrophotometer.
- SNI ISO 8124-3:2010: Toy Safety - Part 3: Specification for migration of certain elements. Allowable lead concentration Pb < 90 mg/kg.
- SNI 7188.6:2010 on Ecolabel Criteria - Part 6: Wall Paint Product category (Voluntary allowable content: Pb < 90 mg/kg)
- SNI 3564:2009 on Emulsion Wall Paint: Voluntary allowable content on heavy metals (Pb, Cu, Hg, Cd, Cr6+) < 90 ppm.
- SNI 06-3685.1-2000 on Specification for red lead ready-mixed paint (mandatory for buildings).

The Minister of Health Regulation Number 7 year 2019 concerning Hospitals' Environmental Health (*Peraturan Menteri Kesehatan* No. 7/2019) advised the use of paints on the floor and walls without heavy metals and or toxic substances. However, there is no further detailed standard or specification.[30] Similar requirements already addressed in the Minister of Health Decree Number 1204 year 2004 (*Keputusan Menteri Kesehatan*) concerning Hospitals' Environmental Health Requirements have been issued and used as one of the primary references in health care facilities.[31]

The Minister of Transportation Number PM 82 year 2018 concerning Road User Control and Safety Equipment stipulates various type of road markers.[32] The Minister of Transport Regulation Number PM 82 year 2018 concerning road safety specifies various road markers. Although the regulation mentioned anticorrosive paints for road markers and signboard were made from "environmentally friendly plastic", there was no further explanation about the content or composition of anticorrosive paints.

In 2016, the Research Centre for Road and Bridges under the Ministry of Public Works and Public Housing released a guidebook about Road Markers. The book provides considerations about the pros and contras of solvent-based paint and water-based paint.[27] The book highlighted that although they get dry quickly, the disadvantages of solvent-based paint were "not environmentally friendly" and "difficult to clean the equipment after the works were completed".

Further, the guidebook stated that the water-based paint is "less toxic because it does not contain VOC" and is "easy to clean the equipment" after the works were completed. Finally, the guidebook recommends the use of thermoplastic road markers or the newly produced paint without acknowledging lead in paint.

However, a study conducted in 2008 by researchers from the same agency observed that road markers applied using three different methods have shown wear and tear between 50 to 100 percent in one year.[28] Further research needs to be done to examine the wear and tear of high lead content road markers and their impact on the workers, public, and the environment.

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[30] *https://peraturan.bpk.go.id/Home/Details/111721/permenkes-no-7-tahun-2019*

[31] *https://persi.or.id/wp-content/uploads/2020/11/kmk12042004.pdf*

[32] *https://jdih.dephub.go.id/assets/uudocs/permen/2018/PM_82_TAHUN_2018.pdf*

To control the elimination of lead in paint in Indonesia, a two-pronged approach may be developed as follows:

a) Top-down approach:
   - Develop an umbrella policy, i.e., Presidential Decree or Government Regulation, with further requirements for the relevant ministries to issue more detailed regulations applicable to the upstream and middle-stream industries.
   - One of the regulations could be the prohibition to import and trade the raw materials, i.e., lead-based pigments and driers, published by the Minister of Trade.
   - Another regulation could be the regulation released by the Minister of Industry stipulating the standard for the green industry, specifically the coating and paint sector.
   - Other regulations could be issued by the Minister of Health concerning occupational health standards that the coating and paint sector has to undertake, including monitoring of blood lead levels (BLLs) among paint sector workers.
   - Develop several relevant Indonesia National Standard or SNI for water-based paint manufacturers using non-lead pigment or driers.

b) Bottom-up approach or consumers' pressures:
   - The Ministry of Public Works and Housings, the Ministry of Education and Culture, and the Ministry of Women and Children's Protections establish the technical specification for public building bidding or tender requirements.
   - The local content requirement for all public buildings and housings should be at least 75 percent.
   - Eco-labels could be displayed on the paint cans or packaging, either as a self-declared label or by a third party.

Figure 2. Bright colours used in many playgrounds and public spaces. Photo: Nexus3.

2. Materials and Methods

This study was conducted from March 2020 to March 2021 during the COVID-19 pandemic through lockdowns and restrictions. The Nexus3 team purchased 120 cans of mixed paints, mainly solvent-based paints, sold from stores in 10 cities in Indonesia—Jakarta, Bogor, Depok, Tangerang, Bekasi, Bandung, Yogyakarta, Surabaya, Sidoarjo, and Denpasar.

In most cases, the study selected one white paint and one or more bright-colored paint such as yellow, red, orange, or green. The paints represented 66 different brands produced by 47 manufacturers, most of which were decorative paints for home use. Additionally, eight water-based paints, three anticorrosive paints, three spray paints, and five industrial paints (i.e., road-marking paint, marine paint, automotive paint) for consumer use were also included in this study. The availability of these paints in retail establishments suggested that they were intended to be used within home environments.

The research team compiled all information, such as colors, brands, manufacturers, the country where they were manufactured, product codes, production dates, and other details as provided on the label of the paints. The team also recorded generic paint colors, e.g., “yellow” instead of “lemon.” For all colored paints, the protocol called for obtaining “bright” or “strong” red and yellow colors when available.

Paint sampling preparation kits containing individually numbered, untreated wood pieces, single-use paintbrushes and stirring utensils made from untreated wood sticks were assembled and shipped to Nexus3 by the staff of IPEN partner NGO, Arnika, in the Czech Republic.

Figure 3. Preparation of samples. Photo: Nexus3.

Figure 4. Preparation of individual sample with the tools needed. Photo: Nexus3.

Each can of paint was thoroughly stirred and was subsequently applied onto individually numbered triplicates of untreated and labelled wood pieces using different new/unused single-use paintbrushes by a researcher of Nexus3, as shown in Figures 5 and 6.

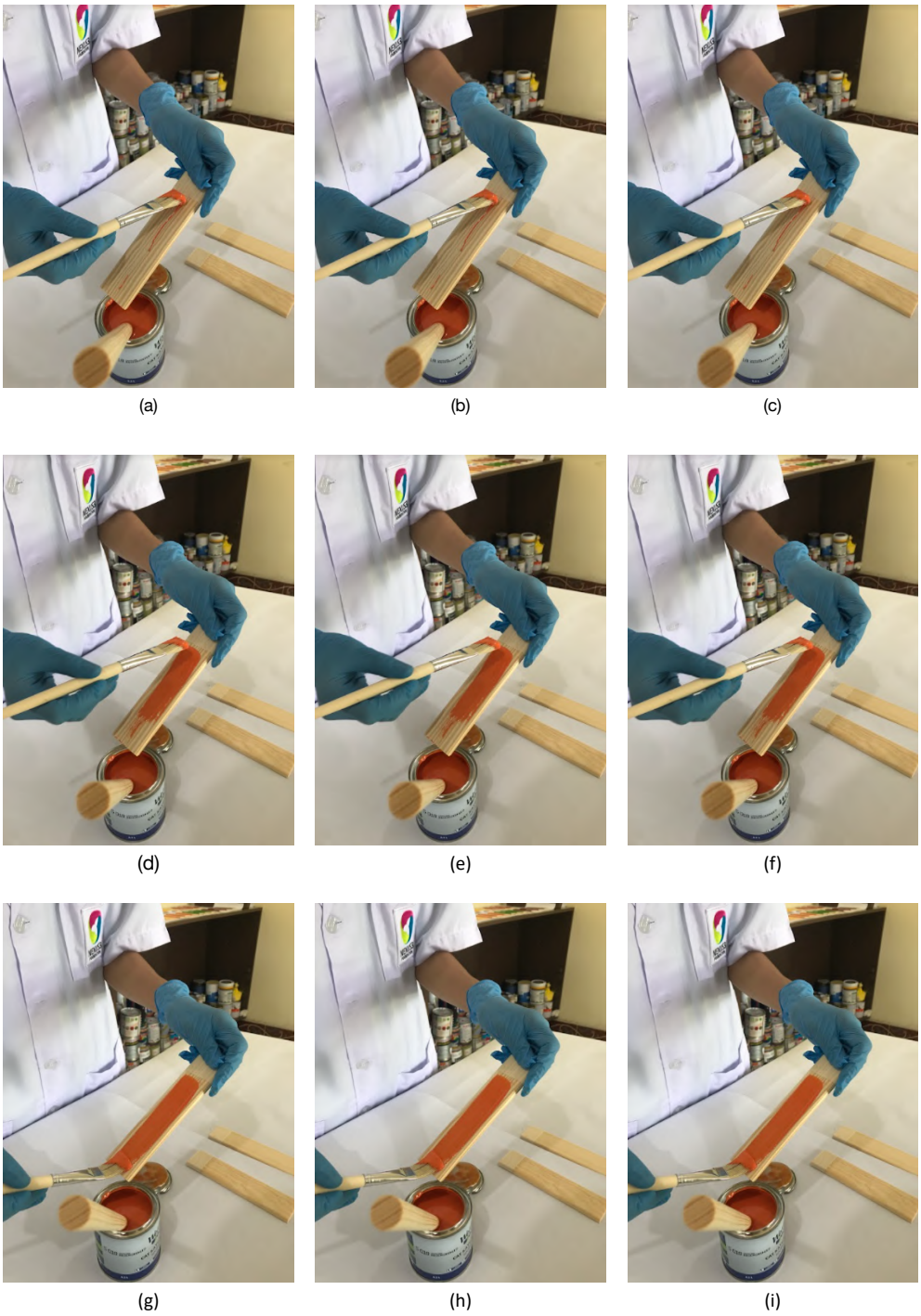

Figure 5. Brushing paint samples onto individually numbered untreated and labelled wood pieces. Photos: Nexus3

(a) (b) (c)

Figure 6. Brushing paint samples onto individually numbered triplicates of wood pieces. Photos: Nexus3

Each stirring utensil and paintbrush was used only for the same paint, and extra caution was taken to avoid cross contamination. All samples were then allowed to dry at room temperature for five to six days.

After drying, the painted wood pieces were placed in individually labeled, resealable plastic bags and shipped for analysis of lead content to SGS Forensic Laboratories in the United States of America—an accredited laboratory for the analysis of total lead content in paints.

The laboratory participates in the Environmental Lead Proficiency Analytical Testing (ELPAT) program operated by the American Industrial Hygiene Association (AIHA), assuring the reliability of the analytical results. In the laboratory selection process, IPEN further assessed the reliability of the laboratory results by conducting independent quality assurance testing. This was made by sending paint samples with known lead content to the laboratory and evaluating the results received.

Figure 7. Paint samples dried for 3x24 hours on top of a piece of paper in room termperature. Photos: Nexus3

(a) (b)

Figure 8. Paints samples packaging. Photo: Nexus3.

The laboratory's lower limit of detection for the lead concentration in the samples is dependent on the amount of paint applied in the samples. Generally, the lowest limit of detection (LOD) for the method used is 60 ppm, but if only a small amount of paint is available, the detection limit increases.

The paint samples were analyzed using method EPA3050B/7000B, i.e., through acid digestion of the samples, followed by Flame Atomic Absorption Spectrometry, as recognized by the WHO as appropriate for the purpose.[29]

3. Results

3.1. Summary of Results

This study shows that:

- 88 out of 120 analyzed paints for home use and industrial use paints (73 percent of paints) were lead paints, i.e., they contained lead concentrations above 90 parts per million (ppm, dry weight). In addition, 47 paints (39 percent of paints) contained extremely high lead concentrations above 10,000 ppm.
- 53 out of 66 analyzed brands (80 percent of paint brands) sold at least one lead paint, i.e., a paint with lead concentration above 90 ppm. Also, 38 out of 66 analyzed brands (58 percent of paint brands) sold at least one lead paint with extremely high lead concentrations above 10,000 ppm.
- 79 out of 104 bright-colored paints (76 percent of bright-colored paints) were lead paints, i.e., they contained lead concentrations above 90 parts per million (ppm), dry weight. Orange paints were the most hazardous with 10 out of 11 paints (91 percent of orange paints) containing lead concentrations greater than 10,000 ppm; 24 out of 44 yellow paints (55 percent of yellow paints), 4 out of 7 green paints (57 percent of green paints), and 9 out of 47 red paints (19 percent of red paints) also contained extremely high lead concentrations above 10,000 ppm.
- The highest lead concentration detected was 250,000 ppm in a road-marking industrial paint. Among decorative paints, a yellow paint contained the highest lead concentration at 150,000 ppm. Among spray paints, a yellow paint contained the highest lead concentration at 67,000 ppm. Among anticorrosive paints, a yellow paint contained the highest lead concentration at 65,000 ppm.
- Only 25 out of 120 paints (21 percent of paints) provided information about lead on their labels and most paints carried little information about ingredients. Two paints from Primatan brand contained 12,000 ppm and 8,900 ppm lead levels despite having a “no added lead” claim on its labels. Most paints were merely labeled as “solvents, pigments and resin,” with no further details on the type of solvents and pigments (organic or inorganic) provided. Most warning symbols on the paint cans indicated the flammability of the paints, but no precautionary warnings on the effects of lead dust to children and pregnant women were provided.

Table 2. Results of lead paint study 2020

Results	Lead concentration in all samples (n=120)	Lead concentration in solvent based paint (ppm) (n=101, spray paints, anticorrosive, and industrial paints excluded)
Average	29,470	25,837
Min	70	70
Max	250,000	150,000

3.2. Lead Content Analysis

Eighty-eight out of 120 analyzed paints (73 percent of paints) for home use and industrial use were lead paints, i.e., contained a lead concentration above 90 ppm—47 of these contained extremely high lead concentrations above 10,000 ppm (39 percent of paints).

A yellow road-marking paint contained the highest concentration of lead at 250,000 ppm, while the lowest concentration of lead less than 60 ppm was detected in 14 paints from the following brands: 4 Seasons (yellow); ABC (red and yellow); Avian (grey); Bee Brand 1000 (yellow); Davies (red); Dulux V Gloss (yellow); Gardex (red and yellow); Glo-Tex (orange and red); Laba-Laba (white); and Nippon Paint 9000 Gloss (red and yellow).

The ten solvent-based paints with the highest amounts of lead are summarized in Table 3.

Table 3. Top 10 Solvent-Based Paints with the Highest Lead Content (2021)

Rank	Sample code	Brand Name	Manufacturer	Type of Paint	Color	Country of Brand Head-quarters	Country of Manufac-turer	Lead Content (ppm)
1	IDA_247	Nippon Paint Roadline Paint	Nipsea Paint and Chemicals	Industrial	Yellow	Japan	Indonesia	250,000
2	IDA_131	Ftalit	Kansai Paint	Decorative	Yellow	Japan	Indonesia	150,000
3	IDA_154	Emco Lux	Mataram	Decorative	Yellow	Indonesia	Indonesia	140,000
	IDA_208	Mowilex	Mowilex Indonesia	Decorative	Yellow	Indonesia	Indonesia	140,000
5	IDA_224	Avian Industrial & Marine Coating	Avia Avian	Industrial	Yellow	Indonesia	Indonesia	110,000
6	IDA_155	Emco Lux	Mataram	Decorative	Green	Indonesia	Indonesia	100,000
7	IDA_179	Danalac	Danapaint Indonesia	Decorative	Yellow	Indonesia	Indonesia	87,000
8	IDA_182	Nippe 2000	Nipsea Paint and Chemicals	Industrial	Orange	Japan	Indonesia	86,000
9	IDA_157	Luna	Citra Warna Abadi	Decorative	Orange	Indonesia	Indonesia	78,000
10	IDA_229	Gendang	Gala Indah Makmur	Decorative	Yellow	Indonesia	Indonesia	72,000

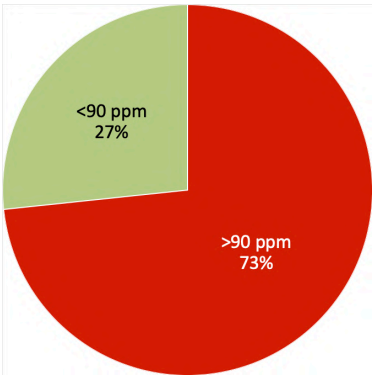

Figure 9. Paint with lead level below and above 90 ppm in this study (n=120)

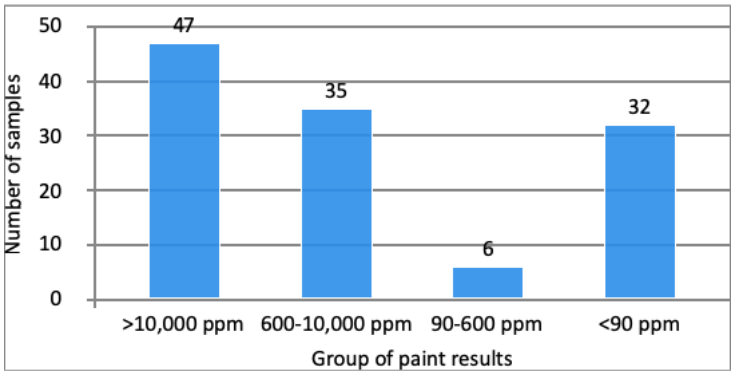

Figure 10. Paint with lead concentrations in different groups (n=120)

3.3. Paint Brand Analysis

Thirty-eight out of 66 analyzed brands (58 percent of paint brands) sold at least one paint with extremely high lead concentration above 10,000 ppm.

Fifty-four out of 66 analyzed brands (82 percent of paint brands) sold at least one lead paint, i.e., paint with a lead concentration above 90 ppm.

Among solvent-based decorative paints, a yellow Ftalit paint contained the highest lead concentration at 150,000 ppm. On the other hand, at least one paint from each of the following brands contained lead concentration below 90 ppm: 4 Seasons (yellow); ABC (red and yellow); Altex (red); ASRI Paint (green, red, and yellow); Avian (grey); Bee Brand 1000 (red and yellow); Belmont (yellow); Davies (red); Dulux V Gloss (red and yellow); Envi (green, red, and yellow); Gardex (red and yellow); Glo-Tex (orange and red); Nippon Paint 9000 Gloss (red and yellow); Penlux (red); Pioneer (red); and Tractor Enamel (yellow). This indicates that the technology to produce paints without added lead exists in Indonesia.

Among anticorrosive paints, a yellow Primtop paint contained the highest lead concentration at 65,000 ppm, followed by Recolac Kuda Terbang with 7,700 ppm lead content. On the other hand, a grey Kansai Primer paint contained 70 ppm lead.

Among spray paints, a yellow Diton spray paint contained the highest lead concentration at 67,000 ppm, followed by a yellow Nippon Pylox spray paint with 47,000 ppm lead content, and a green Artic spray paint with 18,000 ppm lead content. These spray paints were widely used at motorbike service stations or *bengkel* and in artworks such as street murals.

Among industrial paints, a yellow Nippon road-marking paint contained the highest lead concentration at 250,000 ppm. This paint was the only road-marking paint that the research team could find in the market. Usually, road-marking paints were not sold at any retailer's outlet, but rather sold directly by manufacturers to the end users or through a bidding process.

In addition, a yellow Avian industrial and marine coating paint contained 110,000 ppm lead content, an orange Nippe 2000 automotive paint (Nippon) contained 86,000 ppm lead content, and a red Boxer anti-fouling marine paint contained 170 ppm lead content. On the other hand, a white *Laba-Laba* automotive and industrial coating paint contained less than 60 ppm lead content.

3.4. Paint Color Analysis

Seventy-nine out of 104 bright-colored paints (76 percent of bright-colored paints) such as yellow, orange, red, and green contained lead concentrations above 90 ppm, 47 paints of which contained extremely high lead concentrations above 10,000 ppm (45 percent of bright-colored paints).

This study included 47 red paints, 44 yellow paints, 11 orange paints, seven green paints, six white paints, three blue paints, and two grey paints. Yellow, green, and orange paints contained the highest lead concentrations.

This study shows that orange paints most frequently contained extremely high lead concentrations above 10,000 ppm.

Ten out of 11 orange paints (91 percent of orange paints) contained lead levels above 10,000 ppm; 24 out of 41 yellow paints (59 percent of yellow paints) contained lead levels above 10,000 ppm; four out of seven green paints (57 percent of green paints) contained lead levels above 10,000 ppm; and nine out of 45 red paints (20 percent of red paints) contained lead levels above 10,000 ppm.

The distribution of lead concentrations in different colors is shown in Figure 11.

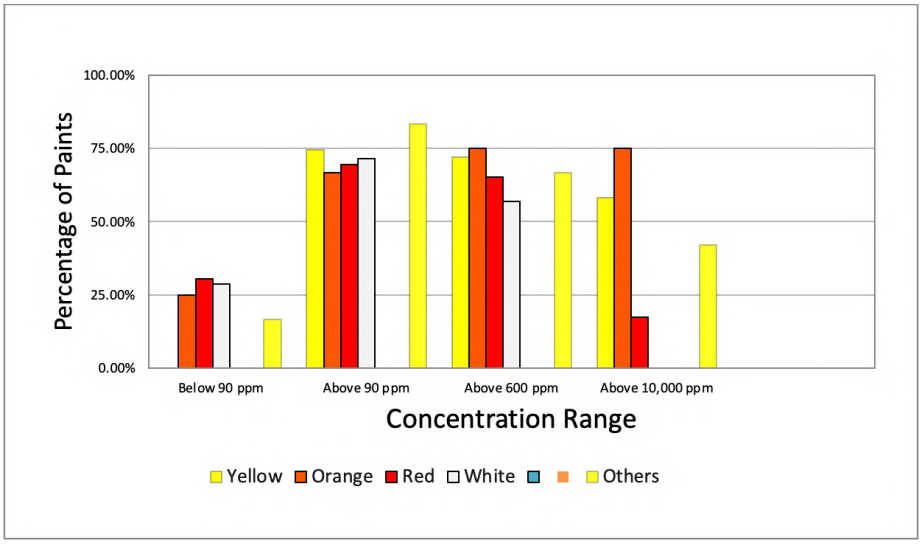

Fig. 11. distribution of lead concentrations in different colors.

3.5. Labeling

In general, most paint can label did not carry meaningful information about lead content or lead paint hazards.

Only 11 out of 115 paints (10 percent of paints) provided information about lead on their labels, and most paint can labels carried little information about any ingredients. Two paints from Primatan brand contained 12,000 ppm and 8,900 ppm lead despite having a “no added lead” claim on its labels. Most paints were merely labelled as “solvents, pigments and resin,” with no further details on the type of solvents and pigments (organic or inorganic) provided on the paint can labels.

Manufacturing dates or batch numbers were included on the labels of 94 out of 120 paints (78.3 percent of paints) included in this study. For paints that only contain batch codes and no manufacturing dates, the way these batch codes were written was not easily understandable to consumers.

Most warning symbols on the cans indicated the flammability of the paints and provided advice on the use of personal protective equipment when handling the paints, but the labels provided no precautionary warnings on the effects of lead dust on children and pregnant women.

Figure 12. Self-declared lead-free labels in some paints (2020)

3.6. Comparison with Results from Earlier Studies

Lead levels in this study are consistent with the results of similar paint studies conducted by Nexus3 in 2013 and 2015.

In 2013 study, 78 cans of decorative paint purchased from Bandung, Denpasar, Jakarta and South Tangerang areas (four areas). The result shows that 77% of the paint tested had lead content greater than 90 ppm.

61% of the samples had lead content greater than 600 ppm and 33% samples had lead content greater than 10,000 ppm which considered hazardous.

In 2015 study, 121 solvent-based paints purchased in Denpasar, Bogor, Depok, Tangerang and Jakarta regions (five regions) in Indonesia were sampled and analyzed.

83 per cent of the earlier paints contained less than 90 ppm lead compared to 73 per cent in the current study.

Similarly, the average percentage of paints with lead above 90 ppm and 10,000 ppm in the 2021 study is lower than the 2015 study. Percentage of the paints in the former study (41 per cent) contained more than 10,000 ppm lead compared to 39 per cent in the current study.

Table 4. Comparison of Lead Concentration in New Solvent-Based Paints from Current Study (2021) with Earlier Studies (2015 and 2013)

Data	2020 Study	2015 Study	2013 Study
Number of paint samples	120	121	78
Number of brands	66	63	43
Percentage of paints with lead below 90 ppm (number of paints)	27% (n=88)	17% (n=20)	23% (n=18)
Percentage of paints with lead above 90 ppm (number of paints)	73% (n=88)	83% (n=101)	77% (n=60)
Percentage of paints with lead above 10,000 ppm (number of paints)	39% (n=47)	41% (n=50)	33% (n=26)
Average lead concentration, ppm (decorative/solvent-based paints)	25,387	20,843	17,300
Average lead concentration, ppm (anticorrosive, industrial and spray paints)	45,000	N/A	N/A
Maximum lead concentration, ppm (brand name)	150,000 (Ftalit)	102,000 (Kuda Terbang)	116,000 (Altex)
	250,000 (Nippon road-marking paint)		

3.7. Price Comparison Based on Lead Concentration

The average price per liter of paints with lead content between below 90 ppm is IDR 84,000 per liter (approx. USD 6.00) and the water-based paint is IDR 105,000 (approx. USD 7.50). Paints with high concentration tend to be cheaper than paint with lead content below 90 ppm, except for industrial paints.

Table 5. Comparison of purchase average price per liter based on lead content (IDR)

Lead concentration (ppm)	Solvent-based	Water-based	Anti-corrosive	Spray-paints	Industrial paints
<90	84,000	105,000	62,000	N/A	55,000
90 - 600	211,000	N/A	N/A	N/A	116,500
600 - 10,000	75,300	N/A	54,000	N/A	N/A
>10,000	72,400	N/A	66,000	78,889	228,000

Fig. 13. Many tools in playgrounds around Jakarta used paints with high lead concentration up to 100,000 ppm. Photo credit: Nexus3.

4. Conclusions and Recommendations

This study demonstrates that solvent-based paints with high concentrations of lead are widely available in Indonesia since the paints sampled for this study are brands commonly sold in retail and online stores all over Indonesia. However, the fact that 27 percent of paints contained lead concentrations below 90 ppm indicates that the technology to produce paints without added lead exists in Indonesia.

The study results provide a strong justification to adopt and enforce a regulation that will ban the manufacture, import, export, distribution, sale and use of all paints with total lead concentrations greater than 90 ppm.

To address the problem of lead in paint, the Nexus3 Foundation and IPEN propose the following recommendations:

For Government and Government Agencies

Since the Global Alliance to Eliminate Lead Paint (GAELP) aimed a global goal to eliminate lead in paint by 2020,[33] the Ministry of Industry, Ministry of Trade, and Ministry of Environment and Forestry should immediately draft a regulation that will ban the manufacture, import, export, distribution, sale and use of all paints that contain total lead concentrations exceeding 90 ppm, the standard recommended in the Model Law and Guidance for Regulating Lead Paint,[34] developed by GAELP and published by the UN Environment Programme.

The Ministry of Environment and Forestry, Ministry of Trade, and Ministry of Health should also require paint companies to display sufficient information indicating harmful content, such as solvents, on paint can labels. To protect consumers from lead hazards, paint companies must also provide easily readable and visible labels on possible lead dust hazards when disturbing painted surfaces. Guidance to scrap lead paints, its diposal, and monitoring need to be developed.

The Ministry of Trade should prohibit the importation, trade and use of lead-based pigment for paint manufatured in Indonesia. Also, prohibit the importation of lead-based paint for use and trade in Indonesia.

The Ministry of Public Works and Housings (PUPR) should include technical specifications of non-lead-based road marking paints and spray paints in all biddings. The Ministry of Public Works and Housings should also develop the guidance document for construction companies to strip off lead-based paints safely.

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[33] *https://sdg.iisd.org/news/global-alliance-to-eliminate-lead-paint-announces-2020-elimination-goal/*

[34] *https://www.unenvironment.org/resources/publication/model-law-and-guidance-regulating-lead-paint*

For Paint Industry

Paint companies that still produce lead paints should expeditiously stop using leaded paint ingredients in paint formulations. Paint companies that have shifted to non-lead paint production should get their products certified through independent, third-party verification procedures to increase the customer´s ability to choose paints with no added lead.

For Individual, Household and Institutional Consumers

Paint consumers should demand paints with no added lead from paint manufacturers and retailers, and full disclosure of a paint product's content. Household and institutional consumers should ask for, consciously buy, and apply only paints with no added lead in places frequently used by children such as homes, schools, daycare centres, parks, and playgrounds.

Consumers' rights are protected by Law No. 8 year 1999 concerning consumers protection.[35] Article 7 of Law No. 8/1999 stipulates one of the obligations of producers "to provide the correct, accurate, and honest information about the condition and assurance of products or services and provide explanations on how to use, repair and maintain them."

Furthermore, Article 9 of the law stipulates that business actors are "prohibited from offering, promoting, advertising goods and/or services incorrectly, and/or as if the goods do not contain hidden defects."

For Organizations and Professional Groups

Public health groups, consumer organizations and other concerned entities should support the elimination of lead paint and conduct activities to inform the public and protect children from lead exposure through lead paint, lead in dust and soil, and other sources of lead.

All Stakeholders

All stakeholders should unite to promote a strong policy that will eliminate lead paint in Indonesia.

[35] *Undang-undang Nomor 8 tahun 1999 tentang Perlindungan Konsumen. Accessed by 20 July 2021, https://peraturan.bpk.go.id/Home/Details/45288/uu-no-8-tahun-1999*

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Annex 1

Table 6. Solvent-Based Paints Included in the Study (n=101)

No.	Sample code	Brand Name	Manufacturer	Color of Paint	Date Manufactured (if given)	Batch # (if given)	Lead-Free Labels
1	IDA_133	4 Seasons	TOA Paint	Yellow	12/07/2020	C200303101	None
2	IDA_191	500 Plus Paints	HPI Indonesia	Red	N/A	NAYQNTO231	None
3	IDA_210	ABC	San Central Indah	Red	N/A	K28600	None
4	IDA_211	ABC	San Central Indah	Yellow	N/A	K27300	None
5	IDA_163	Altex	Atlantic Ocean Paint	Red	N/A	92300113	None
6	IDA_164	Altex	Atlantic Ocean Paint	Green	N/A	90100113	None
7	IDA_165	Altex	Atlantic Ocean Paint	Yellow	N/A	96820113	None
8	IDA_136	Avian	Avia Avian	Red	N/A	S-SIB 12.18	None
9	IDA_137	Avian	Avia Avian	Yellow	N/A	S SIF 13-28	None
10	IDA_166	Avian	Avia Avian	Orange	N/A	S-BJB 03.1B	None
11	IDA_205	Avian	Avia Avian	Grey	N/A	P.SE-JH04.3B	None
12	IDA_215	Bee Brand 1000	Nipsea Paint and Chemicals	Yellow	N/A	2011057459	None
13	IDA_248	Bee Brand 1000	Nipsea Paint and Chemicals	Red	N/A	1602118841	None
14	IDA_171	Bee Brand Junior 66	Nipsea Paint and Chemicals	Orange	N/A	2007104170	None
15	IDA_183	Bee Brand Junior 66	Nipsea Paint and Chemicals	Orange	N/A	N/A	None
16	IDA_240	Belmont	Belmont Paint Indonesia	Yellow	N/A	22403016/89814	No Added Lead
17	IDA_176	Bintang Laut	Warnatama Cemerlang	Yellow	N/A	N/A	None
18	IDA_177	Bintang Laut	Warnatama Cemerlang	Blue	N/A	N/A	None
19	IDA_178	Bitalac	Bital Asia	Orange	N/A	N/A	None
20	IDA_135	Cendrawasih	Cendrawasih Indonesia	Orange	N/A	130115	None
21	IDA_149	Danalac	Danapaint Indonesia	Red	N/A	083-0013	None
22	IDA_179	Danalac	Danapaint Indonesia	Yellow	N/A	083-6512	None
23	IDA_199	Davies	Davies Paints Philippines	Yellow	26/10/2020	10981195	None
24	IDA_200	Davies	Davies Paints Philippines	Red	26/10/2020	10920563	None

No.	Sample code	Brand Name	Manufacturer	Color of Paint	Date Manufactured (if given)	Batch # (if given)	Lead-Free Labels
25	IDA_198	Decolux	Warna Agung	White	N/A	20G27-S1AK4A	None
26	IDA_145	Drasso	Pacific Eka Perkasa	Red	N/A	16D07/18MA	None
27	IDA_146	Drasso	Pacific Eka Perkasa	Orange	N/A	19B20/01ST	None
28	IDA_212	Dulux V Gloss	ICI Paints Indonesia	Red	N/A	4509939184	No Added Lead
29	IDA_213	Dulux V Gloss	ICI Paints Indonesia	Yellow	N/A	4509853261	No Added Lead
30	IDA_249	Duplex	Bina Adidaya	Red	N/A	TJ0382	None
31	IDA_153	Emco Lux	Mataram	Red	N/A	9908100113235	None
32	IDA_154	Emco Lux	Mataram	Yellow	N/A	9908100111828	None
33	IDA_155	Emco Lux	Mataram	Green	N/A	9908100106626	None
34	IDA_151	Envi	Indaco Warna Dunia	Yellow	N/A	900081219050003	No Added Lead
35	IDA_161	Envi	Indaco Warna Dunia	Red	N/A	900230919120005	No Added Lead
36	IDA_162	Envi	Indaco Warna Dunia	Green	N/A	900290919110001	No Added Lead
37	IDA_187	Falcon Supergloss	Multi Supra Indah Paint	Red	N/A	B16B010909	None
38	IDA_188	Falcon Supergloss	Multi Supra Indah Paint	Blue	N/A	B14011028	None
39	IDA_173	Figo	Zeven	Red	N/A	N/A	None
40	IDA_194	Figo	Zeven	Red	17/05/2018	N/A	None
41	IDA_131	Ftalit	Kansai Paint	Yellow	N/A	(040)005558	None
42	IDA_174	Ftalit	Kansai Paint	Red	N/A	7062260	None
43	IDA_237	Galalux	Gala Indah Makmur	Red	N/A	N/A	None
44	IDA_238	Galalux	Gala Indah Makmur	Yellow	N/A	N/A	None
45	IDA_239	Galalux	Gala Indah Makmur	White	N/A	N/A	None
46	IDA_245	Gamalex	Gajah Maju Jaya	Red	N/A	1800400	None
47	IDA_246	Gamalex	Gajah Maju Jaya	Yellow	N/A	1800410	None
48	IDA_201	Gardex	Jotun	Red	N/A	1481-Y93R	100% Lead Free
49	IDA_202	Gardex	Jotun	Yellow	N/A	SO580-Y1OR	None
50	IDA_243	Garuda	USA Paint	Red	N/A	N/A	None
51	IDA_244	Garuda	USA Paint	Yellow	30/08/2013	N/A	None
52	IDA_228	Gendang	Gala Indah Makmur	Red	N/A	MA31X2A	None
53	IDA_229	Gendang	Gala Indah Makmur	Yellow	N/A	AP30X20	None
54	IDA_230	Gendang	Gala Indah Makmur	White	N/A	Cannot be read	None

No.	Sample code	Brand Name	Manufacturer	Color of Paint	Date Manufactured (if given)	Batch # (if given)	Lead-Free Labels
55	IDA_193	Glo-Tex	Pacific Paint	Orange	N/A	90731923	Lead Free
56	IDA_206	Glo-Tex	Pacific Paint	Red	N/A	20013176	Lead Free
57	IDA_172	Glovin	Avia Avian	Red	N/A	S-AFB 26.1	None
58	IDA_167	Kuda Terbang	Trico Paint Factory	Orange	N/A	FHORFL310	None
59	IDA_168	Kuda Terbang	Trico Paint Factory	Red	N/A	FEOHFL457	None
60	IDA_169	Kuda Terbang	Trico Paint Factory	Green	N/A	OSOSFL668	None
61	IDA_189	Lippo	Bersama Kita Besar	Yellow	N/A	EAYWEYYYIOY	None
62	IDA_190	Lippo	Bersama Kita Besar	Red	N/A	YIYWNT0129	None
63	IDA_157	Luna	Citra Warna Abadi	Orange	N/A	N/A	None
64	IDA_242	Masterlac	Bital Asia	Yellow	N/A	477770101	None
65	IDA_192	Mazlex	Gajah Maju Jaya	Yellow	N/A	1501365	None
66	IDA_208	Mowilex	Mowilex Indonesia	Yellow	N/A	35020153	None
67	IDA_216	Nippon Paint 9000 Gloss finish	Nipsea Paint and Chemicals	Red	N/A	2005086711	None
68	IDA_217	Nippon Paint 9000 Gloss finish	Nipsea Paint and Chemicals	Yellow	N/A	2003298117	None
69	IDA_180	Penlux	Difan Prima Paint	Yellow	17/05/2019	241	None
70	IDA_181	Penlux	Difan Prima Paint	Red	02/03/2020	236	None
71	IDA_234	Picolux	Tunggal Djaja Indah	Red	N/A	N/A	None
72	IDA_235	Picolux	Tunggal Djaja Indah	White	N/A	N/A	None
73	IDA_143	Pioneer	Warna Mikha Mitra Sejati	Yellow	N/A	SMY19080981	None
74	IDA_144	Pioneer	Warna Mikha Mitra Sejati	Red	N/A	SV2007151	None
75	IDA_203	Polibest	Tunggal Djaja Indah	Yellow	N/A	Lot.617449	None
76	IDA_204	Polibest	Tunggal Djaja Indah	Red	N/A	Lot.902635	None
77	IDA_170	Primatan	Tanu Alvindo Perkasa	Yellow	N/A	SY.05.T.030	No Added Lead
78	IDA_175	Primatan	Tanu Alvindo Perkasa	Red	N/A	SY.09.S.069	No Added Lead
79	IDA_150	Property Glozz	Kansai Paint	Orange	N/A	50-112-007-2577 / 9010371	None

No.	Sample code	Brand Name	Manufacturer	Color of Paint	Date Manufactured (if given)	Batch # (if given)	Lead-Free Labels
80	IDA_231	Puffin Alkyd Enamel Super Gloss	Puffin Paint	Yellow	N/A	CV.009.026	None
81	IDA_185	RJ London	Erje London Chemical	Red	N/A	25AI33.BK	None
82	IDA_186	RJ London	Erje London Chemical	Blue	N/A	24AI20.BK	None
83	IDA_158	Romatex	Citra Warna Abadi	Red	N/A	N/A	None
84	IDA_250	Seiv	Seiv Indonesia	Red	N/A	04B20	None
85	IDA_147	Seiv Chemolux	Seiv Indonesia	Yellow	N/A	24L19	None
86	IDA_148	Seiv Master Gloss	Seiv Indonesia	Yellow	N/A	10J13	None
87	IDA_141	Sendai	Rajawali Hiyoto	White	N/A	SAP11995448967	None
88	IDA_197	Sendai	Rajawali Hiyoto	Red	N/A	SAM 1214045732	None
89	IDA_214	Simarine Enamel Doff	Sigma Utama Paint	Red	N/A	N/A	None
90	IDA_207	Simarine Enamel Gloss	Sigma Utama Paint	Red	N/A	N/A	None
91	IDA_223	Synthetic 2000	Propan Raya	Yellow	N/A	B# 17J4431112	None
92	IDA_132	Tractor Enamel	Asian Paints	Yellow	N/A	1366410819	None
93	IDA_219	Vim	Bina Adidaya	Red	N/A	N/A	None
94	IDA_220	Vim	Bina Adidaya	Yellow	N/A	N/A	None
95	IDA_156	Weldon WiiGloss	Citra Warna Abadi	Red	N/A	B1008200407	None
96	IDA_159	Weldon WiiGloss	Citra Warna Abadi	Yellow	N/A	B1908200435	None
97	IDA_160	Weldon WiiGloss	Citra Warna Abadi	Green	N/A	B1008200380	None
98	IDA_225	Wita	N/A	Red	03/08/2019	N/A	None
99	IDA_226	Wita	N/A	Yellow	21/08/2019	N/A	None
100	IDA_184	Yoko	Avia Avian	Red	N/A	S.SY-JG 29.7D	None
101	IDA_142	Zinctium	Futanlux Chemitraco	Red	N/A	YL19J09	None

Annex 2

Other paints included in this study

Table 7. Water-Based Paints Included in the Study Purchased in Indonesia (n=8)

No.	Sample code	Brand Name	Manufac-turer	Color of Paint	Date Manufactured (if given)	Batch # (if given)	Information from can label, i.e., lead content, website, other information	Lead-Free Labels
1	IDA_134	Propan Go Fast A-1000	Propan Raya	Red	N/A	2006742	Yes, https://www.propanraya.com/id/	None
2	IDA_138	ASRI Paint	ASRI Paint	Yellow	N/A	N/A	https://asripaint.wordpress.com/	None
3	IDA_139	ASRI Paint	ASRI Paint	Red	N/A	N/A	https://asripaint.wordpress.com/	None
4	IDA_140	ASRI Paint	ASRI Paint	Green	N/A	N/A	https://asripaint.wordpress.com/	None
5	IDA_209	Mowilex	Mowilex Indonesia	Red	N/A	RY9-21821 / AGBC 5421 4912	Non-Toxic	None
6	IDA_221	Lenkote Wood Eco	Avia Avian	Yellow	N/A	S-111 19.6 C	Environmentally friendly, lead free, mercury free	Lead free
7	IDA_222	Belmont Metallic Paint	Belmont Paint Indonesia	Yellow	N/A	137413/CA07	Environmentally friendly	None
8	IDA_233	Orchid Enamel Paint	Bioindustries	Yellow	N/A	N/A	Water-based system, lead, chrome, mercury free	Lead free

Table 8. Anti-corrosive Paints included in the Study Purchased in Indonesia (n=3)

No.	Sample code	Brand Name	Manufac-turer	Color of Paint	Date Manufac-tured (if given)	Batch # (if given)	Information from can label, i.e., lead content, website, other information	Lead-Free Labels
1	IDA_152	Primtop	Propan Raya	Yellow	N/A	16C5440412	www.propanraya.com	None
2	IDA_195	Kansai Primer	Kansai Paint	Grey	N/A	30115 / 50-141-155-1069	ISO 9001, ISO 14001, www.kansaicoatings.co.id	None
3	IDA_241	Recolac Kuda Terbang (anti karat/ anti-rust)	Trico Paint Factory	Red	N/A	AUORRO161	https://tricopaint.wixsite.com/	None

Table 9. Industrial Paints included in the Study Purchased in Indonesia (n=5)

No.	Sample code	Brand Name	Manufac-turer	Color of Paint	Date Manufac-tured (if given)	Batch # (if given)	Information from can label, i.e., lead content, website, other information	Lead-Free Labels
1	IDA_182	Nippe 2000	Nipsea Paint and Chemicals	Orange	N/A	1805113494	Company address	None
2	IDA_196	Laba-Laba Automotive and Industrial Coating	ABCA Indonesia	White	N/A	223803 Base	No	None
3	IDA_224	Avian Industrial & Marine Coating	Avia Avian	Yellow	N/A	S-SJA 15.5C	https://avianbrands.com/	None
4	IDA_227	Boxer Paint Marine Paint Anti-Fouling	Boxer Paint	Red	N/A	ZE.D.04	Anti fouling, harmful, https:// www.boxerpaint.com/?lang=en	None
5	IDA_247	Nippon Paint Roadline Paint	Nipsea Paint and Chemicals	Yellow	N/A	2012113030	https://www.nipponpaint-holdings.com	None

Annex 3

Table 10. Results of Laboratory Analysis of Solvent-Based Paints Purchased in Indonesia

No.	Sample code	Brand Name	Manufacturer	Color of Paint	Date Manufactured (if given)	Batch # (if given)	Lead Content (ppm)	Lead-Free Labels
1	IDA_131	Ftalit	Kansai Paint	Yellow	N/A	(040)005558	150,000	None
2	IDA_132	Tractor Enamel	Asian Paints	Yellow	N/A	1366410819	90	None
3	IDA_133	4 Seasons	TOA Paint	Yellow	12/07/2020	C200303101	< 60	None
4	IDA_135	Cendrawasih	Cendrawasih Indonesia	Orange	N/A	130115	31,000	None
5	IDA_136	Avian	Avia Avian	Red	N/A	S-SIB 12.18	40,000	None
6	IDA_137	Avian	Avia Avian	Yellow	N/A	S SIF 13-28	51,000	None
7	IDA_141	Sendai	Rajawali Hiyoto	White	N/A	SAP11995448967	1,500	None
8	IDA_142	Zinctium	Futanlux Chemitraco	Red	N/A	YL19J09	12,000	None
9	IDA_143	Pioneer	Warna Mikha Mitra Sejati	Yellow	N/A	SMY19080981	32,000	None
10	IDA_144	Pioneer	Warna Mikha Mitra Sejati	Red	N/A	SV2007151	< 70	None
11	IDA_145	Drasso	Pacific Eka Perkasa	Red	N/A	16D07/18MA	7,500	None
12	IDA_146	Drasso	Pacific Eka Perkasa	Orange	N/A	19B20/01ST	67,000	None
13	IDA_147	Seiv Chemolux	Seiv Indonesia	Yellow	N/A	24L19	14,000	None
14	IDA_148	Seiv Master Gloss	Seiv Indonesia	Yellow	N/A	10J13	69,000	None
15	IDA_149	Danalac	Danapaint Indonesia	Red	N/A	083-0013	5,800	None
16	IDA_150	Property Glozz	Kansai Paint	Orange	N/A	50-112-007-2577 / 9010371	48,000	None
17	IDA_151	Envi	Indaco Warna Dunia	Yellow	N/A	900081219050003	80	No Added Lead
18	IDA_153	Emco Lux	Mataram	Red	N/A	9908100113235	46,000	None
19	IDA_154	Emco Lux	Mataram	Yellow	N/A	9908100111828	140,000	None
20	IDA_155	Emco Lux	Mataram	Green	N/A	9908100106626	100,000	None
21	IDA_156	Weldon WiiGloss	Citra Warna Abadi	Red	N/A	B1008200407	1,700	None
22	IDA_157	Luna	Citra Warna Abadi	Orange	N/A	N/A	78,000	None

No.	Sample code	Brand Name	Manufacturer	Color of Paint	Date Manufactured (if given)	Batch # (if given)	Lead Content (ppm)	Lead-Free Labels
23	IDA_158	Romatex	Citra Warna Abadi	Red	N/A	N/A	5,600	None
24	IDA_159	Weldon WiiGloss	Citra Warna Abadi	Yellow	N/A	B1908200435	900	None
25	IDA_160	Weldon WiiGloss	Citra Warna Abadi	Green	N/A	B1008200380	670	None
26	IDA_161	Envi	Indaco Warna Dunia	Red	N/A	900230919120005	< 70	No Added Lead
27	IDA_162	Envi	Indaco Warna Dunia	Green	N/A	900290919110001	< 70	No Added Lead
28	IDA_163	Altex	Atlantic Ocean Paint	Red	N/A	92300113	< 70	None
29	IDA_164	Altex	Atlantic Ocean Paint	Green	N/A	90100113	27,000	None
30	IDA_165	Altex	Atlantic Ocean Paint	Yellow	N/A	96820113	47,000	None
31	IDA_166	Avian	Avia Avian	Orange	N/A	S-BJB 03.1B	37,000	None
32	IDA_167	Kuda Terbang	Trico Paint Factory	Orange	N/A	FHORFL310	64,000	None
33	IDA_168	Kuda Terbang	Trico Paint Factory	Red	N/A	FEOHFL457	5,600	None
34	IDA_169	Kuda Terbang	Trico Paint Factory	Green	N/A	OSOSFL668	45,000	None
35	IDA_170	Primatan	Tanu Alvindo Perkasa	Yellow	N/A	SY.05.T.030	8,900	No Added Lead
36	IDA_171	Bee Brand Junior 66	Nipsea Paint and Chemicals	Orange	N/A	2007104170	38,000	None
37	IDA_172	Glovin	Avia Avian	Red	N/A	S-AFB 26.1	870	None
38	IDA_173	Figo	Zeven	Red	N/A	N/A	6,500	None
39	IDA_174	Ftalit	Kansai Paint	Red	N/A	7062260	24,000	None
40	IDA_175	Primatan	Tanu Alvindo Perkasa	Red	N/A	SY.09.S.069	12,000	No Added Lead
41	IDA_176	Bintang Laut	Warnatama Cemerlang	Yellow	N/A	N/A	8,400	None
42	IDA_177	Bintang Laut	Warnatama Cemerlang	Blue	N/A	N/A	340	None
43	IDA_178	Bitalac	Bital Asia	Orange	N/A	N/A	42,000	None
44	IDA_179	Danalac	Danapaint Indonesia	Yellow	N/A	083-6512	87,000	None
45	IDA_180	Penlux	Difan Prima Paint	Yellow	17/05/2019	241	63,000	None
46	IDA_181	Penlux	Difan Prima Paint	Red	02/03/2020	236	80	None

No.	Sample code	Brand Name	Manufacturer	Color of Paint	Date Manufactured (if given)	Batch # (if given)	Lead Content (ppm)	Lead-Free Labels
47	IDA_183	Bee Brand Junior 66	Nipsea Paint and Chemicals	Orange	N/A	N/A	42,000	None
48	IDA_184	Yoko	Avia Avian	Red	N/A	S.SY-JG 29.7D	16,000	None
49	IDA_185	RJ London	Erje London Chemical	Red	N/A	25AI33.BK	1,900	None
50	IDA_186	RJ London	Erje London Chemical	Blue	N/A	24AI20.BK	2,500	None
51	IDA_187	Falcon Supergloss	Multi Supra Indah Paint	Red	N/A	B16B010909	3,700	None
52	IDA_188	Falcon Supergloss	Multi Supra Indah Paint	Blue	N/A	B14011028	3,200	None
53	IDA_189	Lippo	Bersama Kita Besar	Yellow	N/A	EAYWEYYYIOY	2,000	None
54	IDA_190	Lippo	Bersama Kita Besar	Red	N/A	YIYWNT0129	16,000	None
55	IDA_191	500 Plus Paints	HPI Indonesia	Red	N/A	NAYQNTO231	660	None
56	IDA_192	Mazlex	Gajah Maju Jaya	Yellow	N/A	1501365	58,000	None
57	IDA_193	Glo-Tex	Pacific Paint	Orange	N/A	90731923	< 60	Lead Free
58	IDA_194	Figo	Zeven	Red	17/05/2018	N/A	6,700	None
59	IDA_197	Sendai	Rajawali Hiyoto	Red	N/A	SAM 1214045732	2,300	None
60	IDA_198	Decolux	Warna Agung	White	N/A	20G27-S1AK4A	1,400	None
61	IDA_199	Davies	Davies Paints Philippines	Yellow	26/10/2020	10981195	3,700	None
62	IDA_200	Davies	Davies Paints Philippines	Red	26/10/2020	10920563	< 60	None
63	IDA_201	Gardex	Jotun	Red	N/A	1481-Y93R	< 60	100% Lead Free
64	IDA_202	Gardex	Jotun	Yellow	N/A	SO580-Y1OR	< 60	None
65	IDA_203	Polibest	Tunggal Djaja Indah	Yellow	N/A	Lot.617449	33,000	None
66	IDA_204	Polibest	Tunggal Djaja Indah	Red	N/A	Lot.902635	2,600	None
67	IDA_205	Avian	Avia Avian	Grey	N/A	P.SE-JH04.3B	< 60	None

No.	Sample code	Brand Name	Manufacturer	Color of Paint	Date Manufactured (if given)	Batch # (if given)	Lead Content (ppm)	Lead-Free Labels
68	IDA_206	Glo-Tex	Pacific Paint	Red	N/A	20013176	< 60	Lead Free
69	IDA_207	Simarine Enamel Gloss	Sigma Utama Paint	Red	N/A	N/A	1,100	None
70	IDA_208	Mowilex	Mowilex Indonesia	Yellow	N/A	35020153	140,000	None
71	IDA_210	ABC	San Central Indah	Red	N/A	K28600	< 60	None
72	IDA_211	ABC	San Central Indah	Yellow	N/A	K27300	< 60	None
73	IDA_212	Dulux V Gloss	ICI Paints Indonesia	Red	N/A	4509939184	< 70	No Added Lead
74	IDA_213	Dulux V Gloss	ICI Paints Indonesia	Yellow	N/A	4509853261	< 60	No Added Lead
75	IDA_214	Simarine Enamel Doff	Sigma Utama Paint	Red	N/A	N/A	1,400	None
76	IDA_215	Bee Brand 1000	Nipsea Paint and Chemicals	Yellow	N/A	2011057459	< 60	None
77	IDA_216	Nippon Paint 9000 Gloss finish	Nipsea Paint and Chemicals	Red	N/A	2005086711	< 60	None
78	IDA_217	Nippon Paint 9000 Gloss finish	Nipsea Paint and Chemicals	Yellow	N/A	2003298117	< 60	None
79	IDA_219	Vim	Bina Adidaya	Red	N/A	N/A	12,000	None
80	IDA_220	Vim	Bina Adidaya	Yellow	N/A	N/A	9,000	None
81	IDA_223	Synthetic 2000	Propan Raya	Yellow	N/A	B# 17J4431112	53,000	None
82	IDA_225	Wita	N/A	Red	03/08/2019	N/A	4,400	None
83	IDA_226	Wita	N/A	Yellow	21/08/2019	N/A	55,000	None
84	IDA_228	Gendang	Gala Indah Makmur	Red	N/A	MA31X2A	5,800	None
85	IDA_229	Gendang	Gala Indah Makmur	Yellow	N/A	AP30X20	72,000	None
86	IDA_230	Gendang	Gala Indah Makmur	White	N/A	Cannot be read	1,300	None
87	IDA_231	Puffin Alkyd Enamel Super Gloss	Puffin Paint	Yellow	N/A	CV.009.026	12,000	None
88	IDA_234	Picolux	Tunggal Djaja Indah	Red	N/A	N/A	9,400	None
89	IDA_235	Picolux	Tunggal Djaja Indah	White	N/A	N/A	3,100	None
90	IDA_237	Galalux	Gala Indah Makmur	Red	N/A	N/A	5,700	None
91	IDA_238	Galalux	Gala Indah Makmur	Yellow	N/A	N/A	42,000	None

No.	Sample code	Brand Name	Manufacturer	Color of Paint	Date Manufactured (if given)	Batch # (if given)	Lead Content (ppm)	Lead-Free Labels
92	IDA_239	Galalux	Gala Indah Makmur	White	N/A	N/A	110	None
93	IDA_240	Belmont	Belmont Paint Indonesia	Yellow	N/A	22403016/89814	70	No Added Lead
94	IDA_242	Masterlac	Bital Asia	Yellow	N/A	477770101	220	None
95	IDA_243	Garuda	USA Paint	Red	N/A	N/A	380	None
96	IDA_244	Garuda	USA Paint	Yellow	30/08/2013	N/A	14,000	None
97	IDA_245	Gamalex	Gajah Maju Jaya	Red	N/A	1800400	1,400	None
98	IDA_246	Gamalex	Gajah Maju Jaya	Yellow	N/A	1800410	24,000	None
99	IDA_248	Bee Brand 1000	Nipsea Paint and Chemicals	Red	N/A	1602118841	< 70	None
100	IDA_249	Duplex	Bina Adidaya	Red	N/A	TJ0382	33,000	None
101	IDA_250	Seiv	Seiv Indonesia	Red	N/A	04B20	4,100	None

Annex 4

Table 11. Distribution of Lead Concentration by Brands (n=66)

No.	Brand Name	No. of Samples	No. of Samples <90 ppm	No. of Samples >90 ppm	No. of Samples >10,000 ppm	Minimum Lead Content (ppm)	Maximum Lead Content (ppm)
1	4 Seasons	1	0	0	0	< 60	< 60
2	500 Plus Paints	1	0	1	0	660	660
3	ABC	2	1	0	0	< 60	< 60
4	Altex	3	1	2	2	< 70	47,000
5	Artic	1	0	1	1	18,000	18,000
6	ASRI	3	3	0	0	< 70	< 70
7	Avian	5	1	4	4	< 60	110,000
8	Bee Brand	4	1	3	3	< 60	42,000
9	Belmont	2	2	0	0	70	70
10	Bintang Laut	2	0	2	0	340	8,400
11	Bitalac	1	0	1	1	42,000	42,000
12	Boxer Paint	1	0	1	0	170	170
13	Cendrawasih	1	0	1	1	31,000	31,000
14	Danalac	2	0	2	1	5,800	87,000
15	Davies	2	1	1	0	< 60	3,700
16	Decolux	1	0	1	0	1,400	1,400
17	Diton	1	0	1	1	67,000	67,000
18	Drasso	2	0	2	1	7,500	67,000
19	Diton Spray Paint	1	0	1	1	67,000	67,000
20	Dulux V Gloss	2	2	0	0	< 60	< 70
21	Duplex	1	0	1	1	33,000	33,000
22	Emco Lux	3	0	3	3	46,000	140,000
23	Envi	3	3	0	0	< 70	80
24	Falcon Supergloss	2	0	2	0	3,200	3,700
25	Figo	2	0	2	0	6,500	6,700
26	Ftalit	2	0	2	2	24,000	150,000
27	Galalux	3	0	3	1	110	42,000
28	Gamalex	2	0	2	1	1,400	24,000
29	Gardex	2	2	0	0	< 60	< 60

No.	Brand Name	No. of Samples	No. of Samples <90 ppm	No. of Samples >90 ppm	No. of Samples >10,000 ppm	Minimum Lead Content (ppm)	Maximum Lead Content (ppm)
30	Garuda	2	0	2	1	380	14,000
31	Gendang	3	0	3	1	1,300	72,000
32	Glo-Tex	2	2	0	0	< 60	< 60
33	Glovin	1	0	1	0	870	870
34	Kansai	1	1	0	0	70	70
35	Kuda Terbang	3	0	3	2	5,600	64,000
36	Laba-Laba	1	1	0	0	< 60	< 60
37	Lippo	2	0	2	1	2,000	16,000
38	Luna	1	0	1	1	78,000	78,000
39	Masterlac	1	0	1	0	220	220
40	Mazlex	1	0	1	1	58,000	58,000
41	Mowilex	1	0	1	1	140,000	140,000
42	Nippe 2000	1	0	1	1	86,000	86,000
43	Nippon Paint	5	2	2	2	< 60	250,000
44	Nippon Pylox	1	0	1	1	47,000	47,000
45	Orchid	1	0	1	0	490	490
46	Penlux	2	1	1	1	80	63,000
47	Picolux	2	0	2	0	3,100	9,400
48	Pioneer	2	1	1	1	< 70	32,000
49	Polibest	2	0	2	1	2,600	33,000
50	Primatan	2	0	2	1	8,900	12,000
51	Primtop	1	0	1	1	65,000	65,000
52	Property Glozz	1	0	1	1	48,000	48,000
53	Puffin	1	0	1	1	12,000	12,000
54	Recolac	1	0	1	0	7,700	7,700
55	RJ London	2	0	2	0	1,900	2,500
56	Romatex	1	0	1	0	5,600	5,600
57	Seiv	3	0	3	2	4,100	69,000
58	Sendai	2	0	2	0	1,500	2,300
59	Simarine	2	0	2	0	1,100	1,400
60	Synthetic 2000	1	0	1	1	53,000	53,000
61	Tractor Enamel	1	1	0	0	90	90
62	Vim	2	0	1	1	9,000	12,000

No.	Brand Name	No. of Samples	No. of Samples <90 ppm	No. of Samples >90 ppm	No. of Samples >10,000 ppm	Minimum Lead Content (ppm)	Maximum Lead Content (ppm)
63	Weldon WiiGloss	3	0	3	0	670	1,700
64	Wita	2	0	2	1	4,400	55,000
65	Yoko	1	0	1	1	16,000	16,000
66	Zinctium	1	0	1	1	12,000	12,000

Annex 4

Table 12. Distribution of Lead Concentration by Color

No.	Colour	No. of Samples	No. of Samples <90 ppm	No. of Samples <90 ppm	No. of Samples >10,000 ppm	Minimum Lead Content (ppm)	Maximum Lead Content (ppm)	The most dangerous colours
1	Yellow	44	13	31	24	< 60	250,000	55%
2	Orange	11	1	10	10	< 60	86,000	91%
3	Red	47	14	33	9	< 60	46,000	19%
4	Green	7	2	5	4	< 70	100,000	57%
5	Blue	3	0	3	0	340	3,200	0%
6	White	6	1	5	0	< 60	3,100	0%
7	Grey	2	2	0	0	< 60	70	0%
	Total	120	33	87	47			

Annex 5

Table 13. Paint manufacturers of samples collected in this study (n=47)

No.	Manufacturer	Type of company	Website
1	PT ABCa Indonesia	National	http://abca-indonesia.com/#/
2	PT Artic Paint	National	https://www.articpaint.com/
3	PT Asian Paints Indonesia	MNC	https://www.asianpaints.com/
4	ASRI Paint	Local	https://asripaint.wordpress.com/
5	PT Atlantic Ocean Paint	National	www.atlanticoceanpaint.com
6	PT Avia Avian	National	https://avianbrands.com/
7	PT Belmont Paint Indonesia	National	https://belmont.co.id/
8	PT Bersama Kita Besar	National	https://ptbkb.id/
9	PT Bina Adidaya	National	https://www.binaadidaya.com/
10	PT Bioindustries	National	https://www.bioindustries.co.id/
11	PT Bital Asia	National	www.bitalasia.com
12	PT Putra Jaya Adi Sentosa	National	https://www.boxerpaint.com/
13	CV Cendrawasih Indonesia	Local	https://cendrawasihchemical.com/
14	PT Citra Warna Abadi	National	https://www.weldon.co.id/tentang
15	PT Danapaint Indonesia	National	https://www.archify.com/id/product/danapaint
16	Davies Paints Philippines	MNC	https://www.daviespaints.com.ph/
17	PT Difan Prima Paint	National	https://www.difanprimapaint.com/
18	PT Erje London	MNC	http://www.rjlondon.co.id/company/about-us
19	PT Futanlux Chemitraco	National	https://www.futanluxpaint.com
20	PT Gajah Maju Jaya	National	Not available
21	PT Gala Indah Makmur	National	https://www.daftarperusahaan.com/bisnis/gala-indah-makmur-pt
22	HPI Indonesia	National	Not available
23	PT ICI Paints Indonesia	MNC	https://www.akzonobel.com/en
24	PT Indaco Warna Dunia	National	https://www.indaco.id/
25	PT Jotun Indonesia	MNC	https://www.jotun.com/id/id/decorative
26	PT Kansai Paint	MNC	https://www.kansaicoatings.co.id
27	PT Mataram Paints	National	https://www.matarampaint.com/about.php?lg=eng
28	PT Mowilex Indonesia	National	https://mowilex.com/en/

No.	Manufacturer	Type of company	Website
29	PT Multi Supra Indah Paint	National	https://www.multisupraindahpaint.com/
30	PT Nipsea Paint and Chemicals	MNC	https://www.nipponpaint-holdings.com
31	PT Pacific Eka Perkasa	National	https://pacificpaint.com/
32	PT Pacific Paint	National	https://pacificpaint.com/
33	PT Propan Raya	National	www.propanraya.com
34	PT Puffin Paint	National	www.puffinpaint.com
35	PT Rajawali Hiyoto	National	https://www.instagram.com/hiyotoid/?hl=en
36	PT San Central Indah	National	https://www.sci-paint.com/category/cat-kayu-dan-besi
37	PT Seiv Indonesia	National	https://www.seiv.co.id/
38	PT Sigma Utama Paint	National	https://www.sigmautama.com/
39	PT Tanu Alvindo Perkasa	National	http://tanalpaint.com/shop/
40	PT TOA Paint	MNC	https://www.toagroup.com/en/products/special-paint
41	PT Trico Paint Factory	National	https://tricopaint.wixsite.com/
42	PT Tunggal Djaja Indah	National	https://www.tdipaint.com/
43	USA Paint	National	Not available
44	PT Warna Agung	National	www.warna-agung.com
45	PT Warna Mikha Mitra Sejati	National	https://mail.warnamikha.com/about.html
46	PT Warnatama Cemerlang	National	https://www.cemerlangpaint.com/enamel-paint
47	PT Zeven	National	http://ptzeven.com/index.php/site/companyProfile.html

Tabel 14. Responses from companies about the results of this study

No	Company Name	Response Date	Response	PIC	Statement
1	PT Rajawali Hiyoto	9-Aug-2021	Clarification and had a zoom call	Sammy Felisario R & D Manager	In the process of reformulation for lead-free paint production
2	PT Mataram Paint	12-Aug-2021	Responded to the results	Freddy Pangkey Owner	In the process of reformulation for lead-free paint production
3	PT Sigma Utama	13-Aug-2021	Responded to the results and filled out the form regarcing lead usage in their products	Diana Nur R & D	In the process of reformulation for lead-free paint production
4	PT Mowilex Indonesia	26-Aug-2021	Responded to results via email and a letter of commitment to produce lead-free paint, filled out the form regarding lead usage in their production, and had a zoom call with Mowilex's top management	Niko Savafi President Director	Mowilex has produced lead-free paint and launched a take back program and campaign #mowilexpastiman
5	PT TOA Paint Indonesia	27-Aug-2021	Responded to the results and asked for clarification about their results <60ppm	Nikodemus Joko Product Marketing	TOA paint results was <60ppm because their product is water-based and tinting paints
6	PT Dana Paint	6-Sep-2021	Reply to the results via email and letter	Maria Yudi GM Technical	If there is a stipulation from the government that the maximum Pb in solvent-based paint is 90 mg/kg, then we will follow that rule. We, as a member of APCI, have coordinated this matter with APCI
7	PT Futanlux Chemitraco	14-Sep-2021	Replied to the results via email, and filled out the form for the use of lead in the product	Jovianto Tjo Managing Director	Currently in the process of replacing the drier and pigment

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