PAKISTAN

LEAD IN SOLVENT-BASED PAINTS FOR HOME USE IN PAKISTAN

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NATIONAL REPORT

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While this study was undertaken with funding assistance from the NYCT and the Swedish Government, responsibility for the content lies entirely with IPEN and SDPI. The NYCT and the Swedish Government do not necessarily share the expressed views and interpretations.

Established in 1998, IPEN is currently comprised of over 500 Participating Organizations in 116 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.

IPEN
a toxics-free future

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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 dangerously 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 approximately 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 Pakistan. 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 Pakistan. Finally, it proposes action steps by different stakeholders to protect children and others from lead paint.

This study was conducted by Sustainable Development Policy Institute (SDPI) in partnership with IPEN.

IPEN is an international NGO network of health and environmental organizations from all regions of the world of which SDPI 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.

SDPI was founded in August 1992 on the recommendation of the Pakistan National Conservation Strategy (NCS), also called Pakistan's Agenda 21. This document, approved in March 1992 by the Federal Cabinet, outlined the need for an independent non-profit organization to serve as a source of expertise for policy analysis and development, policy intervention, and policy and program advisory services. SDPI is registered under the Societies Registration Act, XXI of 1860. The mandate was to conduct policy advice, policy oriented research and advocacy from a broad multi-disciplinary perspective to promote the implementation of policies, programs, laws and regulations based on sustainable development. The goal is to catalyze the transition towards sustainable and just development in Pakistan.

EXECUTIVE SUMMARY

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 Pakistan, a new standard promulgated in 2017 establishes the permissible maximum lead limit at 100 ppm for enamels. However, the implementation of laws and regulations is severely lacking in the country.

From October to December 2016, SDPI purchased a total of 58 cans of solvent-based paint intended for home use from stores in Islamabad and Rawalpindi, Pakistan. The paints represented 21 different brands produced by 18 manufacturers. All paints were analyzed by an accredited laboratory in the United States of America for their lead content, based on 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

35 out of 58 analyzed solvent-based paints for home use (60 percent of paints) were lead paints, i.e., they contained lead concentrations above 90 parts per million (ppm, dry weight of paint). This is also the regulatory limit for lead in decorative paint in e.g., Cameroon, India, the Philippines, and the United States of America. Moreover, 14 paints (24 percent of paints) contained dangerously high lead concentrations above 10,000 ppm. The highest lead concentration detected was 110,000 ppm in a yellow solvent-based paint with "lead free" label and sold for home use.

On the other hand, 23* out of 58 solvent-based paints for home use (40 percent of paints) contained lead concentrations below 90 ppm, suggesting that the technology to produce paint without lead ingredients exists in Pakistan.

17 out of 21 analyzed brands (81 percent of paint brands) sold at least one lead paint, i.e. a paint with lead concentration above 90 ppm. 14 out of 21 analyzed brands (67 percent of paint brands) sold at least one lead paint with dangerously high lead concentrations above 10,000 ppm.

Yellow paints most frequently contained dangerously high lead concentrations above 10,000 ppm. Of 15 yellow paints, 12 (80 percent of yellow paints), contained lead levels above 10,000 ppm and of 4 green paints, 2 (50 percent of green paints) contained lead levels above 10,000 ppm.

In general, some paint can labels provided information about lead content or the hazards of lead paint as 23 out of 58 paints (40 percent of paints) provided information about lead on their labels indicating "lead free" or "no added lead" claims. However, 10 out of 23 paints with "lead free" claims (43 percent of paints with lead free labels) contained lead levels ranging from 1,200 ppm to 110,000 ppm—a clear indication of false advertising which misleads the public. Most paints carried little information about any ingredients on can labels and were merely labeled 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 24 out of 58 paints (41 percent of paints) included in this study. Most warning symbols on the paint cans indicate the flammability of the paints, but had no precautionary warnings on the effects of lead dust to children and pregnant women were provided.

* Six paints (PAK-3, PAK-4, PAK-6, PAK-17, PAK-47, and PAK-50) contained lead concentrations "below 300 ppm," "below 200 ppm," or "below 100 ppm." For this report, these were approximated as "below 90 ppm" in order to compare them to the 90-ppm cut-off limit. It should however be noted that this may lead to an underestimation of the number of paints containing lead concentrations above 90 ppm.

CONCLUSIONS

This study demonstrates that solvent-based paints for home use with high concentrations of lead are widely available in Pakistan since the paints included in this study are brands commonly sold in retail stores all over Pakistan. The results are a cause of concern in terms of health and well-being of the people of Pakistan, particularly children who are most at risk. However, the fact that 23 out of 58 paints (40 percent of paints) contained lead concentrations below 90 ppm indicates that the technology to produce paints without added lead exists in Pakistan. 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 paints with total lead concentrations greater than 90 ppm.

RECOMMENDATIONS

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

Government and Government Agencies

Pakistan Standards & Quality Control Authority (PSQCA) should immediately take steps to ban the manufacture, import, export, distribution, sale and use of lead paints, i.e. paints that contain total lead concentrations exceeding 100 ppm, the standard adopted by Pakistan in 2017. They should also require paint companies to display sufficient information indicating toxic content on paint can labels and provide a warning on possible lead dust hazards when distributing painted surfaces.

Relevant governmental departments at the federal, provincial and local levels in Pakistan should work with PSQCA to overcome the challenges posed by the threat of lead based paints to the health and well being of the people of Pakistan, particularly children. Such initiatives would include capacity building programs that ensure that the authorities understand the risks and threats posed by lead in paints and are able to work together to address the issue. Moreover, the relevant departments would work with the PSQCA to ban trade in adulterated, unregistered, unlabeled, repackaged and uncertified paint products.

Paint Industry

Paint companies that still produce lead paint should expeditiously stop the use of 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.

Individual, Household and Institutional Consumers

Paint consumers should demand paints with no added lead from paint manufacturers and retailers, as well as 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, day care centers, parks and playgrounds.

Civil Society Organizations

Public health groups, consumer organizations, academia, and other concerned entities to support the elimination of lead based paints, and conduct activities to inform and protect children from lead exposure. Such initiatives will include an assessment and study of activities that will reduce children's and workers' exposure to pollutants such as lead in paints.

All Stakeholders

All stakeholders should come together and unite in promoting a strong policy that will eliminate lead paint in Pakistan.

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, very large amounts of lead-contaminated dust is produced, which 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 soil 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 some cases, children pick up paint chips and put them directly into their mouths. 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 that children ingest lead is through lead-contaminated dust and soil that gets onto their hands.[3]

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 of ingested lead than 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 that has accumulated in her body to her developing child.[4] Lead is also transferred through breast milk when lead is present in a nursing mother.[5]

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.[6] Lead is also categorized as an endocrine-disrupting chemical (EDC).[7]

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.[8]

According to the World Health Organization (WHO): "Lead has no essential role in the human body, and lead poisoning accounts for about 0.6 percent 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 due to modifiable environmental factors.[9]

In recent years, medical researchers have been documenting significant health impacts in children from lower and lower levels of lead exposure.[2, 6] According to the factsheet on Lead Poisoning and Health from WHO: "There is no known level of lead exposure that is considered safe."[10]

When a young child is exposed to lead, the harm to her or his nervous system makes it more likely that the child will have difficulties in school and engage in impulsive and violent behavior.[11] 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 impact 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 all low- and middle-income countries estimated a total cumulative cost burden of $977 billion international dollars† per year.[12] The study considered the neurodevelopmental effects on lead-exposed children, as measured by reduced IQ points, and 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 major source.

† An International dollar is a currency unit used by economists and international organizations to compare the values of different currencies. It adjusts the value of the U.S. dollar to reflect currency exchange rates, purchasing power parity (PPP), and average commodity prices within each country. According to the World Bank, "An international dollar has the same purchasing power over GDP as the U.S. dollar has in the United States." The international dollar values in this report were calculated from a World Bank table that lists GDP per capita by country based on purchasing power parity and expressed in international dollars.

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 percent of Gross Domestic Product (GDP);

Latin America and the Caribbean: $142.3 billion of economic loss, or 2.04 percent of GDP; and

Asia: $699.9 billion of economic loss, or 1.88 percent of GDP.

Country estimates used in this study can be accessed at a publicly available website, **http://www.med.nyu.edu/pediatrics/research/environmentalpediatrics/leadexposure**, and shows that ***economic loss in Pakistan is estimated at $37.8 billion, or 7.75 percent of Gross Domestic Product (GDP).***

1.2 THE USE OF LEAD IN PAINT

Paints contain high levels of lead when the paint manufacturer intentionally adds one or more leaded compounds to the paint for some purpose. A paint product may also contain some amount of lead when paint ingredients contaminated with lead are used, or when there is cross-contamination from other product lines in the same factory. Leaded paint ingredients are most commonly intentionally used in solvent-based paint due to their chemical properties, and solvent-based paints have been found to have high lead content in many countries.[13-15]

The leaded compounds most commonly added to paints are pigments. Pigments are used to give the paint its 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 for use as driers (sometimes called drying agents or drying catalysts). Leaded compounds are also sometimes 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 ingredi-

Lead Paint Terminology

As used in this booklet:

• "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.

ents 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.

Most highly industrial countries adopted laws or regulations to control the lead content of decorative paints beginning in the 1970s and 1980s. Many also imposed controls on the lead content of paints used on toys and for other applications likely to contribute to lead exposure in children. These regulatory actions were taken based on scientific and medical findings that lead paint is a major source of lead exposure in children, and that lead exposure in children causes serious harm, especially to children aged six years and under.

The use of lead in production of decorative paint is prohibited in the European Union through regulations related to safety of consumer products and specific prohibitions for most leaded raw materials. In the U.S., Canada, Australia and

other countries with regulations restricting the use of leaded ingredients in decorative paint, standards specifying a maximum lead limit are in place. The current standard for household paints in e.g., the U.S., the Philippines, India and Cameroon is a total maximum lead content of 90 ppm, and adherence to this ensures that a manufacturer can sell its paint anywhere in the world. Some other countries such as Brazil, South Africa and Sri Lanka have established standards of 600 ppm total lead.

1.3 PAINT MARKET AND REGULATORY FRAMEWORK IN PAKISTAN

Market:

Pakistan's local paint industry operates both in organized and unorganized sectors. Specific and accurate data regarding Pakistan's paint market is unavailable. Whatever is available is estimated and approximated as paints manufacturers do not share data publically states CEO AkzoNobel, Jahanzeb Khan (The News, 2017). According to an estimate, around 140 large scale and more than 2000 units of paint manufacturers operate in Pakistan (Siddiqi, 1991). Being unorganized helps in avoiding tax and excise duties, and hence, results in both substandard paints and relatively lower prices. Pakistan's paint manufacturing output has been erratic from 1991 to 1998 owing to availability of raw materials, tax reforms for paint industry and demand patterns. At the time of Pakistan's creation only one paint manufacturer existed by the name of Ravi paints in Lahore. Virtually all demands were met through imports. By 1991, Pakistan had more than 2000 paint manufacturing units. Pakistan is now self-sufficient when it comes to paints. Out of 2000 units, 140 are large scale units. Pakistan's main demand comes from government institutions of defense, dams, shipyards and railways (Siddiqi, 1991). Only half of what was produced in 1991 could be manufactured in 1997 and 1998 (The Free Library).

The four largest paint manufacturers in Pakistan constitute about two-thirds of the paint market in Pakistan. The make-up of the paint industry in Pakistan is as follows:

- ICI Paints (now AkzoNobel) constitute 33 percent market share;
- Berger Paints constitute 21 percent market share;
- Master Paints constitute 8 percent market share;
- Kansai Paints constitute 4 percent market share; and
- Others, including manufacturers from the unorganized sector constitute 34 percent market share (Sethi n.d).

Manufacturers from the unorganized sector commands a sizeable proportion of the paint market in Pakistan's paint industry as they sell relatively cheaper paint products. Government statistics show that Pakistan's paints and varnish output has grown from 10,922 tonnes in 2000-2001 to 48,631 tonnes in 2014-2015. The output has been erratic and does not follow a constant increase (Pakistan Economic Survey, 2016).

The rapid developments in the construction and housing industry have greatly increased the demand for decorative paints. Housing sectors share in GDP has maintained a growth of 3.99% annually. This is evident from the official turnovers the two giant paint manufacturers have posted. AkzoNobel Pakistan reported turnover of 6.9 billion Rupees and 7.2 billion in years 2014 and 2015 respectively. Berger Pakistan reported annual turnover of 5.08 billion Rupees in 2016 as compared to 4.3 billion in 2015 (Dawn, 2017).

Regulatory Framework:

The PSQCA Act 1996 of the Parliament empowers Pakistan Standards & Quality Control Authority, as National Standard Body of Pakistan under the administrative control of Ministry of Science & Technology. The Act of 1996 entails that the authority has following functions such as inspection and testing of products and services for their quality, specification and characteristics, during use and for import and export purposes. The Act further states that anyone who violates any section of the Act can be subject to imprisonment and fine or both. The inspectors of PSQCA under the Act are liable to hold, detain or seize material or article that does not conform to Pakistan standards. Pakistan Standards and Quality Control Authority (PSQCA) in 2017 approved new quality standards through the "National Standard Committee for Chemicals". The new standard establishes the permissible maximum lead limit at 100 ppm for enamels. Yet, as the results of this study show the implementation of the standards is severely lacking.

2. MATERIALS AND METHODS

From October to December 2016, 58 cans of solvent-based paint intended for home use were purchased by SDPI from various stores in the cities of Islamabad and Rawalpindi, Pakistan. The paints represented 21 different brands produced by 18 manufacturers.

In most cases, one white paint and one or more bright-colored paint such as red or yellow were selected. Additionally, 2 anticorrosive paints 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. Excluded were automotive and industrial paints that are not typically used for domestic housing applications.

During the paint sample preparation, information such as color, brand, manufacturer, country where manufactured, product codes, production dates, and other details as provided on the label of the paint can were recorded. Generic paint colors were recorded, e.g., "yellow" instead of "sunflower." For all colored paints, the protocol called for obtaining "bright" or "strong" red and yellow paints 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 SDPI by the staff of the IPEN partner NGO, Arnika, in The Czech Republic.

Each can of paint was thoroughly stirred and was subsequently applied onto individually numbered triplicates of untreated; labeled wood pieces using different unused, single-use paintbrushes by a researcher of SDPI as shown in Figure 1.

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, resalable plastic bags and shipped for analysis of lead content to Forensic Analytical Laboratories, Inc. in the United States of America. The laboratory participates in the Environmental Lead Proficiency Analytical Testing (ELPAT) Program operated by the American Industrial Hygiene Association. In the laboratory selection process, IPEN further assessed the reliability of the laboratory results by conducting

an independent quality assurance testing. This was made by sending paint samples with a known lead content to the laboratory, and evaluating the results received.

The laboratory's lower limit of detection for the lead concentration in the paint samples is dependent on the amount of paint in the samples. Generally, the lowest detection limit 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.[16]

Figure 2. Preparation of paint samples for testing.

3. RESULTS

3.1 SUMMARY OF RESULTS

This study shows that:

- 35 out of 58 analyzed solvent-based paints (60 percent of paints) were lead paints, i.e., they contained lead concentrations above 90 parts per million (ppm), dry weight. In addition, 14 paints (24 percent of paints) contained dangerously high lead concentrations above 10,000 ppm. On the other hand, 23 out of 58 solvent-based paints for home use (40 percent of paints) contained lead concentrations below 90 ppm, suggesting that the technology to produce paint without lead ingredients exists in Pakistan.
- 17 out of 21 analyzed brands (81 percent of paint brands) sold at least one lead paint, i.e., paint with lead concentration above 90 ppm. Also, 14 out of 21 analyzed brands (67 percent of paint brands) sold at least one lead paint; with dangerously high lead concentrations above 10,000 ppm.
- 29 out of 40 bright-colored paints (72 percent of bright-colored paints) were lead paints, i.e., they contained lead concentrations above 90 parts per million (ppm), dry weight. Yellow-colored paints were the most hazardous with 12 out of 15 paints (80 percent of yellow paints) containing lead concentrations greater than 10,000 ppm; and 2 out of 4 green paints (50 percent of green paints) also contained dangerously high lead concentrations above 10,000 ppm.
- The highest lead concentration detected was 110,000 ppm in a yellow Berger solvent-based paint with "lead-free" label and sold for home use.
- 23 out of 58 paints (40 percent of paints) provided information about lead on their labels indicating "lead free" or "no added lead" claims. However, 10 out of 23 paints with "lead free" claims (43 percent of paints with lead free labels) contained lead levels ranging from 1,200 ppm to 110,000 ppm—a clear indication of false advertising which misleads the public. Most paints carried little information about ingredients on paint can labels and 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.

3.2 LEAD CONTENT ANALYSIS

35 out of 58 analyzed solvent-based paints (60 percent of paints) were lead paints, i.e., contained a lead concentration above 90 ppm—14 of these contained dangerously high lead concentrations above 10,000 ppm (24 percent of paints).

A yellow solvent-based paint contained the highest concentration of lead at 110,000 ppm, while the lowest concentration of lead less than 60 ppm was detected in paints from the following brands: Berger (red), Diamond (red), Homex (red and white), New City (white), Nippon (red and white), Sparco (white), and Wetser 77 (red and white).

The ten solvent-based paints with the highest amounts of lead are summarized in Table 1.

TABLE 1. TOP 10 SOLVENT-BASED PAINTS WITH THE HIGHEST LEAD CONTENT

Ranking	Sample Number	Brand	Manufacturer	Color	Lead Content (ppm)
1	Pak 33	Berger	Berger Paints	Yellow	110,000
2	Pak 55	Marilac	Goldberg Paint Industries	Yellow	93,000
3	Pak 16	Diamond	Diamond Paints	Yellow	87,000
4	Pak 1	Honey Gold	Honey Gold Paints	Yellow	83,000
5	Pak 63	Brighto	Brighto Paints	Yellow	82,000
6	Pak 32	Homebrite	S.M.S. Paint Industries	Yellow	76,000
7	Pak 27	Happilac	Karss Paint Industries	Yellow	75,000
8	Pak 45	Nippon	Nippon Paints	Green	32,000
9	Pak 22	Top Lac	Federal Paints	Yellow	32,000
10	Pak 14	Wester 77	Federal Paints	Yellow	31,000

3.3 PAINT BRAND ANALYSIS

14 out of 21 analyzed brands (67 percent of paint brands) sold at least one paint with dangerously high lead concentration above 10,000 ppm.

Among solvent-based decorative paints, a yellow Berger Paint contained the highest concentration of lead at 110,000 ppm. On the other hand, at least one paint from each of the following brands contained lead below 90 ppm: Berger (red), Buxly (red and white), Chawla (white), Diamond (red and white), Dulux (green, red and white), Homebrite (white), Homex (white), Kansai (red, white and yellow), Master (white), New City (white), Nippon (red and white), Sparco (white), and Wester 77 (red and white). This indicates that the technology to produce paints without added lead exists in Pakistan.

Both two anticorrosive paints contained less than 90 ppm lead, with Zic Paints containing 70 ppm, and Homex containing less than 60 ppm.

Two solvent-based paints produced by multinational companies but manufactured in Pakistan—one from Berger and one from Nippon Paint—contained lead concentrations at 110,000 ppm and 32,000 ppm, respectively. Berger is owned by the India-based Berger Paints India Ltd, the second largest paint manufacturer in India, while Nippon Paint is owned by the Japan-based Nippon Paint Co., Ltd, the largest paint manufacturer in Japan.

In 2016, Coatings World released its Top Companies Report based on annual sales of paints and coatings products worldwide, and ranked Nippon Paint Co., Ltd as the seventh largest paint manufacturer and Berger Paints India Ltd as the 24th largest paint manufacturer in the world.[17]

3.4 PAINT COLOR ANALYSIS

29 out of 40 bright-colored paints (72 percent of bright-colored paints) such as yellow, orange and red contained lead concentrations above 90 ppm, 14 paints of which contained dangerously high lead concentrations above 10,000 ppm (35 percent of bright-colored paints).

This study included 19 red decorative paints, 18 white decorative paints, 15 yellow decorative paints, four green decorative paints, and two red anticorrosive paints. Yellow and green paints contained the highest lead concentrations.

Among bright-colored paints, 14 out of 15 yellow paints (93 percent of yellow paints) contained lead concentrations above 90 ppm, 12 paints of which exceeded more than 10,000 ppm of lead (80 percent of yellow paints); three out of four green paints (75 percent of green paints) contained lead concentrations

above 90 ppm, 2 paints of which exceeded more than 10,000 ppm of lead (50 percent of green paints).

The distribution of lead concentrations in different colors is shown in Figure 2.

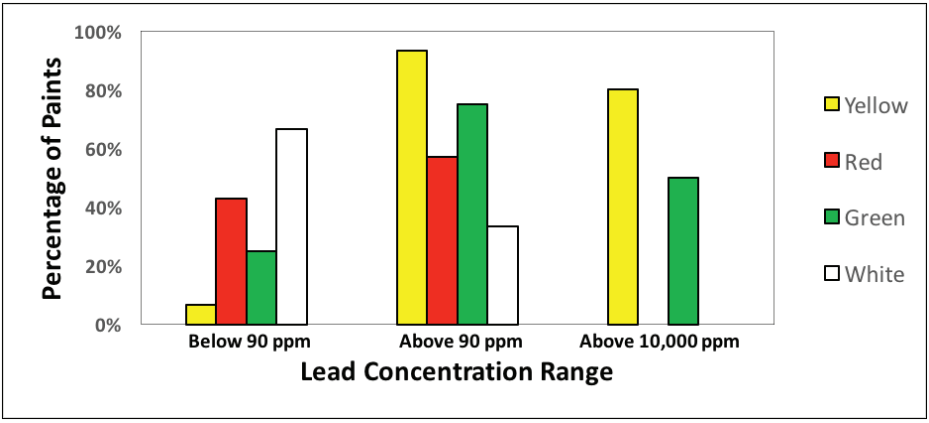

Figure 2. Distribution of lead concentrations in home-use solvent-based paints by color.

3.5 LABELING

In general, some paint can labels provided information about lead content or the hazards of lead paint 23 out of 58 paints (40 percent of paints) provided information about lead on their labels indicating "lead free" or "no added lead" claims. However, 10 out of 23 paints with "lead free" claims (43 percent of paints with lead free labels) contained lead levels ranging from 1,200 ppm to 110,000 ppm—a clear indication of false advertising which misleads the public. Most paint can labels carried little information about any ingredients and were merely labeled 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 24 out of 58 paints (41 percent of paints) included in this study. 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.

4. CONCLUSIONS AND RECOMMENDATIONS

This study demonstrates that solvent-based paints for home use with high concentrations of lead are widely available in Pakistan since the paints sampled for this study are brands commonly sold in retail stores all over Pakistan. However, the fact that 23 out of 58 paints (40 percent of paints) contained lead concentrations below 90 ppm indicates that the technology to produce paints without added lead exists in Pakistan. 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 paints with total lead concentrations greater than 90 ppm.

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

For the Pakistan Standards & Quality Control Authority (PSQCA) to immediately take steps to ban the manufacture, import, export, distribution, sale and use of lead paints, i.e. paints that contain total lead concentrations exceeding 100 ppm, the standard adopted by Pakistan in 2017. They should also require paint companies to display sufficient information indicating toxic content on paint can labels and provide a warning on possible lead dust hazards when distributing painted surfaces.

For relevant governmental departments at the federal, provincial and local levels in Pakistan to work with PSQCA to overcome the challenges posed by the threat of lead based paints to the health and well being of the people of Pakistan, particularly children. Such initiatives would include capacity building programs that ensure that the authorities understand the risks and threats posed by lead in paints and are able to work together to address the issue. Moreover, the relevant departments would work with the PSQCA to ban trade in adulterated, unregistered, unlabeled, repackaged and uncertified paint products.

For paint companies that still produce lead paints to expeditiously stop the use of 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 paint consumers to demand paints with no added lead from paint manufacturers, as well as 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, day care centers, parks and playgrounds.

For public health groups, consumer organizations, academia, and other concerned entities to support the elimination of lead based paints, and conduct activities to inform and protect children from lead exposure. Such initiatives will include an assessment and study of activities that will reduce children's and workers' exposure to pollutants such as lead in paints.

For all stakeholders to come together and unite in promoting a strong policy that will eliminate lead paint in Pakistan.

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APPENDIX

TABLE 2. SOLVENT-BASED PAINTS FOR HOME USE INCLUDED IN THE STUDY.

Sample number	Brand Name	Color of Paint	Volume (L)	Price (Pak Rupees)	Date Manufactured	Batch No.	Date of Purchase	Is there website on the paint can?
Pak 33	Berger	Yellow	1	350	N.A		17-12-2016	http://berger.com.pk
Pak 28	Berger	Red	1	350	N.A		17-12-2016	http://berger.com.pk
Pak 63	Brighto	Yellow	1	380	N.A		17-12-2016	www.brightopaints.com
Pak 24	Brighto	Red	1	380	N.A		17-12-2016	www.brightopaints.com
Pak 11	Brighto	White	1	380	N.A		17-12-2016	www.brightopaints.com
Pak 15	Buxly	Green	1	350	N.A		17-12-2016	www.buxly.com
Pak 47	Buxly	White	1	350	N.A		17-12-2016	www.buxly.com
Pak 3	Buxly	Red	1	350	N.A		17-12-2016	www.buxly.com
Pak 60	Chawla	Yellow	1	350	N.A		17-12-2016	http://www.chawlagroup.com
Pak 61	Chawla	Red	1	350	N.A		17-12-2016	http://www.chawlagroup.com
Pak 56	Chawla	White	1	350	N.A		17-12-2016	http://www.chawlagroup.com
Pak 16	Diamond	Yellow	1	350	N.A		17-12-2016	www.diamondpaints.com
Pak 36	Diamond	Red	1	350	N.A		17-12-2016	www.diamondpaints.com
Pak 18	Diamond	White	1	350	N.A	476056	17-12-2016	www.diamondpaints.com
Pak 42	Dulux	White	1	350	N.A		17-12-2016	www.icidulux.com.pk/en
Pak 17	Dulux	Green	1	350	N.A	209108	17-12-2016	www.icidulux.com.pk/en
Pak 21	Dulux	Red	1	350	N.A	047084	17-12-2016	www.icidulux.com.pk/en
Pak 27	Happilac	Yellow	1	350	N.A		17-12-2016	www.happilacpaints.com
Pak 49	Happilac	Red	1	350	N.A		17-12-2016	www.happilacpaints.com
Pak 38	Happilac	White	1	350	N.A		17-12-2016	www.happilacpaints.com
Pak 32	Homebrite	Yellow	1	350	N.A		17-12-2016	
Pak 7	Homebrite	Red	1	350	N.A		17-12-2016	
Pak 6	Homebrite	White	1	350	N.A		17-12-2016	

Sample number	Brand Name	Color of Paint	Volume (L)	Price (Pak Rupees)	Date Manufactured	Batch No.	Date of Purchase	Is there website on the paint can?
Pak 48	Homex	Yellow	1	350	N.A		17-12-2016	www.norson.com.pk
Pak 58	Homex	Red	1	350	N.A		17-12-2016	www.norson.com.pk
Pak 37	Homex	White	1	350	N.A		17-12-2016	www.norson.com.pk
Pak 1	Honey Gold	Yellow	1	350	N.A	4105	17-12-2016	
Pak 34	Honey Gold	White	1	350	N.A	1622211	17-12-2016	
Pak 66	Honey Gold	Red	1	350	N.A	16262610	17-12-2016	
Pak 50	Kansai	Red	1	350	N.A	70641	17-12-2016	www.kansaipaint.com.pk
Pak 4	Kansai	Yellow	1	350	N.A	65898	17-12-2016	
Pak 5	Kansai	White	1	350	N.A	99389	17-12-2016	
Pak 55	Marilac	Yellow	1	350	N.A		17-12-2016	
Pak 8	Marilac	Red	1	350	N.A		17-12-2016	
Pak 62	Marilac	White	1	350	N.A		17-12-2016	
Pak 10	Master	Yellow	1	375	N.A	4909	17-12-2016	www.masterpaints.com
Pak 35	Master	Red	1	375	N.A	5230	17-12-2016	www.masterpaints.com
Pak 19	Master	White	1	375	N.A	7426	17-12-2016	www.masterpaints.com
Pak 64	New City	Yellow	1	300	N.A		17-12-2016	
Pak 26	New City	Red	1	300	N.A		17-12-2016	
Pak 57	New City	White	1	300	N.A		17-12-2016	
Pak 45	Nippon	Green	1	350	N.A		17-12-2016	www.nipponpaint.com
Pak 30	Nippon	Red	1	350	N.A		17-12-2016	www.nipponpaint.com
Pak 46	Nippon	White	1	350	N.A		17-12-2016	www.nipponpaint.com
Pak 22	Toplac	Yellow	1	350	N.A		17-12-2016	www.federalpaints.com.pk
Pak 65	Toplac	Red	1	350	N.A		17-12-2016	www.federalpaints.com.pk
Pak 39	Toplac	White	1	350	N.A		17-12-2016	www.federalpaints.com.pk
Pak 29	Triangle	Yellow	1	350	N.A	081115	17-12-2016	
Pak 2	Triangle	Red	1	350	N.A	0903016	17-12-2016	

Sample number	Brand Name	Color of Paint	Volume (L)	Price (Pak Rupees)	Date Manufactured	Batch No.	Date of Purchase	Is there website on the paint can?
Pak 40	Triangle	White	1	350	N.A	2411016	17-12-2016	
Pak 14	Wester 77	Yellow	1	300	N.A	C6067	17-12-2016	www.federalpaints.com.pk
Pak 13	Wester 77	White	1	300	N.A	K6155	17-12-2016	www.federalpaints.com.pk
Pak 52	Wester 77	Red	1	300	N.A	F6156	17-12-2016	www.federalpaints.com.pk
Pak 23	Zic Paints (red oxide primer)	red	1	100	N.A		17-12-2016	
Pak 51	Homex (red oxide primer)	red	1	170	N.A		17-12-2016	

TABLE 3. RESULTS OF LABORATORY ANALYSIS OF SOLVENT-BASED PAINTS FOR HOME USE.

Sample No.	Brand	Color of Paint	Total Lead Concentration, Dry Weight (ppm)	Country of Brand Headquarters	Country of Manufacture	Is there information on can about lead content of paint?
Pak 35	Master	Red	5,400	Pakistan	Pakistan	
Pak 10	Master	Yellow	18,000	Pakistan	Pakistan	
Pak 19	Master	White	Below 70	Pakistan	Pakistan	
Pak 1	Honey Gold	Yellow	83,000	Pakistan	Pakistan	
Pak 34	Honey Gold	White	3,100	Pakistan	Pakistan	
Pak 66	Honey Gold	Red	1,100	Pakistan	Pakistan	
Pak 42	Dulux	White	Below 70	Netherlands	Pakistan	"No Added Lead and Mercury"
Pak 17	Dulux	Green	Below 200	Netherlands	Pakistan	"No Added Lead and Mercury"
Pak 21	Dulux	Red	Below 90	Netherlands	Pakistan	"No Added Lead and Mercury"
Pak 33	Berger	Yellow	110,000	India	Pakistan	"Lead Free"
Pak 28	Berger	Red	Below 60	India	Pakistan	"Lead Free"
Pak 43	Sparco	White	Below 60	Pakistan	Pakistan	"Lead Free"
Pak 67	Sparco	Red	1,200	Pakistan	Pakistan	"Lead Free"
Pak 25	Sparco	Green	5,200	Pakistan	Pakistan	"Lead Free"
Pak 2	Triangle	Red	2,500	Pakistan	Pakistan	
Pak 40	Triangle	White	170	Pakistan	Pakistan	
Pak 29	Triangle	Yellow	27,000		Pakistan	
Pak 30	Nippon	Red	Below 60	Japan	Pakistan	
Pak 45	Nippon	Green	32,000	Japan	Pakistan	
Pak 46	Nippon	White	Below 60	Japan	Pakistan	
Pak 14	Wester 77	Yellow	31,000	Pakistan	Pakistan	
Pak 13	Wester 77	White	Below 60	Pakistan	Pakistan	
Pak 52	Wester 77	Red	Below 60	Pakistan	Pakistan	
Pak 48	Homex	Yellow	8,300	Pakistan	Pakistan	
Pak 58	Homex	Red	2,800	Pakistan	Pakistan	

Sample No.	Brand	Color of Paint	Total Lead Concentration, Dry Weight (ppm)	Country of Brand Headquarters	Country of Manufacture	Is there information on can about lead content of paint?
Pak 37	Homex	White	Below 60	Pakistan	Pakistan	
Pak 63	Brighto	Yellow	82,000	Pakistan	Pakistan	"Lead Free"
Pak 24	Brighto	Red	1,900	Pakistan	Pakistan	"Lead Free"
Pak 11	Brighto	White	1,900	Pakistan	Pakistan	"Lead Free"
Pak 27	Happilac	Yellow	75,000	Pakistan	Pakistan	
Pak 38	Happilac	White	2,600	Pakistan	Pakistan	
Pak 49	Happilac	Red	4,000	Pakistan	Pakistan	
Pak 47	Buxly	White	Below 100	Pakistan	Pakistan	"Lead Free"
Pak 3	Buxly	Red	Below 100	Pakistan	Pakistan	"Lead Free"
Pak 15	Buxly	Green	12,000	Pakistan	Pakistan	"Lead Free"
Pak 8	Marilac	Red	3,200	Pakistan	Pakistan	
Pak 55	Marilac	Yellow	93,000	Pakistan	Pakistan	
Pak 62	Marilac	White	2,700	Pakistan	Pakistan	
Pak 50	Kansai	Red	Below 200	Japan	Pakistan	"No Added Lead or Mercury"
Pak 5	Kansai	White	80	Japan	Pakistan	"No Added Lead or Mercury"
Pak 4	Kansai	Yellow	Below 100	Japan	Pakistan	"No Added Lead or Mercury"
Pak 32	Homebrite	Yellow	76,000	Pakistan	Pakistan	
Pak 7	Homebrite	Red	110	Pakistan	Pakistan	
Pak 6	Homebrite	White	Below 100	Pakistan	Pakistan	
Pak 65	Toplac	Red	3,200	Pakistan	Pakistan	
Pak 39	Toplac	White	1,500	Pakistan	Pakistan	
Pak 22	Toplac	Yellow	32,000	Pakistan	Pakistan	
Pak 51	Homex (red oxide primer)	red	Below 60	Pakistan	Pakistan	
Pak 23	Zic Paints (red oxide primer)	red	70	Pakistan	Pakistan	
Pak 60	Chawla	Yellow	24,000	Pakistan	Pakistan	"Lead and Mercury Free"
Pak 56	Chawla	White	Below 70	Pakistan	Pakistan	"Lead and Mercury Free"

Sample No.	Brand	Color of Paint	Total Lead Concentration, Dry Weight (ppm)	Country of Brand Headquarters	Country of Manufacture	Is there information on can about lead content of paint?
Pak 61	Chawla	Red	1,700	Pakistan	Pakistan	"Lead and Mercury Free"
Pak 64	New City	Yellow	8,100	Pakistan	Pakistan	
Pak 26	New City	Red	450	Pakistan	Pakistan	
Pak 57	New City	White	Below 60	Pakistan	Pakistan	
Pak 36	Diamond	Red	Below 60	Pakistan	Pakistan	"Lead Free"
Pak 18	Diamond	White	Below 60	Pakistan	Pakistan	"Lead Free"
Pak 16	Diamond	Yellow	87,000	Pakistan	Pakistan	"Lead Free"

TABLE 4. DISTRIBUTION OF LEAD CONCENTRATION BY BRAND.

Brand	No. of samples	No. of samples above 90 ppm	No. of samples above 10,000 ppm	Minimum lead content (ppm)	Maximum lead content (ppm)
Berger	2	1	1	Below 60	110,000
Brighto	3	3	1	1900	82,000
Buxly	3	1	1	Below 100	12,000
Chawla	3	2	1	Below 70	24,000
Diamond	3	1	1	Below 60	87,000
Dulux	3	0	0	Below 70	Below 200
Happilac	3	3	1	2,600	75,000
Homebrite	3	2	1	Below 100	76,000
Homex	3	2	0	Below 60	8,300
Honey Gold	3	3	1	1100	83,000
Kansai	3	0	0	80	Below 200
Marilac	3	3	1	2700	93,000
Master	3	2	1	Below 70	18,000
Newcity	3	2	0	Below 60	8,100
Nippon	3	1	1	Below 60	32,000
TopLac	3	3	1	1500	32,000
Triangle	3	3	1	170	27,000
Wester	3	1	1	Below 60	31,000
Sparco	3	2	0	Below 60	5,200
Zic Paints (red oxide primer)	1	0	0	70	70
Homex (red oxide primer)	1	0	0	Below 60	Below 60

TABLE 5. DISTRIBUTION OF LEAD CONCENTRATION BY COLOR.

Colors	No. of samples	No. of samples above 600 (ppm)	No. of samples above 10,000 (ppm)	Minimum lead content (ppm)	Maximum lead content (ppm)
Red	21	10	0	Below 60	5,400
Yellow	15	14	12	Below 100	110,000
White	18	5	0	Below 60	3,100
Green	4	3	0	Below 200	32,000

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