Lead in New Decorative Paints

A study by

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Foreword

Lead still finds its way into paints, which are used in our daily lives. The paints are on walls, in toys, on furniture, in fact probably everywhere where one can see man-made colour. Lead has been recognised as prime toxic by WHO. It impacts over 40 million children worldwide, over 97 percent of whom live in developing countries. It is in these countries that lead in paints still exists, mostly purposely added by paint manufacturers evidently to improve sheen, longevity or durability of the colour.

The incredible part of the story is that there are commercially available substitutes, and have existed for the past century. As early as 1935, countries in Europe had banned the use of lead in household paints, while the United States did so in 1971. For over half a century the paint industry has known about the grave health impacts that lead in paints has on children who lick baby cots, suckle toys, or simply ingest lead laden household dust. Lead can irreversibly lower IQ, and also cause a series of coordination skill deficiencies. In fact the map of the countries where lead is still added to paints is like the political map of the world. This puts to shame all arguments about CSR and is nothing short of a criminal act.

The industry pleads ignorance. Or simply it uses the cost argument to justify its act. In this case these are nothing more than a red herring. In India, as per Toxics Link studies, only one major manufacturer of paints did not add lead to its paints, while all the other major brands did. In fact this leading brand has a competitive and significant market share. When asked by outraged parents, they simply justified this by claiming that it makes the paint 'better.'

In 2007, when the outcry about lead in children's toys was raised in the U.S. and Europe, it was quickly tracked to paints. In India too, the toy industry found itself ducking as another Toxics Link report found toys in India laced with lead and cadmium. However even two years later, Indian paints still have lead in them despite claims being made of its removal by major manufacturers.

It was to determine the global pattern of lead in paints that this study of paints in 10 countries was initiated. Working with the International POPs Elimination Network (IPEN), 10 developing countries were identified, which also had very active partner NGOs. IPEN is a global network of more than 700 public interest non-governmental organisations in over 100 countries working together for a toxics-free future, including the elimination of persistent organic pollutants, on an expedited yet socially equitable basis. This mission also includes achieving a world in which all chemicals are produced and used in ways that eliminate significant adverse effects on human health and the environment, and where persistent organic pollutants (POPs) and chemicals of equivalent concern no longer pollute our local and global environments, and no longer contaminate our communities, our food, our bodies, or the bodies of our children and future generations.

To investigate the problem globally, Toxics Link and IPEN partnered together in 2008 to test paints for lead in local markets in countries across Africa, Asia, Latin America and Eastern Europe. The results confirmed that lead in paints is still being produced and sold, exposing children and communities to this toxic substance.

In parallel, the international community has taken action to build on this NGO initiative. Toxics Link as a member of IPEN proposed a Global Partnership to eliminate lead from paint to Forum VI of the Intergovernmental Forum on Chemical Safety (IFCS) in September 2008. IFCS, through a resolution passed at Forum VI, and the SAICM Emerging Issues Policy process, has endorsed this NGO initiative. Moreover, this issue is one of the four SAICM Emerging Issues set for discussion and cooperative action at ICCM2.

Lead samples were obtained and analysed in Delhi through Toxics Link. The results only prove what was already believed to be so. Very high lead level was found in all countries some with 100 percent of the samples exceeding standards. The study was first released at the ICCM2 in Geneva in May 2009, and helped in informing the delegates to adopt a resolution to form a Global Partnership under the auspices of UNEP and WHO to eliminate lead from paints by 2020. It is an ambitious but achievable goal.

Meanwhile all the NGO partners in the study have committed to raising the issue in their own countries and encourage Government and Industry to take immediate corrective action to remove lead at source. We hope for a lead exposure free world!

Ravi Agarwal
Director

About Toxics Link and IPEN

Toxics Link is an information outreach and environmental advocacy organisation set up in 1996. It has a special emphasis on reaching out to grassroots groups and community based organisations. Its engagements include research, outreach and policy advocacy on issues of communities and urban waste, toxics free healthcare, hazardous waste and pesticides.

Toxics Link works closely with all stakeholders working on similar issues and has been conducive to the formation of several common platforms for them. It is a part of international networks working on similar issues.

The mission of the organisation is:

> *"Working together for environmental justice and freedom from toxics. We have taken upon ourselves to collect and share both information about the sources and dangers of poisons in our environment and bodies, and information about clean and sustainable alternatives for India and rest of the world"*

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IPEN: The International POPs Elimination Network (IPEN) is a global network of more than 700 public interest non-governmental organisations in over 100 countries working together for a toxics-free future, including the elimination of persistent organic pollutants, on an expedited yet socially equitable basis

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Acknowledgement

Toxics Link acknowledges the following partner organisations for their important role in the timely execution of the project: Centre for Environmental Justice, Sri Lanka; Ecological Waste Coalition of the Philippines, Inc. (EcoWaste Coalition), Philippines; Campaign for Alternative Industry Network (CAIN), Thailand; AGENDA for Environment and Responsible Development, Tanzania; GroundWork- Friends of the Earth, South Africa; Friends of the Environment (FOTE)/Strategic Research and Action for Environmental Development (SRADev), Nigeria; Pesticide Action Network (PAN), South Africa and Senegal; Centre for Environmental Solutions, Belarus; Red de Acción en Plaguicidas y sus Alternativas en México (RAPAM)/Centro de Analisis y Acción en Tóxicos y sus Alternativas (CAATA), Mexico; and APROMAC – Environment Protection Association, Brazil.

This global study required a near-flawless coordination to procure paint samples from 10 countries situated in different continents and time zones. This was made possible by Bjorn Beeler and Jennifer Federico of the IPEN Secretariat through excellent coordination. Coordinators of the IPEN regional hubs were also very helpful. Toxics Link received vital help from Manny Calonzo, one of the regional coordinators of the IPEN South-East Asia hub, from inception to conclusion of this study. His keen interest in this study was very supportive of our efforts.

Toxics Link also acknowledges with gratitude valuable comments it received on the draft report from Judy Stober, Executive Secretary, IFCS; Jack Weinberg and Joe Digangi, IPEN; Prof C. Scott Clark of University of Cincinnati, USA, and Perry Gottesfeld, Director, OK International, San Francisco, USA. Their knowledge sharing is immensely appreciated.

SSNC, IPEN and Centre for the Study of Public Policy, Lowell Center for Sustainable Production, University of Massachusetts Lowell, USA provided crucial financial support to this study. Without their help this study may not have been possible.

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Executive Summary

Paints in general are differentiated into decorative or architectural paints and industrial paints. Lead is used in paints mainly as a colouring agent. Lead is also used to make paints more durable and corrosion resistant.

Lead based paint in older houses has long been associated with elevated blood lead in children residing there. Repeated studies have concluded that lead paint is a significant source of lead poisoning.

Several recent studies have indicated the presence of lead in high concentrations in new decorative enamel paints available for purchase by the public in five countries (Van Alphen, 1999[1] ; Clark et al, 2006[2] ; Adebamowo et al, 2007[3] ; Kumar and Gottesfeld, 2008[4]). There is an urgent need to determine the lead content of paints in other countries to document the need worldwide for a ban on its continued use. Considering the dangerous effects of lead on human health, several countries enacted laws to regulate the lead concentrations in paints. The United States recently revised the maximum allowable concentration of lead in new paints from 600 ppm to 90ppm.

It is also important to determine the extent of lead in paints and its contamination of household dust in order to develop sound programmes to reduce exposure to lead. A pilot study in a cross section of houses in Delhi documented very high levels of lead in household dust.

There is a need for additional such studies elsewhere to determine the sources of lead in the dust, so that remedial programmes will address the major contributing sources of lead that are endangering the children and pregnant women who spend their longest time in these houses.

Children are known to eat paint chips. More commonly lead paints in and around homes contribute to dust and soil contamination that is often the most significant source of exposure for children. Children then ingest lead from playing close to the ground and having frequent hand-to-mouth contact. Significant exposure may also occur from lead paint when smaller particles become airborne during sanding and scrapping while repainting and remodelling. In addition, damaged paint and the weathering of paints on the exterior of buildings also contribute to lead in soil.

In the United States, health authorities recommend a public health intervention when a child is found to have a blood lead level of 10 µg/dl or more. Recent body of literature points out that there may be no safety margin at existing exposures and that children exposed to even < 10 µg/dl have shown intellectual impairment. Young children (below six years old) are recognized as the most susceptible to lead exposure even at low levels. Pregnant women are the second most vulnerable group. Lead also crosses the placenta and reaches the developing foetus.

The sixth session of the Intergovernmental Forum on Chemical Safety (IFCS), held from 15-19 September 2008 in Dakar, Senegal, adopted a unanimous resolution to eliminate lead from paints worldwide.

Toxics Link and International POPs Elimination Network (IPEN) decided to work with other partner organisations in various regions of the world to determine the total lead (Pb) concentration in new decorative paints available in various developing countries in order to know the amount of lead being used in developing countries.

1. Van Alphen, M. (1999). Lead in paints in water in India. In: George, A. M. (Ed.), Proceedings of the International Conference on Lead Poisoning Prevention & treatment: Implementing a national program in Developing countries, February 8-10, 1999. The George Foundation, Bangalore, India, pp. 265-272
2. Clark CS, Rampal KG, Thuppil V, Chen CK, Clark R, Roda S. The lead content of currently available new residential paint in several Asian countries. Environmental Research 2006; 102: 9-12.
3. Adebamowo EO, Clark CS, Roda S, Agbede OA, Sridhar MKC, Adebamowo CA. Lead content of dried films of domestic paints currently sold in Nigeria. Science of the Total Environment 2007; 388 (1-3): 116-120.
4. Kumar, A and Gottesfeld, P. (2008). Lead content in household paints in India. Science of the Total Environment, 407(1), 333-337

After initial background research, the following 10 countries were selected for sampling:

i. Sri Lanka from South Asia
ii. Philippines from South East Asia
iii. Thailand from South East Asia
iv. Tanzania from Africa
v. South Africa from Africa
vi. Nigeria from Africa
vii. Senegal from Africa
viii. Belarus from East Europe
ix. Mexico from Latin America
x. Brazil from Latin America

Samples were received during the months of November 2008 to February 2009. A total of 317 paint samples, including 26 samples from India, were further processed for lab analysis. Samples were analysed according to Standard Operating Procedures for Lead in Paint by Hotplate or Microwave-based Acid Digestions and Inductively Coupled Plasma Emission Spectroscopy, EPA, PB92-114172, Sept. 1991; SW846-740 (U.S. EPA, 2001)

Results

The major findings of the study are:

1. Overall 317 paint samples, including 232 enamel samples, 78 plastic samples, and seven varnish samples were analysed for lead concentrations.
2. Taking all samples together, 53 percent of samples were found to contain more than 90 ppm of lead, while 50 percent samples had lead concentrations of more than 600 ppm.
3. Some 68.5 percent of enamel samples had lead concentrations more than 90 ppm, while 65 percent of enamel samples had lead concentrations of more than 600 ppm.
4. Only 10 percent of plastic paint samples had concentrations more than 90 ppm.
5. The overall average of lead concentrations was 18,220.3 ppm, while for enamel samples the average was 23,707.1 ppm. For plastic samples, the average was 1,508.5 ppm.
6. Taking all samples together, 50 percent of samples had lead concentrations of more than 1,541.2 ppm. In the case of enamel samples, the median lead concentration was 3,914.2 ppm. In the case of plastic paint samples, the median lead concentration was nine ppm, which implied that 50 percent of plastic samples had lead concentrations of more than nine ppm.
7. Lead concentrations ranged from 0.6 ppm to 505,716 ppm (51 percent).
8. Multinational paint brands used in more than one country showed variation in lead concentrations for samples sourced from different countries.
9. (a) Of 54 paint companies with products containing lead greater than 90 ppm, six were subsidiaries of U.S. corporations, and an additional eight were subsidiaries of European or Japanese companies.
   (b) At least three of the paint companies with products containing lead above 90 ppm have ISO 14001 Certification in the country where the paints were purchased, and an additional seven companies claim to adhere to ISO 14001.
   (c) Ten of the paint companies are subsidiaries or market licensed brands of larger companies that are ISO 14001 certified.

Conclusions

Major conclusions drawn from the study of paint samples from 10 countries around the globe are:

1. With a few exceptions, all plastic paint samples had low lead concentrations, often below 90 ppm.
2. Majority of enamel paint samples had lead concentrations higher than 90 ppm or 600 ppm.
3. Presence of small amount of lead in a majority of plastic samples may be due to the impurities in the raw materials, as a significant percentage of samples had lead less than 20 ppm. Out of 317 samples of plastic paints, 101 samples (32 percent) had less than 20 ppm of lead.
4. It is also observed that there is a little difference in the percentage of samples having lead concentrations greater than 90 ppm and percentage samples having lead concentrations more than 600 ppm.
5. It is obvious that alternatives to lead in paints exist, as a number of brands from various countries show consistently low lead concentrations even in their enamel products. Cleaner substitutes for lead based pigments, such as titanium dioxide, have been in use for some time now.
6. There is a general lack of awareness on the whole issue of lead in a majority of countries, which participated in the present study.
7. In the absence of any mandatory standard for lead in paints, industries, big and small, are indulging with lead without caring for its environmental and health impacts.

Introduction and Literature Survey

Paints in general are differentiated into decorative or architectural paints and industrial paints. While decorative paints serve the housing sector, industrial paints include powder coatings, high performance coating, and automotive and marine paints. Decorative paints are primarily used on the interior or exterior of homes and buildings and include other coatings such as emulsions, enamels, varnishes, wood finishes, and distempers. Based on the solvents used, decorative paints are further classified into water-based and oil-based paints. Plastic or latex or emulsion paints are water-based while enamel paints are oil-based.

Per capita annual consumption of paints varies in different regions of the world. While the global average is 15 kg per capita per annum, in developed countries the average is 22 kg. South-East Asian countries consume 4 kg of paint per capita per annum. India's per capita per annum consumption is 0.5 kg. The average consumption includes both decorative and industrial paints. The market share of decorative and industrial paints also varies among countries. It is observed that in developed countries the market share of these two segments typically are in the proportion of 50:50, while in developing countries decorative paints dominate the market share, with India typically having decorative and industrial paints in a 70:30 proportion. Within the industrial paint segment, it is the automotive sector that is the largest consumer of paint products.

Use of Lead in Paints

Lead• is used in paints mainly as a colouring agent, but also for durability and corrosion resistance. Lead also helps in drying paints faster. It provides longevity to coatings on walls, woods and metals. A number of lead compounds can be used as paint pigments such as lead oxide, lead carbonate (also known as white lead), and lead chromates/molybdates (ILZSG, 2004). Lead carbonate was historically used for wall paint in households and still is a significant source of lead exposure. Lead chromates, molybdates, and sulphates are also widely used. They are inorganic pigments for bright and opaque yellow, red, and orange colours in paints. There are, however, readily available substitutes for all these lead compounds.

Lead-based paint in older houses has long been associated with elevated blood lead in children residing in such houses (Clark, et al., 1985). The causal relationships were considered to be mainly due to ingestion of lead-based paint chips (Lin-Fu, 1967). In one of the first studies on lead in paints and soil, Clark, et al., (2005) concluded that lead paint should be considered a significant potential source of lead poisoning in India. They also determined that lead was in 29 paint samples collected from Gujarat and Karnataka in India and reported that 11 of the samples were equal to or exceeded 1.0 mg/cm3 after the application of one to three coats.

In one of the studies to investigate the sources of lead in the environment of children with elevated blood lead concentrations, with the help of a field portable X-ray fluorescence (XRF) analyser, Kuruvilla A., et al., (2004) attributed high blood lead levels in one student to the brightly coloured swings painted with lead-based paint in an area where he routinely played. In another case, high blood lead level was associated with a railing coated with lead-based yellow paint where the child played. The third child with high blood lead level had the habit of licking the

• Lead (Pb) is categorized as a heavy metal belonging to group IV A (14) of the periodic table having atomic number 82 and relative atomic mass 207.2. Pure lead is a silvery-white metal that oxidizes and turns blue-grey when exposed to air (U.S. EPA, 1998). It is soft (enough to be scratched by fingernail), dense (11.3 g/cm3), malleable and readily fusible. Alloying it with small amounts of arsenic, copper, antimony, or other metals hardens lead. Lead-containing products are manufactured using these alloys. The use of lead, and the process of extracting lead from ore, date back to ancient times; the earliest known example of metallic lead is a metal figure recovered from the Temple of Abydus in Upper Egypt, considered to date from 4000 BC (Thornton et al., 2001). Metallic lead occurs rarely in nature. Lead is usually obtained from sulphide ores, often in combination with other elements such as zinc, copper, and silver. Its abundance in Earth's crust is about 0.0013 percent. Lead exists in three oxidation states Pb(0)-elemental form, Pb(II), and Pb(IV) and has three chemical forms, namely metallic lead, inorganic lead compounds, and organic lead compounds.

painted surface (pica), leading to ingestion of lead. Another interesting study done by Clark, et al., (2006), found 66 percent of new paint samples purchased from China, India, and Malaysia contained 5,000 ppm of lead or more, while 78 percent contained 600 ppm or more. They also pointed out that lead content in paints depended upon the regulations. The same brand could have different contents of lead in different countries depending upon whether or not any regulation existed (Clark, et al., 2006). They also reported that 100 percent (n=17) of paint samples from India had more than 600 ppm of lead concentration, while 83 percent samples had more than 5,000 ppm of lead contents. Kumar and Gottesfeld (2008) have reported that 84 percent of enamel paint samples from India that they analysed had lead more than 600 ppm, with concentrations ranging up to 140,000 ppm (0.0025 to 14 percent). All plastic (water-based) paints that they analysed had lead in low concentrations below 25 ppm.

Human Exposure Pathways

Although children are known to eat paint chips, more commonly lead paint on the interior and exterior of homes contributes to dust and soil contamination that is often the most significant source of exposure for children. Children can ingest lead from playing close to the ground and having frequent hand-to-mouth contact. Significant exposure can also occur from lead paint when smaller particles become airborne during sanding and scrapping while repainting and remodelling. In addition, damaged paint and the weathering of paint on the exterior of buildings also contribute to lead in soil. Contaminated soil is a particularly significant source of exposure to children. Ingestion of contaminated soil, dust, and lead-based paint chips and licking of toys in hand-to-mouth activity are important sources of lead exposure in infants and young children. In infants and young children as much as 50 percent of dietary lead is absorbed, although absorption rates for lead from soils, dusts, and paint chips can be lower depending upon the bioavailability (IPCS, 1995).

Health Impacts of Lead

That lead is a toxic element has been well established (WHO, 1995; U.S. Department of Health and Human Services, 1988; Goldstein, 1992). It is the toxicity of lead that led the U.S. Centers for Disease Control and Prevention (CDC) to consider lead concentrations in blood higher or equal to 10 µg/dl as being elevated. In fact, a recent body of literature points out that there may be no safety margin at existing exposures and that children exposed to even < 10 µg/dl have shown intellectual impairment (Koller, et al., 2004; Needleman, 1995; Needleman and Bellinger, 2001; Needleman, et al., 2002). Some recent investigations have revealed that even low-level and long-term lead exposure can lead to health related problems such as renal dysfunction or delayed puberty in girls (Selvan, et al., 2003; Wu, et al., 2003; Marsden, 2003).

A WHO/UNECE, 2006 document describes the health effects of lead. According to this document:

> *"Lead is a well known neurotoxic metal. Impairment of neurodevelopment in children is the most critical lead effect. Exposure in uterus, during breast-feeding, and in early childhood may all be responsible for the effects. Lead accumulates in skeleton and its mobilization from bones during pregnancy and lactation causes exposures to foetus and breast fed infant. Hence, life time exposure of woman before pregnancy is important. Epidemiological studies show consistently that effects in children are associated with lead levels in blood (Pb-B) of about 100-150 g/l. There are indications that lead is harmful even at blood lead concentrations considerably below 100 g/l and there may be no threshold for these effects." (WHO/UNECE, 2006)*

Young children (below six years old) are recognized as the most susceptible to lead exposure even at low levels. Pregnant women are the second most vulnerable group. Lead also crosses the placenta and reaches the developing foetus. Absorbed lead is rapidly taken up by blood and soft tissue, followed by a slower redistribution to bone. Bone accumulates lead during much of the human life span and may serve as an endogenous source of lead that may be released slowly over many years after the exposure stops (IPCS, 1995). New research findings suggest that lead neurotoxicity among humans is enhanced during perinatal stage, from conception to two years old (Schnaas et al., 2006).

Table 1 describes symptoms associated with different possible blood lead levels in children and adults.

Regulations for Lead in Paints

For over 70 years now, dangers represented by lead-based paint manufacturing and application had led many countries to enact bans or restrictions on the use of white lead for interior paint: France, Belgium, and Austria in 1909; Tunisia and Greece in 1922; Czechoslovakia in 1924; Great Britain, Sweden, and Belgium in 1926; Poland in 1927; Spain and Yugoslavia in 1931; and Cuba in 1934 (Markowitz, 2000). In 1922, the third International Labour Conference of the League of Nations recommended the banning of white lead for interior use (AJPH, 1923).

In 2008, the U.S. Congress lowered the standard for lead in residential paints and paints on products

Table 1. Symptoms associated with blood lead levels in children and adults

Effect in children	Pb-blood (µg/dl)	Effect in adults
Mortality	150	
	100	Encephalopathy
Encephalopathy		
Nephropathy		Anaemia
Anaemia		
Abdominal pain		
	50	Decrease in haemoglobin synthesis
Decrease in haemoglobin synthesis	40	Infertility (men)
	Nephropathy	
Diminished vitamin D metabolism	30	Hearing loss
Diminished nerve conduction	20	
Erythropoietic protoporphyria	10	Hypertension
Hearing loss		Miscarriages
Reduced growth		

Source: Agency for Toxic Substances and Disease Registry (ATSDR), 1990. Case Studies in Environmental Medicine, No. 1

used by children from 0.06 percent (600 ppm) to 0.009 percent (90 ppm). The new standard enforced by the Consumer Products Safety Commission becomes effective in August 2009.

In 1997, Australia recommended 0.1 percent of total lead as the maximum amount of lead in domestic paint (DEH 2001). Singapore has a standard of 0.06 percent of lead in new paints. In China the standard is 90 ppm (Barboza, D., 2007).

In a majority of developed countries, concerted efforts have led in recent years to a reduction in the release of lead into the ambient environment, reflecting a decline in the commercial use of lead, particularly in petrol (CDC, 1991; Edwards-Bert et al., 1994). Blood lead levels in the general population in these countries have fallen dramatically over the past 20 years, thanks to the phasing out of lead from petrol and the reduction of environmental exposure to the metal (Edwards-Bert et al., 1994; Annest, 1983; Pirkle, et al., 1994). In the U.S. between 1976 and 1991, the mean blood lead level of persons aged one to 74 years dropped by 78 percent from 12.8 µg/dl to 2.8 µg/dl (Pirkle, et al., 1994). Mean blood lead levels of children aged one to five years declined by 72 to 77 percent for various social groups of children (Pirkle, et al., 1994).

Lead continues to be a significant public health problem in developing countries where there are considerable variations in the sources and pathways of exposure (Tong and McMichael, 1999; Falk H, 2003). In a study done on 281 children in Lebanon, it was found that the mean Pb-B was 66.0 µg/l with 14 percent children having Pb-B more than 100 µg/l (Nuwayhid, et al., 2003). Logistic regression analysis showed that elevated Pb-B was associated with paternal manual jobs (odds ratio [OR] of 4.74), residence being located in high traffic areas (OR: 4.59), summer season (OR of 4.39), using hot tap water for cooking (OR of 3.96), and living in older buildings (OR of 2.01).

In a study investigating the prevalence of elevated blood lead (Pb-B) levels in children one to six years old in Kaduna, Nigeria, mean Pb-B was found to be 10.6 µg/dl and two percent of children had Pb-B levels higher than 30 µg/dl (Nriagu, 1997). The strongest associations were found between Pb-B and whether family owned a car or lived in a house on tarred road. In a similar study done in Karachi, it was found that about 80 percent (n=430) of children (aged 36 to 60 months) had blood lead concentrations higher than 10 µg/dl (Rahbar, et al., 2002). It also derived that, at the five percent level of significance, houses nearer to the main intersection in the city center, application of surma (kohl) to children's eyes, father's exposure to lead at workplace, parent's illiteracy, and child's habit of hand-to-mouth activity were among variables associated with elevated lead concentrations in blood.

In a study on lead poisoning in major Indian cities, the George Foundation reported 51.4 percent of the total sampled population having more than 10 µg/dl of Pb-B, while 12.6 percent having more than 20 µg/dl of Pb-B (the George Foundation, 1999). In cities like Delhi and Kolkata, almost 19 percent of sampled population had blood lead concentration of more than 20µg/dl. In Mumbai, some 14.7 percent of children had more than 20 µg/dl of blood lead concentration.

In a study conducted to estimate the Pb-B and prevalence of lead toxicity in school children and children residing in urban slums in Delhi, it was found that the mean Pb-B was 7.8 µg/dl and proportion of children having more than 10 µg/dl of Pb-B was 18.4 percent (Kalra, V., et al., 2003). It also suggested that distance of the residence or school from a main road appeared to be associated with higher blood lead concentrations, but these differences were not statistically significant. Similar reports highlight high concentrations of blood lead in children in various other cities in India and relate it with local practices and exposure pathways (Kumar and Kesaree, 1999; Kaul, 1999; Patel, et al., 2001).

Study Objectives and Methodology

Objectives

The sixth session of the Intergovernmental Forum on Chemical Safety (IFCS), held from 15 to 19 September 2008 in Dakar, Senegal, adopted a unanimous resolution to eliminate lead from paints worldwide. The text of the resolution is given in Appendix 1. The issue of lead in paints was also on the agenda of the second session of the International Conference on Chemicals Management (ICCM) held in Geneva from 11 to 15 May 2009. To better inform the international debate on the issue, Toxics Link and International POPs Elimination Network (IPEN) decided to work with other partner organisations in various regions of the world to determine the total lead (Pb) concentration in new decorative paints available in various developing countries in the world in order to know the amount of lead being used in developing countries. This project was jointly funded by the Swedish Society for Nature Conservation (SSNC), IPEN, and the Centre for the Study of Public Policy.

Sampling

Due to the paucity of time and resources, it was decided to sample new paints from only 10 countries across the continents. The following criteria were adopted:

1. Absence of similar study in the country
2. Presence of strong and effective organisations for campaigns and follow up

The following 10 countries were selected:

- Sri Lanka from South Asia
- Philippines and Thailand from South East Asia
- Tanzania, South Africa, Nigeria and Senegal from Africa
- Belarus from Eastern Europe
- Mexico and Brazil from Latin America

In each of these countries Toxics Link worked closely with the IPEN International Coordinator and Regional Hubs to identify partner organisations, and, thereafter, collectively agreed on how to conduct the sample collection of new paints as per the guidelines (see Appendix II). The samples were sent via courier or air cargo to the New Delhi office of Toxics Link. Each partner organisation was supposed to send 25 to 30 samples of both plastic and enamel paints in various colours. However, a majority of the samples were of enamel paints. Since the previous studies have indicated comparatively low levels of lead in plastic paints, and for other logistical reasons, like the cost and convenience of dispatch, the total number of plastic paint samples from each partner organisation was kept at less than 10 out of 30.

The following organisations were involved in the sampling and collating basic information on paint industries from their respective countries. These organisations are also part of IPEN.

- Centre for Environmental Justice, 20A, Kuruppu Road, Colombo 08, Sri Lanka
- Ecological Waste Coalition of the Philippines, Inc. (EcoWaste Coalition), Unit 329, Eagle Court Condominium, Matalino Street, Barangay Central, Quezon City, Philippines
- Campaign for Alternative Industry Network (CAIN), 211/2, Ngamwongwan Rd., Soi 31, Muang, Nonthaburi 11000, Thailand
- AGENDA for Environment and Responsible Development, Sinza B 545, Mashujaa St. Sinza Palestina, P.O. Box 77266, Dar es Salaam, Tanzania
- GroundWork- Friends of the Earth, PO BOX 2375, Pietermaritzburg, 3200, South Africa
- Friends of the Environment (FOTE)/Strategic Research and Action for Environmental Development (SRADev), 106/110 Lewis Street, Lagos, Nigeria
- Pesticide Action Network (PAN) Africa, N° 15 Rue 1XJ Castors-Derklé Dakar, BP 15938, Dakar Fann, Senegal
- Centre for Environmental Solutions, P.O. Box 21, Minsk, 220141, Belarus
- Red de Acción en Plaguicidas y sus Alternativas en México (RAPAM)/Centro de Análisis y

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- APROMAC - Environment Protection Association, Rua Octavio Secundino, 340 CEP 80520-480, Curitiba - Paraná - Brazil

A few samples from Indian markets were also collected to examine the claims of a few brands, which had announced lead phase out from their enamel products some time in 2008.

Samples were received from November 2008 to February 2009 in New Delhi; they were labelled and given unique identification number. A total of 317 paint samples, which included 26 samples from India, were further prepared for lab analysis.

Materials and Methods

Samples were analysed according to the standard operating procedures for lead in paint by hotplate or microwave-based acid digestions and inductively coupled plasma emission spectroscopy, EPA, PB92-114172, Sept. 1991; SW846-740 (U.S. EPA, 2001)

Sample preparation

1. Each wet paint sample was applied on a clean glass surface (one square foot) using a different brush for each sample to avoid any contamination. Samples, thus applied were left to dry for a minimum of 72 hours.
2. After drying, samples were scraped off from the glass surfaces using sharp and clean knives. One knife per sample was used to avoid any contamination.
3. Thus scraped, samples were collected in polyethylene bags and sent to Delhi Test House, A-62/3, G.T. Karnal Road, Industrial Area, Opposite Hans Cinema, Azadpur, Delhi-110033 for analysis. Delhi Test House (DTH) is accredited by National Accreditation Board for Testing and Calibration Laboratories (NABL).

Laboratory Methods

1. Each scraped sample was crushed using mortar and pestle to make samples as homogenous as possible. Latex paint does not grind hence they were torn into small pieces using pre-cleaned steel scissors.
2. Some 0.3 g of each paint sample was taken on a glass slide and placed in an oven at 120°C for two hours to remove any moisture.
3. Some 0.1 g of each of the dried paint sample was then accurately weighed into a closed Teflon vessel and then digested/extracted.
4. Standards were also prepared similarly.

Digestion Procedures

1. Three millilitres of concentrated nitric acid (HNO_3) was added into Teflon vessels and then placed in an oven at 150°C for one hour.
2. Vessels were then allowed to cool to room temperature.
3. Solution along with any precipitate was transferred to a 25 ml volumetric flask.
4. Flask was diluted to volume with deionised water and mixed well. Precipitate, if any, was allowed to settle and then the solution was filtered.
5. Sample blanks were also prepared similarly.

Digested samples were then analysed for total lead (Pb) in atomic absorption spectrometer (AAS) fitted with Graphite Furnace (GF) of make GBC, Model -932 Plus. Dilutions were performed if needed to fit with the calibration curve. Recovery was between 80 to 120 percent for different lot of digestions. The detection limit of method was 1.25 ppm.

Results and Discussion

SRI LANKA

Background

The paint industry in Sri Lanka comprises about 30 large and small players, some of which are well known having strong market presence of brands. According to the Census and Statistics Department of the Government of Sri Lanka, 100 companies operated in 2003, which declined to 60 in 2004. Some of the major companies/brands are listed below:

1. CIC Paints, foreign collaboration with ICI
2. Macksons Paints Lanka, with foreign collaboration
3. Causeway Paints, with foreign collaboration
4. Masons Mixtures, with foreign collaboration
5. Lankem Ceylon
6. Asian Paints Lanka, with foreign collaboration
7. Paints & General Industries, with foreign collaboration
8. Silicone Coatings (Pvt) Ltd
9. Nippolac

Results

Lead concentration in the paint samples received from Sri Lanka with their general description is given in Table 2. Out of 33 paint samples received from Sri Lanka, 19 samples were of enamel paints, 10 emulsions or plastic paints, one weather coat paint, and three varnishes, including a polyurethane varnish. These samples belonged to four brands, namely Nippolac, Robbialac, Berlux, and ICI.

Statistical measure of lead concentration in enamel, plastic, and varnish samples are given in Table 3. Table 4 shows the distribution of paint samples having lead concentration more than 90 ppm. As mentioned earlier, as per a recent change in the law, the U.S. has 90 ppm of lead as the upper limit for new residential paints, which earlier was 600 ppm. So, the present data have been compared with both 90 ppm and 600 ppm of lead concentrations.

Some major findings about lead in paint samples from Sri Lanka are:

1. The arithmetic mean of lead concentration in all samples was 15,927 ppm. The arithmetic mean for enamel samples was 25,210 ppm; for emulsion samples and varnish samples the average lead content was 4,177 ppm and 220 ppm respectively.
2. Lead concentration in samples varied from four ppm to 137,325 ppm (14 percent). The highest concentration of lead was found in enamel paint samples.
3. Enamel paints contained high concentrations of lead ranging up to 14 percent. About 68.4 percent of enamel samples showed lead concentrations higher than 90 ppm or 600 ppm. A high of 45.4 percent of all samples had lead concentrations higher than 90 ppm. Only one emulsion sample had lead in very high concentration (five percent). One polyurethane varnish sample had lead concentration equal to 605 ppm.
4. Except one sample, all other plastic paint samples contained less than 90 ppm of total lead concentration. Without this particular sample (sample number SRL 12 having lead concentration 45,743.1 ppm), the arithmetic mean of emulsion samples was 20 ppm.
5. Only one paint company, namely ICI, which had both enamel and emulsion samples, showed lead levels at less than 90 ppm for all samples.

Conclusions

Major conclusions drawn from the study of paint samples from Sri Lanka are:

1. In general, plastic samples have low lead concentrations (less than 90 ppm).
2. Enamel paint samples have high lead concentrations (more than 600 ppm; lead concentra-

tions ranging up to 14 percent).

3. Only one company, ICI, has its enamel products containing lead in lower concentrations.

Table 2. Lead concentrations in paint samples from Sri Lanka

Sample no.	Paint brand	Location of purchase	Volume of paint sample	Price of the can SLR	Type of paint	Colour of the paints	Pb concentration (ppm)	Pb concentration (%)
SRL 01	Nippolac	Colombo	1 Litre	645	Emulsion	Sun Flower	25.2	0.00252
SRL 02	Nippolac	Colombo	1 Litre	645	Emulsion	Jade Green	21.2	0.00212
SRL 03	Nippolac	Colombo	1 Litre	645	Emulsion	Poppy red	14.2	0.00142
SRL 04	Nippolac	Colombo	1 Litre	645	Emulsion	Paradise Blue	33.3	0.0033
SRL 05	Nippolac	Colombo	200 ml	210	Enamel	Antique Brown	5,137.4	0.5
SRL 06	Nippolac	Colombo	200 ml	210	Enamel	White	3,296	0.3
SRL 07	Nippolac	Colombo	200 ml	210	Enamel	Sylvan Green	55,237	5.5
SRL 08	Nippolac	Colombo	200 ml	210	Enamel	Sunrise	137,325	14
SRL 09	Nippolac	Colombo	200 ml	210	Enamel	Post office Red	7,432	0.7
SRL 10	Nippolac	Colombo	200ml	210	Enamel	Oxford Blue	21,116	2.1
SRL 11	Nippolac	Colombo	200 ml	185	PU Varnish		604.7	0.1
SRL 12	Robbialac	Colombo	1 Litre	645	Emulsion	Sunset	45,743.1	5
SRL 13	Robbialac	Colombo	1 Litre	645	Emulsion	Regatta Blue	49.5	0.00495
SRL 14	Robbialac	Colombo	1 Litre	825	Weather Coat	Black	6	0.0006
SRL 15	Robbialac	Colombo	1 Litre	645	Emulsion	Poppy red	6	0.00058
SRL 16	Robbialac	Colombo	500 ml	415	Enamel	Dark Green	20,904.3	2.09043
SRL 17	Robbialac	Colombo	500 ml	360	Enamel	Golden Yellow	133,463	13.3
SRL 18	Robbialac	Colombo	500 ml	360	Enamel	Oxford Blue	4,164	0.4
SRL 19	Robbialac	Colombo	500 ml	415	Enamel	Black	8,851.3	0.8
SRL 20	Robbialac	Colombo	500 ml	360	Enamel	Jasmine Yellow	32,254.5	3.2
SRL 21	Robbialac	Colombo	500 ml	415	Enamel	Post office Red	3,772.5	0.4
SRL 22	Robbialac	Colombo	500 ml	440	Varnish	Mahogany	34.4	0.00344
SRL 23	Berlux	Colombo	1 Litre	545	Enamel	Sun Kissed Yellow	11.2	0.00112
SRL 24	Berlux	Colombo	500 ml	399	Enamel	King Coconut	45,991.3	5
SRL 25	ICI	Colombo	500 ml	440	Enamel	Saffron (Lo)	4	0.00037
SRL 26	ICI	Colombo	500 ml	440	Enamel	Poppy	4.1	0.00041
SRL 27	ICI	Colombo	500 ml	440	Enamel	Black	8	0.00077
SRL 28	ICI	Colombo	500 ml	440	Enamel	White	9	0.00086
SRL 29	ICI	Colombo	500 ml	440	Enamel	Regeta Blue	8	0.00077
SRL 30	ICI	Colombo	1 Litre	648	Emulsion	Royal Gold	10.2	0.00102
SRL 31	ICI	Colombo	1 Litre	648	Emulsion	Phantom Blue	21.2	0.00212
SRL 32	ICI	Colombo	1 Litre	648	Emulsion	White	14.3	0.00143
SRL 33	ICI	Colombo	500 ml	431	Varnish	PU Varnish	20.4	0.00204

Table 3. Statistical measure of lead concentrations in samples from Sri Lanka

	All samples	Enamel samples	Emulsions samples	Varnish samples
Average	15,927	25,210	4,177	220
Standard deviation	34,317	42,089.3	13,786	20.4
Maximum	137,325	1,373,247	45,743.1	605
Minimum	4	4	6	333.4

Table 4. Distribution of samples having lead concentrations more than 90 ppm and 600 ppm

	No. of samples	No. of samples bearing more than 90 ppm of lead	No. of samples bearing more than 600 ppm of lead
Enamel	19	13 (68.4%)	13 (68.4%)
Emulsions	11	1 (10%)	1 (10%)
Varnish	3	1 (33.3%)	1 (33.3%)
Total	33	15 (45.4%)	15 (45.4%)

PHILIPPINES

Background

The Philippine paint sector was established in 1911. According to the Chemical Industries Association of the Philippines, or Samahan sa Pilipinas ng mga Industriyang Kimika (SPIK), there are currently over 100 direct manufacturers in the paints and coating industry, 67 of which are considered significant in size. The members of the sector own assets in the order of Php 4.5 billion.[5] One of the biggest associations in the country's paint sector is the Philippine Association of Paint Manufacturers, Inc. (PAPM). It was established in 1961. It is a privately operated non-stock, non-profit, non-sectarian, and non-political organisation with more that 70 member companies.[6]

Pacific Paint (Boysen) Philippines Inc., maker of Boysen paints, is the leading paint company in the country with 70 percent market share.[7] The said paint brand was given the most Trusted Brand Award by Readers Digest (Asia) for two consecutive years -2006 and 2007.

Based on the survey of the EcoWaste Coalition, the partner organisation in the present study, other major brands being sold in many hardware stores in Metro Manila are: Nation, the economical paint line of Boysen; Davies, and Coat Saver, manufactured by Charter Chemical and Coating Corporation; Dutch Boy and its product line by United Paints, Inc.; Welcoat and Rain or Shine by Asian Coatings, Inc.; and Sphero by Globesco, Inc.

Boysen Paints Philippines is a local paint company, which is a licensed manufacturer of Boysen Paints, a U.S.-based multinational company. Other major international players operate through licensees and subsidiaries in the Philippine market. Charter Chemicals and Coating Corporation is a licensee of Japanese company Chugoku Paints. Dutch Boy is also a Philippine subsidiary of Berger Paints International. Welcoat and Rain or Shine paint brands are made by Welbest Manufacturing, Inc., which has a joint-venture with a Japanese company Shinto Paint.

Based on phone interviews and site visits conducted by the EcoWaste Coalition to major hardware stores in Metro Manila, the most purchased decorative paints (in no particular order) were Boysen, Nation, Dutch Boy, Coat Saver, and Welcoat. Water-based coatings make up 40 percent of the market, and these are dominated by 100 percent acrylic and vinyl acetate/acrylic. On the other hand, alkyl coatings dominate the solvent sector and these are used on wood and metal surfaces.[8]

The Philippine government identified lead as one of the priority chemicals that should be regulated due to its hazardous effect on health and environment. Under the country's Toxic Substances, Hazardous, and Nuclear Wastes Control Act of 1990 or Republic Act (RA) 6969 and Department of Environment and Natural Resources (DENR) Administrative Order 2005-05, a Chemical Control Order (CCO) should be issued to regulate the use, manufacture, import, export, transport, processing, storage, possession and wholesale of lead. In 2007, the DENR issued a draft CCO for lead, which is yet to be finalized.

The interviews with the Bureau of Product Standards of the Department of Trade and Industry (DTI) reveal that there is no standard set by the government for the use of lead in paints. According to a source in the PAPM Environment and Health Safety Committee, the association also has not prescribed any lead limit to its member manufacturers. According to the source, the association is pre-occupied with occupational safety concerns. There are plans to address the issue of lead in paints in 2009, particularly after the controversies surrounding the recall of toys contaminated with high lead levels. The officer explains that some PAPM-affiliated manufac-

5. http://www.spik-ph.org/index.php?content=2&article=8
6. http://www.spik-ph.org/index.php?content=2&article=8
7. http://www.spik-ph.org/index.php?content=2&article=8
8. http://www.spik-ph.org/index.php?content=2&article=8

turers are reportedly still using lead because going lead-free will require technology shift and system upgrading. He also said that their group could not provide technical assistance for technology upgrade, especially to their small members.

However, some paint companies claim to offer lead-free products such as Boysen and Dutch Boy. SPIK projects that a trend towards the greater use of water-based paints can be expected over the next ten years. Both SPIK and PAPM boast that the overall quality of paints produced in the Philippines is one of the best in Asia.

Prices of paint products vary. Among the local brands, Boysen, Davies and Dutch Boy are some of the more expensive decorative paints with prices ranging from USD 2.50 to 3.00, followed by Welcoat, Coat Saver, and Nation. Industrial paints like Sphero are more expensive with price ranging from USD 3.00 to 4.00 per litre (conversion rate estimate: USD 1.00 = Php 48.00). Lead-free, top of the line brands of Boysen, Davies, and Dutch Boy and U.S.-made paints such as Ace Paints made by Ace Hardware Corp are more expensive with prices ranging from USD 5.00 up to 10.00 per litre. Cheap and small brands such as Master, Destiny, Hudson, and Mana are available in some hardware stores with prices ranging from USD 1.00 to 2.00 per litre.

According to a market research by a global consultancy company Information Research (IRL) titled A Profile of the Asia-Pacific Industry, eighth edition, which was released in 2008, the Philippines ranks sixth in terms of paint demands in 2006 totalling 250,000 tons. Of the available brands, Master, Boysen, Hudson, Mna, Destiny, Challengar, Popular, Olympic, Welcoat, Coat Saver, Nation, Globe, Davies Megacryl, Davies Gloss-it, Sphero, Dutch Boy, Gloss Masta, and Ace paint were sampled.

Results

The relevant description of the Philippines paint samples is given in the Table 5. Table 6 presents the concentrations of lead in paint samples in both ppm and percentage. Some of the general statistical measures of lead concentration (ppm) have been given in Table 7, while Table 8 depicts the distribution of samples with more than 90 ppm or 600 ppm lead concentration.

Broad observations made from the study of the Philippines paint samples are:

1. Overall 25 samples were analysed for total lead concentration. Of these, 15 samples were enamel paints and 10 plastic types.
2. The arithmetic mean of lead concentration of all samples was 17,016.4 ppm. Lead concentration varied from a minimum of 0.6 ppm ("not detected" values were taken as half of the detection limit in the method adopted for lead analysis to avoid any bias. 1.2 ppm being the detection limit in the method, "not detected" values were adjudged as 0.6 ppm for statistical measurements) to 189,163.5 ppm (19 percent).
3. The arithmetic mean of lead concentration in enamel paint samples was 28,354 ppm with concentration varying from 3.4 ppm to 189,163.5 ppm (19 percent). The median of lead concentration in enamel samples was 3,199 ppm, which means that half of the samples have lead concentrations higher than 3,199 ppm.
4. The arithmetic mean of plastic paint samples was 11 ppm with lead concentrations varying from 0.6 ppm to 40.2 ppm. The median is nine ppm.
5. Out of 15 enamel paint samples, 10 samples (67 percent) had lead concentration higher than 90 ppm, while nine samples (60 percent) had lead concentrations higher than 600 ppm.
6. No plastic paint sample had lead concentration higher than 90 ppm.
7. In total, 40 percent samples from the Philippines had lead concentrations higher than 90 ppm and 36 percent had higher than 600 ppm.
8. Enamel samples of Master, Olympic, Welcoat, Coat saver, Nation, Globe, Davies Gloss, and Dutch Boy brands were found to have high lead concentration.
9. Enamel samples of Boysen, Mana, Popular, Hudson, and Sphero brands had low lead concentration.
10. It was also interesting to observe that all enamel samples with lead concentrations less than 90 ppm were of white colour. One sample with a lead concentration of more than 90 ppm but less than 600 ppm was of silver finish aluminium colour.
11. Two enamel samples showed very high lead concentrations: PLP 21 of orange colour had 19 percent lead while PLP 16 of yellow colour had 14 percent lead.

Conclusions

1. In general, plastic paint samples have low concentration of lead - well below 90 ppm.

2. Enamel paint samples contain high concentrations of lead. The average lead concentration in enamel samples is 28,354 ppm with the range varying up to 19 percent.

Table 5. Description of paint samples from Philippines

Sample no.	Paint brand	Date of purchase	Location of purchase	Manufacturer	Volume of paint samples	Price of the can in USD	Type of paint-latex / enamel	Colour of the paints
PLP 01	Master	11/24/08	Quezon City	Times Paint Corporation	80 ml	1.2	Enamel (Quick Drying)	Ultra Marine Blue
PLP 02	Boysen	11/24/08	Quezon City	Pacific Paint (Boysen) Philippines, Inc.	250 ml	0.9	Latex	Thalo Blue
PLP 03	Boysen	11/24/08	Quezon City	Pacific Paint (Boysen) Philippines, Inc.	250 ml	1.1	Enamel (Quick Drying)	White
PLP 04	Hudson	11/24/08	Quezon City	Century Chemical Corporation	250 ml	0.9	Latex	Venetian Red
PLP 05	Mana	11/24/08	Quezon City	Globesco, Inc.	250 ml	0.9	Enamel	White
PLP 06	Destiny	11/24/08	Quezon City	Paradise Chemical Corp.	60 ml	0.5	Latex (Acrylic)	Thalo Green
PLP 07	Challanger	11/24/08	Quezon City	Mayon Industries Corp.	60 ml	0.4	Enamel (Quick Drying)	Red
PLP 08	Master	11/25/08	Makati City	Times Paint Corporation	250 ml	1.1	Enamel (Quick Drying)	Mandarin Red
PLP 09	Popular	11/25/08	Makati City	H-Chem Industries, Inc.	1 L	2.4	Enamel (Quick Drying)	White
PLP 10	Popular	11/25/08	Makati City	H-Chem Industries, Inc.	1 L	1.6	Latex (Flat)	White
PLP 11	Hudson	11/25/08	Quezon City	Century Chemical Corporation	250 ml	1.2	Enamel (Quick Drying)	Silver Finish Aluminum
PLP 12	Olympic	11/25/08	Quezon City	Century Chemical Corporation	250 ml	0.8	Enamel (Quick Drying)	Jade Green
PLP 13	Welcoat	11/25/08	Quezon City	Irvine Coatings, Inc.	250 ml	1	Enamel (Quick Drying)	Black
PLP 14	Coat Saver	11/25/08	Quezon City	Charter Chemical and Coating Corp.	250 ml	1	Enamel (Quick Drying)	Emerald Green
PLP 15	Nation	11/25/08	Quezon City	Pacific Paint (Boysen) Philippines, Inc.	250 ml	0.7	Enamel (Quick Drying)	French Blue
PLP 16	Globe	11/26/08	Quezon City		60 ml	0.6	Enamel (Quick Drying)	Yellow
PLP 17	Welcoat	11/26/08	Quezon City	Asian Coatings Phils, Inc.	1 L	2.2	Latex (Flat)	White
PLP 18	Davies Megacryl	11/26/08	Quezon City	Charter Chemical and Coating Corp.	1 L	2.8	Latex (Gloss)	White
PLP 19	Davies Gloss-it	11/26/08	Quezon City	Charter Chemical and Coating Corp.	1 L	3.2	Enamel (Quick Drying)	Whisper Blue
PLP 20	Sphero	11/26/08	Quezon City	Globesco, Inc.	1 L	6	Enamel (Hi-Gloss Lacquer)	White
PLP 21	Dutch Boy Gloss Masta	11/26/08	Quezon City	United Paints, Inc.	250 ml	1.5	Enamel (Quick Drying)	Orange
PLP 22	Nation	11/26/08	Quezon City	Pacific Paint (Boysen) Philippines, Inc.	1 L	2	Latex (Flat)	White
PLP 23	Coat Saver	11/26/08	Quezon City	Charter Chemical and Coating Corp.	1 L	2.6	Latex (Gloss)	White
PLP 24	Boysen	11/27/08	Quezon City	Pacific Paint (Boysen) Philippines, Inc.	250 ml	0.9	Latex	Venetian Red
PLP 25	Ace Paint	11/27/08	Quezon City	Ace Hardware Corporation	1 L	9	Latex (Acrylic)	Ultra White

Table 6. Concentration of lead (in both ppm and %) in paint samples from Philippines

Sample no.	Paint brand	Type of paint-latex/enamel	Colour of the paints	Pb concentration (in ppm)	Pb concentration (in %)
PLP 01	Master	Enamel (Quick Drying)	Ultra Marine Blue	12,704	1.3
PLP 02	Boysen	Latex	Thalo Blue	11	0.00108
PLP 03	Boysen	Enamel (Quick Drying)	White	61	0.0061
PLP 04	Hudson	Latex	Venetian Red	ND	
PLP 05	Mana	Enamel	White	40.5	0.00405
PLP 06	Destiny	Latex (Acrylic)	Thalo Green	40.2	0.00402
PLP 07	Challanger	Enamel (Quick Drying)	Red	141	0.0141
PLP 08	Master	Enamel (Quick Drying)	Mandarin Red	2,363.5	0.2
PLP 09	Popular	Enamel (Quick Drying)	White	13	0.00126
PLP 10	Popular	Latex (Flat)	White	7	0.00066
PLP 11	Hudson	Enamel (Quick Drying)	Silver Finish Aluminum	18	0.00179
PLP 12	Olympic	Enamel (Quick Drying)	Jade Green	26,897	3
PLP 13	Welcoat	Enamel (Quick Drying)	Black	14,388	1.4
PLP 14	Coat Saver	Enamel (Quick Drying)	Emerald Green	34,630	3.5
PLP 15	Nation	Enamel (Quick Drying)	French Blue	5,569.1	0.6
PLP 16	Globe	Enamel (Quick Drying)	Yellow	136,114	14
PLP 17	Welcoat	Latex (Flat)	White	12	0.00118
PLP 18	Davies Megacryl	Latex (Gloss)	White	ND	
PLP 19	Davies Gloss-it	Enamel (Quick Drying)	Whisper Blue	3,199	0.3
PLP 20	Sphero	Enamel (Hi-Gloss Lacquer)	White	3.4	0.00034
PLP 21	Dutch Boy Gloss Masta	Enamel (Quick Drying)	Orange	189,163.5	19
PLP 22	Nation	Latex (Flat)	White	17.4	0.00174
PLP 23	Coat Saver	Latex (Gloss)	White	2.3	0.00023
PLP 24	Boysen	Latex	Venetian Red	16	0.00159
PLP 25	Ace Paint	Latex (Acrylic)	Ultra White	ND	

Table 7. Statistical measures of lead concentrations (ppm) in samples from Philippines

	All samples	Enamel samples	Latex samples
Arithmetic mean	17,016.4	28,354	11
Standard deviation	45,373	56,435.1	12.2
Maximum	189,163.5	189,163.5	40.2
Minimum	0.6	3.4	0.6
Median	40.2	3199	9

Table 8. Distribution of samples having lead concentrations more than 90 ppm and 600 ppm

	No of samples	No. of samples bearing more than 90 ppm of lead	No. of samples bearing more than600 ppm of lead
Enamel paint Samples	15	10 (66.7%)	9 (60%)
Latex paint Samples	10	0	0
Total	25	10 (40%)	9 (36%)

THAILAND

Background

According to the Department of Industrial Work, Ministry of Industry, Thailand had 296 paint factories at the end of year 2007 with a total investment of more than 9,300 million baht. With overall 9,300 employees in the industry, a majority of paint factories are the small enterprises. There are only six big paint industries in Thailand, namely TOA Paint (Thailand) Co. Ltd., Eason Paint Public Company Ltd., Nippon Paint (Thailand) Co. Ltd., Thai Kansai Paint Co. Ltd., AkzoNobel (former ICI, Thailand), and Jotun Thailand Ltd.

TOA Paint and Eason Paint are wholly Thai owned. These paint companies dominate the market. AkzoNobel is a multinational company with headquarters based in Amsterdam. Jotun Thailand Ltd. is also a multinational company with its head office located in Sandefjord, Norway. Sampling was done from the following brands: TOA, Captain, Beger, Nippon, Rust-Oleum, and Delta.

Thailand's Paint Industry can be classified into decorative and industrial segments. In Thailand, industrial paints dominate over decorative paints. In 2008, total value of paint market in Thailand was estimated at 24,500 million baht, which included 12,600 million baht from industrial paint and 11,900 million baht from decorative paint.

Market share of the major brands of decorative paints in 2007 is given in Table 9.

In Thailand, the following types of decorative paints are manufactured: primer, emulsion paints (plastic), enamel paints and alkyd oil paints. Industrial paints are used for automotive refinished paint, motorcycle coating, packaging coating, steel structure, waterborne coating, concrete structures, flooring, tank coating, fireproofing, heat resistance, and other special purposes. Wood paints are used as primers and top coatings.

Table 9. Market share of major brands of decorative paint in Thailand in 2007

Company	Brand	Market share in %
TOA Paint (Thailand) Co., Ltd.	TOA	40
AkzoNobel	ICI	15
Captain Paint (Thailand) Co., Ltd.	Captain	15
Beger Limited	Beger	8
Jotun Thailand Limited	Jotun	7
Others		15

Like many other Asian countries, Thailand too has a standard for lead in paint, which is voluntary in nature. Thailand Industrial Standard Institute, Ministry of Industry, is the nodal agency for the regulation. However, this institute does not have any mandate for post-market monitoring programs. Thailand has a series of product standards, which limit lead concentration in its paint. Such standards (voluntary) are given in Table 10 below.

Table 10. Some standards (voluntary) for limiting lead concentrations in paints in Thailand

Standard number	Standard name	Lead concentration
TIS 272-2549	Emulsion paints for general purposes	< 0.01% by weight of non volatile substances
TIS 1406-2540	Flat enamel	< 0.06% by weight of non volatile substances
TIS 1005-2548	Standard for semi-gloss enamel	< 0.06% by weight of nonvolatile substances

Thailand's import and export of paints and varnish during 2006 and 2008, provided by the Thai Ministry of Commerce, is presented in Table 11.

Table 11. Thai import and export of paints and varnish during 2006-2008

2006		2007		2008	
Quantity in tons	Value in bahts	Quantity in tons	Quantity in tons	Value in bahts	Quantity in tons
43,458	8,162.85	45,130	8,138.95	51,235	9,822.41
21,467	2,222.47	23,452	2,312.85	29,250	2,976.97

Quantity: Ton, Value: Million Baht

Results

Table 12 gives sampling description. Lead concentrations in samples from Thailand are depicted in Table 13. Table 14 presents the statistical measurements of lead concentrations in samples from Thailand. The distribution of samples having lead concentrations more than 90 ppm or 600 ppm is given in Table 15.

Table 12. Description of paint samples received from Thailand

Sample no.	Paint brand	Date of purchase	Date of manufacturing	Model	Product no. sample	Volume of paint in Thai baht	Price of the can plastic / enamel	Type of paint	Colour of the paint
THL 01	TOA	1/31/2009	Base-09/2009	Super Shield	Colour G199	100 ml	294	Plastic	Red
THL 02	TOA	1/31/2009	Base-12/2008	4 SEASONS	Colour A4099	100 ml	241	Plastic	Blue
THL 03	TOA	1/31/2009	Base-12/2008	4 SEASONS	Colour A2099	100 ml	217	Plastic	Yellow
THL 04	TOA	1/31/2009	Base-09/2008	4 SEASONS	Colour A3006	100 ml	137	Plastic	Apple green
THL 05	Captain	1/31/2009		Shield Plus	Colour C222	100 ml	292	Plastic	Red
THL 06	Captain	1/31/2009		Parashield	Colour G3566	100 ml	249	Plastic	Blue
THL 07	Captain	1/31/2009		Longlife	Colour L1300	100 ml	284	Plastic	Yellow
THL 08	Beger	1/31/2009	Base-11/08 (Semi Gloss)	Beger Shield	Lot no. 084067	100 ml	256	Plastic	Red
THL 09	Beger	1/31/2009	Base-11/08 (Semi Gloss)	Beger Shield	Lot no. 084067	100 ml	274	Plastic	Blue
THL 10	Beger	1/31/2009	Base-08/08 (Semi Gloss)	Beger Shield	Lot no. 084066	100 ml	234	Plastic	Green
THL 11	TOA	2/1/2009	Base-12/08 Gloss Glipton	Super High 1208 colour 8093	Lot no. 302873	100 ml	321	Enamel	Red
THL 12	TOA	2/1/2009	Base-12/08 Gloss Glipton	Super High 1208 colour 7861	Lot no. 302873	100 ml	270	Enamel	Yellow
THL 13	TOA	2/1/2009	Base-01/09 Gloss Glipton	Super High 0109 colour 7349	Lot no. 303464	100 ml	337	Enamel	Blue
THL 14	Beger	2/1/2009	Base-12/08 (Super Gloss)	Beger Shield colour 115-6	Lot no. 087949	100 ml	363	Enamel	Red
THL 15	Beger	2/1/2009	Base-01/09 (Super Gloss)	Beger Shield colour 088-6	Lot no. 090095	100 ml	338	Enamel	Yellow
THL 16	Beger	2/1/2009	Base-12/08 (Super Gloss)	Beger Shield colour 031-6	lot no. 087949	100 ml	217	Enamel	Blue
THL 17	Jotun	2/1/2009	Base-12/08	Gardex	S0580-Y	100 ml	477	Enamel	Red
THL 18	Jotun	2/1/2009	Base-01/10/08	Gardex	S1080-R	100 ml	378	Enamel	Yellow
THL 19	Jotun	2/1/2009	Base-12/08	Gardex	S4055-B	100 ml	271	Enamel	Blue
THL 20	Nippon	2/1/2009	26/09 Alkyd Enamel	Shield Pro 20090122	9810 lot no.	100 ml	140	Enamel	Red
THL 21	Nippon	2/1/2009	13/09 Alkyd Enamel	Shield Pro 20090105	9804 lot no.	100 ml	140	Enamel	Yellow
THL 22	Nippon	2/1/2009	12/8/2009 Alkyd Enamel	Shield Pro 20081204	9807 lot no.	100 ml	140	Enamel	Blue
THL 23	Rust-Oleum	2/1/2009	8/8/2009 Hi Gloss	Protective Enamel	Safety Red 964	100 ml	270	Enamel	Red
THL 24	Rust-Oleum	2/1/2009	11/7/2009 Hi Gloss	Protective Enamel	Safety Yellow 944	100 ml	235	Enamel	Yellow
THL 25	Rust-Oleum	2/1/2009	10/27/2008 Hi Gloss	Protective Enamel	Deep Blue 122	100 ml	259	Enamel	Blue
THL 26	Delta	2/1/2009	-/12/2007	Gloss Enamel	Signal Red 202	100 ml	149	Enamel	Red
THL 27	Delta	2/1/2009	-/07/2008	Gloss Enamel	Royal Blue 403	100 ml	149	Enamel	Blue

Observations made from the study of paint samples from Thailand are:

1. The arithmetic mean of lead concentration of all samples was 38,970.5 ppm. The lead concentrations varied from 0.6 ppm to 505,716 ppm (51 percent).
2. The median for entire range of samples was 2.2 ppm.
3. The arithmetic mean of the lead concentrations of enamel samples was 61,893 ppm.
4. The arithmetic mean of lead concentrations of the plastic samples was three ppm. The range varied from 0.6 ppm to 15 ppm.
5. A total of 27 paint samples, which included 17 enamel paint samples and 10 plastic paint samples, were analysed.

6. Out of 17 enamel samples, eight samples (47.1 percent) were found to have lead of more than 90 ppm. The same percentage of samples also exceeded 600 ppm lead concentration. The average lead concentration in these samples was 61,892.5 ppm.
7. None of the plastic samples had lead concentration exceeding 90 ppm or 600 ppm; most plastic samples were found to have lead value of "not detected".
8. Enamel paint samples of TOA, Beger, and Jotun had lead concentration of less than 90 ppm.
9. Enamel samples of Nippon, Rust-Oleum, and Delta were found to have very high lead concentrations ranging from 1.4 percent to 51 percent.

Conclusions

Some of the major conclusions drawn from the analysis of Thai samples are:

1. All plastic paint samples had lead in low concentrations (less than 90 ppm).
2. Some 47.1 percent of enamel samples had lead higher than 90 ppm. 30 percent of the total samples exceeded 90 ppm. The average lead concentration was 38,969 ppm.
3. Some of the enamel samples showed very high concentrations of lead, ranging up to 51 percent. The highest concentration of lead (51 percent) was found in a yellow colour sample (THL 21).

Table 13. Lead concentrations (in both ppm and %) in paint samples from Thailand

Sample no.	Paint brand	Type of paint-plastic / enamel	Colour of the paints	Pb concentration (in ppm)	Pb concentration (in %)
THL 01	TOA	Plastic	Red	15	0.00149
THL 02	TOA	Plastic	Blue	3.1	0.00031
THL 03	TOA	Plastic	Yellow	3.3	0.00033
THL 04	TOA	Plastic	Apple green	2.2	0.00022
THL 05	Captain	Plastic	Red	ND	
THL 06	Captain	Plastic	Blue	ND	
THL 07	Captain	Plastic	Yellow	ND	
THL 08	Beger	Plastic	Red	ND	
THL 09	Beger	Plastic	Blue	ND	
THL 10	Beger	Plastic	Green	ND	
THL 11	TOA	Enamel	Red	ND	
THL 12	TOA	Enamel	Yellow	ND	
THL 13	TOA	Enamel	Blue	ND	
THL 14	Beger	Enamel	Red	35	0.00348
THL 15	Beger	Enamel	Yellow	ND	
THL 16	Beger	Enamel	Blue	8.5	0.00085
THL 17	Jotun	Enamel	Red	ND	
THL 18	Jotun	Enamel	Yellow	ND	
THL 19	Jotun	Enamel	Blue	ND	
THL 20	Nippon	Enamel	Red	77,637	8
THL 21	Nippon	Enamel	Yellow	505,716	51
THL 22	Nippon	Enamel	Blue	14,287.4	1.4
THL 23	Rust-Oleum	Enamel	Red	43,042	4.3
THL 24	Rust-Oleum	Enamel	Yellow	333,695	33.4
THL 25	Rust-Oleum	Enamel	Blue	24,260	2.4
THL 26	Delta	Enamel	Red	30,643.2	3.1
THL 27	Delta	Enamel	Blue	22,850	2.3

Table 14. Statistical measures of lead concentrations (ppm) in samples from Thailand

	All samples	Enamel samples	Plastic samples
Arithmetic mean	38,970.5	61,893	3
Standard deviation	113,718.5	139,667.5	4.4
Maximum concentration	505,716	505,716	15
Minimum concentration	0.6	0.6	0.6
Median	2.2	35	0.6

Table 15. Distribution of samples having lead concentrations more than 90 ppm or 600 ppm

	No. of samples	No. of samples bearing more than 90 ppm of lead	No. of samples bearing more than 600 ppm of lead
Enamel paint samples	17	8 (47.1%)	8 (47.1%)
Latex paint samples	10	0	0
Total	27	8 (30%)	8 (30%)

TANZANIA

Background

The major paint brands in Tanzania include Coral, Sadolin, Goldstar, and Galaxy. Most of these brands are owned locally. Some brands operate in collaboration with foreign players. Out of these brands, Sadolin, Goldstar, and Coral were sampled. Tanzania manufactures paints for both household and industrial purposes. There is no regulation in the country addressing lead in paints. However, there exists a voluntary standard on paints that stipulates the maximum allowable contents of lead in paints. Standard TZS 722:2008 is for matt emulsion paints for interior and exterior use, and the maximum lead content allowed is 0.045 percent (m/m).

Results

Lead concentrations in paint samples from Tanzania and their relevant description are given in Table 16. Table 17 depicts the common statistical measurements of lead concentration in samples, while distribution of samples having lead concentrations more than 90 ppm or 600 ppm is presented in Table 18.

The following observations were drawn about lead contents in paint samples from Tanzania.

1. The arithmetic mean of lead concentrations in all samples was 11,187.3 ppm. The range of lead concentrations varied from 13 ppm to 120,862.1 ppm.
2. The median for all samples was 3,631.5 ppm, i.e., 50 percent of samples have lead concentration more than 3,631.5 ppm.
3. For enamel paints the arithmetic mean of lead concentrations was 14,537 ppm. The lead concentrations varied from a minimum of 193.2 ppm to a maximum of 120,862.1 ppm (12.1 percent). The median value for enamel samples was 4,130.5 ppm.
4. For plastic paint samples the arithmetic mean was 22.2 ppm. The range of lead concentrations varied from 13 ppm to 40.2 ppm. The median value for water-based samples was 19 ppm.
5. A total of 26 paint samples, which included 20 enamel paint samples and six plastic paint samples, were analysed. Out of 20 enamel paint samples, all samples (100 percent) had lead concentration more than 90 ppm, while 19 samples (95 percent) had lead concentrations more than 600 ppm. 95 percent samples also exceeded the Tanzanian voluntary standards of 450 ppm.
6. All plastic paint samples had lead concentrations less than 90 ppm.
7. Considering all samples, 77 percent of samples had lead concentrations exceeding 90 ppm, while 73 percent of samples exceeded 600 ppm.
8. The highest concentration of lead was found in a yellow colour enamel paint sample. The lead concentration in this sample (TNZ 25) was 12.1 percent.

Conclusions

Some broad conclusions drawn from the study of lead content in paint samples from Tanzania are:

1. All enamel paint samples were found to have lead concentrations higher than 90 ppm. Some 95 percent of plastic paint samples had lead concentrations higher than 600 ppm or 450 ppm, the Tanzanian voluntary standard. The average lead concentration of paint samples was 11,187.4 ppm.
2. All plastic paint samples were found to have lead concentrations of less than 90 ppm.

Table 16. Lead concentrations (both in ppm and %) in paint samples received from Tanzania along with their description.

Sample no.	Paint brand	Date of purchase (dd/mm/yy)	Volume of paint samples	Price of the can in TZS	Type of paint-plastic / enamel	Colour of the paints	Pb concentration (ppm)	Pb concentration (%)
TNZ 01	Goldstar	13/11/08	4 l	6,500	Water-based	Mist Pink	19.3	0.00193
TNZ 02	Sadolin	13/11/08	4 l	6,500	Water-based	Summer Blue	17.1	0.00171
TNZ 03	Sadolin	13/11/08	4 l	6,500	Oil-based	Black	2,219	0.2
TNZ 04	Sadolin	13/11/08	4 l	6,500	Water-based	Mist Pink	26	0.003
TNZ 05	Coral	13/11/08	4 l	6,500	Water-based	Summer Blue	18	0.0018
TNZ 06	Sadolin	13/11/08	4 l	6,500	Oil-based	Mist Pink	2,670.2	0.3
TNZ 07	Coral	13/11/08	4 l	6,500	Water-based	Candy Pink	13	0.00127
TNZ 08	Goldstar	13/11/08	4 l	6,500	Water-based	Summer Blue	40.2	0.00402
TNZ 09	Goldstar	13/11/08	1 l	5,000	Oil-based	Green	3,651	0.4
TNZ 10	Goldstar	13/11/08	1 l	5,000	Oil-based	Akot Green	3,612.2	0.4
TNZ 11	Goldstar	13/11/08	1 l	5,000	Oil-based	Yellow	2,522	0.2
TNZ 12	Sadolin	13/11/08	1 l	5,000	Oil-based	Sunglow yellow	3,914.2	0.4
TNZ 13	Goldstar	13/11/08	1/2 l	3,000	Oil-based	Black	11,360	1.1
TNZ 14	Goldstar	13/11/08	1/2 l	3,000	Oil-based	White	3,387	0.3
TNZ 15	Coral	13/11/08	1/2 l	3,000	Oil-based	Red	44,068.5	4.4
TNZ 16	Sadolin	13/11/08	1 l	5,000	Oil-based	Green	31,581	3.1
TNZ 17	Sadolin	13/11/08	1 l	5,000	Oil-based	Blue	4,073.1	0.4
TNZ 18	Sadolin	13/11/08	1/2 l	3,000	Oil-based	Grey	9,841	0.9
TNZ 19	Sadolin	13/11/08	1/2 l	3,000	Oil-based	White	1,541.2	0.1
TNZ 20	Goldstar	13/11/08	1/2 l	3,000	Oil-based	Blue	4,188	0.4
TNZ 21	Coral	13/11/08	1/2 l	3,000	Oil-based	White	7,602	0.8
TNZ 22	Goldstar	13/11/08	1/2 l	3,000	Oil-based	Red	193.2	0.01
TNZ 23	Coral	13/11/08	1/2 l	3,000	Oil-based	Black	5,484	0.5
TNZ 24	Coral	13/11/08	400 ml	3,000	Oil-based	Blue	7,722	0.8
TNZ 25	Coral	13/11/08	400 ml	3,000	Oil-based	Yellow	120,862.1	12.1
TNZ 26	Coral	13/11/08	1/2 l	3,000	Oil-based	Green	20,248	2.0

TZS: Tanzanian Shilling

Table 17. Statistical measures of lead concentrations (ppm) in paint samples from Tanzania

	All samples	Oil-based samples	Water-based samples
Arithmetic mean	11,187.3	14,537	22.2
Standard deviation	24,645	27,350	10
Maximum concentration	120,862.1	120,862.1	40.2
Minimum concentration	13	193.2	13
Median	3,631.5	4,130.5	19

Table 18. Distribution of samples having lead concentrations more than 90 ppm or 600 ppm

	No. of samples	No. of samples bearing more than 90 ppm of lead	No. of samples bearing more than 600 ppm of lead
Oil-based samples	20	20 (100%)	19 (95%)
Water-based samples	6	0	0
Total	26	20 (77%)	19 (73%)

SOUTH AFRICA

Background

In South Africa, the major paint brands are Plascon (30 percent market share) and Dulux (20 percent market share). Prominent Paints claims to be the third largest brand in South Africa (anecdotally they seem to have a larger market share only in certain provinces, namely Western Cape and Gauteng, and Kwa-Zulu Natal). Other brands include Homestead, Warrior Paints, Dekro, Chemspec (mostly industrial with a small market share in decorative paints), Duraline, and Duram. Exact market share of the smaller companies is not known. According to the Gauteng Economic Development Agency, there are over 350 paint manufacturers in the country. Of the brands mentioned here, samples were collected for Prominent Paints, Plascon, Dekade, Dulux, and SPRAYON.

Paint industry in South Africa recorded R4 billion revenue in 2006. Plascon's revenue for the year end-September 2008 was R2.7 billion, while operating profit increased by 10 percent to R397m.[9] Plascon employs approximately 1,350 people. Dulux has annual revenue of around R700 million. Chemspec's revenue increased to R322.5 million in the six months by September 2008 (Business Report, 26 Nov 2008).

Plascon is a part of a larger corporation called Freeworld Coatings Ltd, active in South Africa and also Southern Africa, China, England, and Australia.[10] Plascon was formerly a part of BarloWorld, but was unbundled in 2007.

Dulux was formerly owned by the South African company AECI but later sold to ICI (Imperial Chemicals Industries) in 2007.[11] Through this purchase, ICI owns the Dulux brand in South Africa, Botswana, Malawi, Namibia, Swaziland and Zambia through its subsidiaries. ICI is now a part of the AkzoNobel Corporation. In 2003, AkzoNobel had claimed to have globally phased out lead use in its paint products.[12]

Prominent Paints is owned by Sigma Coatings (formerly SigmaKalon), which in January 2008 integrated with PPG Industries Group, one of the largest paint and coatings corporations in the world.[13] Plascon and Dulux together make up 50 percent of market share. However, there are many paint manufacturers and small-scale retailers.

South Africa manufactures both decorative and industrial paints. As stated earlier, decorative paints are intended for household use while industrial paints are for the automotive and marine sectors. These are available in two variants water-based and oil-based. . Decorative paints tend to label themselves as 'lead-free', but according to both Plascon and Dekro, some industrial paints still contain lead.

The legislative framework

In South Africa there was a voluntary agreement among the members of the South African Paint Manufacturers Association (SAPMA) in 1970 to keep lead levels low in their paints. The Recommended Code of Practice also stated that SAPMA members must affix warning labels on paint cans that contain more than 0.15 percent lead. In March 2008, lead regulations under the Hazardous Substances Act were published for the public comment. However, the current status of the legislation is not clear.

A Medical Research Council study has found very high blood lead levels among children than the permissible 10 µg per decilitre of blood.[14] A study of paint samples collected from dwellings located in randomly selected Johannesburg suburbs by South

9. http://www.fin24.com/articles/default/display_article.aspx?ArticleId=2428538
10. http://www.freeworldcoatings.com/docs/CO_STRUCTURE.PDF
11. http://uk.reuters.com/article/hotStocksNews/idUKWLB895820070717
12. http://platform.akzonobel.com/Akzo.Web.GDS/Asset.aspx?id=ce8fea43-95ba-4e2b-8ebb-206665d59888&noredirect=true
13. http://corporateportal.ppg.com/PPG/ACEMEA/AfricaAsia.htm
14. MRC News, December 2006; Retrieved from http://www.mrc.ac.za/mrcnews/dec2006/stripped.htm on 11 November 2008.
15. Mathee, et al., 2007.

African Medical Research Council had found that most manufacturers of decorative paints were not complying with their own voluntary Code of Conduct.[15] It also found that plastic paints and white enamel paints did not contain lead, but pigmented enamel paints did. In response, the Department of Health started an awareness and lead poisoning prevention campaign and legislation was drawn up. The legislation (Hazardous Substances Act), published for comment in March 2008, states that 'leaded paint' is one that contains lead in quantities greater than 0.06 percent (or 600 ppm), and that any paint (or similar surface coating) with higher than 600 ppm is banned for sale under the Hazardous Substances Act.

The March 2008 legislation bans children's toys and furniture coated with leaded paint, use of leaded paint in residences, schools, pre-school institutions, hospitals, parks, playgrounds, and public buildings where consumers have direct access to the painted surface.

Agricultural and industrial paints containing lead are not banned, but must carry warning labels that clearly state their lead status, and should not be used on interior surfaces near children. Unfortunately, there is no further information on the legislation whether it has been approved or not; although all of the paint retailers questioned seemed to think that the legislation was already in place or would be in place soon – by the middle of 2009. Most retailers also emphasized the link between lead and children. In South Africa, many paint cans are labelled as either "Lead-free" or "Contains lead."

Paint sampling in South Africa

The following paint samples were purchased and sampled from South Africa: Prominent Paints (one litre), costing R70.61 at a factory shop in Pietermaritzburg; Dekade (500 ml), costing between R56 and R58 (varying colours) at a retail outlet; Plascon (500 ml), costing R58.05; and Dulux (one litre), costing between R116 and R121 at any outlet in Pietermaritzburg.

In terms of cost, all paints, other than Prominent Paints, are on a par. Prominent Paint and Dulux do not retail tins smaller than one litre. However, Dekade has much smaller operation and perhaps does not benefit from the economies of scale in the way that Dulux and Plascon might.

Trade in paints

Prominent Paint has recently expanded into China, where it has opened the first of 10 stores, and has exported the largest ever order of paint from South Africa.[16] Chemspec has exported automotive finishes to Mauritius and China, and is currently in talks with a partner company in East Asia to distribute a water-based automotive paint.

Chemspec currently manufactures in South Africa and in the U.S. and exports 13 percent of its South African production. Plascon does not import any paint, but exports to sub-Saharan Africa. Similarly, Dulux exports to sub-Saharan Africa and the Indian Ocean islands, but does not import into South Africa. Dekade does not export at all and its market is localized in Kwa-Zulu Natal.

Plascon claims that its decorative paint is completely lead-free, and has been so for three years. They obtain lead-free pigments for their enamel paints from suppliers in the European Union, and state that they had chosen this route because of the human safety issue. However, Plascon states that some of its industrial paints still do contain lead. Dulux is also phasing out lead from its paints, but certain colours still contain lead. Chemspec's decorative paints division also claims to be lead-free. According to one of Dekade's retail outlet, it only uses lead for certain colours and that it was compliant with legislation because the tins are labelled as such.

Information received from the South African Oil and Color Chemists Association states that lead in paints in South Africa is used primarily as a pigment. Dulux uses lead in their decorative paints as a pigment. Plascon's industrial paint still contains lead as a pigment, because it is cheaper than the pigments they obtain from the EU. Other manufacturers that use lead in their industrial formulations include Dekro. Dekade also uses lead as a pigment for its paints. The head chemist from Dekade stated that it would not require a technology shift to phase out lead from paint; however, the major limitation in going for lead-free alternatives is the cost difference, which can be up to three times higher. (Dekade claims to produce entirely lead-free ranges). Titanium dioxide is a well-established alternative to lead-based pigments in paints.

Results

A summary description of paint samples received from South Africa is given in Table 19, and their corresponding lead contents (in ppm and in %) are shown in Table 20. Some of the major features of the findings are:

1. All paint samples received from South Africa were enamel paints.
2. Some 65.5 percent of the total samples had lead concentrations more than 90 ppm.
3. Some 62 percent of the total samples had lead

16. http://www.geda.co.za/live/content.php?Item_ID=76

Table 19. Description of paint samples from South Africa

Sample	Paint brand	Date of Purchase	Volume of paint samples	Type of paint-Plastic/ enamel	Colour of the paints	Remarks
RSA 01	Prominent Paints	24/11/08	1 l	Enamel	Cosmos 4055	
RSA 02	Prominent Paints	24/11/08	1 l	Enamel	Chrome yellow	
RSA 03	Prominent Paints	24/11/08	1 l	Enamel	Signal red	
RSA 04	Prominent Paints	24/11/08	1 l	Enamel	Black	
RSA 05	Prominent Paints	24/11/08	1 l	Enamel	White	
RSA 06	Prominent Paints	24/11/08	1 l	Enamel	Green	
RSA 07	Dekade	25/11/08	500 ml	Super gloss enamel	Gold yellow	Label mentions "contains lead"
RSA 08	Dekade	25/11/08	500 ml	Super gloss enamel	Black	
RSA 09	Dekade	25/11/08	500 ml	Super gloss enamel	Deep blue	
RSA 10	Dekade	25/11/08	500 ml	Super gloss enamel	Windsor Green	Label mentions "contains lead"
RSA 11	Dekade	25/11/08	500 ml	Super gloss enamel	White	
RSA 12	Dekade	25/11/08	500 ml	Super gloss enamel	Orange	
RSA 13	Dekade	25/11/08	500 ml	Super gloss enamel	Signal red	Label mentions "contains lead"
RSA 14	Plascon	24/11/08	500 ml	Super universal enamel	Black GZ	Label mentions "lead free"
RSA 15	Plascon	24/11/08	500 ml	Super universal enamel	Super white NY	
RSA 16	Plascon	24/11/08	500 ml	Super universal enamel	Midnight Blue	Label mentions "lead free"
RSA 17	Plascon	24/11/08	500 ml	Super universal enamel	Brilliant Green	Label mentions "lead free"
RSA 18	Plascon	24/11/08	500 ml	Enamel	Calypso	Label mentions "lead free"
RSA 19	Plascon	24/11/08	500 ml	Enamel	Medium yellow	Label mentions "lead free"
RSA 20	Plascon	24/11/08	500 ml	Enamel	Signal red	Label mentions "lead free"
RSA 21	Dulux	25/11/08	1 l	Gloss enamel	Golden Yellow	Label mentions "lead free"
RSA 22	Dulux	25/11/08	1 l	Gloss enamel	Signal red	Label mentions "lead free"
RSA 23	Dulux	25/11/08	1 l	Gloss enamel	Brilliant white	
RSA 24	Dulux	25/11/08	1 l	Gloss enamel	Green	Label mentions "lead free"
RSA 25	Dulux	25/11/08	1 l	Gloss enamel	Kingfisher Blue	
RSA 26	Dulux	25/11/08		Gloss enamel	Black	Label mentions "lead free"
RSA 27	Dulux	25/11/08		Gloss enamel	Orange	
RSA 28	SPRAYON	24/11/08	250 ml	Spray paint	Tangerine	Label mentions "contains no lead"
RSA 29	SPRAYON	24/11/08	250 ml	Spray paint	Sunshine yellow	Label mentions "contains no lead"

concentration more than 600 ppm.

4. The arithmetic mean of the lead concentrations of all samples was 19,862 ppm (two percent) with lead concentrations varying from three ppm (0.0003 percent) to 195,289 ppm (19.5 percent).
5. The median lead concentration of all samples was 11 ppm (0.00108 percent), implying that 50 percent of the samples had lead concentration more than 11 ppm (0.00108 percent).
6. Plascon and Dulux samples, the two major brands that claim to produce lead-free paints, had lead concentrations lower than 600 ppm. Dulux samples of all colours had lead concentration of less than 600 ppm and majority of them were labelled as 'lead free'. This concentration of 600 ppm is the South African standard for lead in paints, as per the Hazardous Substances Act published in 2008. In fact, the majority of samples from these two brands had lead concentrations lower than 90 ppm. However, one sample had lead concentration of 506 ppm.
7. Interestingly not all brands follow their own agreed code of practices of labelling paint cans if it contains lead more than 1,500 ppm (or 0.1 percent).
8. There were five samples, three of Prominent Paints and two of Dekade paints, which had lead in high concentrations-more than 1,500 ppm (0.1 percent), ranging from 1,986.4 ppm (0.2 percent) to 54,778 ppm (5.5 percent), but without any warning labels.
9. There were two samples, spray paints of Sprayon, which had lead in high concentrations contrary to their claims. One sample (RSA 28) was found to be 10.2 percent lead while the other (RSA 29) was 19.5 percent lead. These samples prominently mention 'no lead' on their labels.

Conclusions

The following conclusions can be drawn about lead in paints in South Africa.

1. Some 65.5 percent of total samples (only

Table 20. Lead concentrations (in ppm and %) in paint samples from South Africa

Sample no.	Paint brand	Type of paint-Plastic/ enamel	Colour of the paints	Remarks	Pb concentration (ppm)	Pb concentration (%)
RSA 01	Prominent paints	Enamel	Cosmos 4055		11.2	0.00112
RSA 02	Prominent paints	Enamel	Chrome yellow		54,778	5.5
RSA 03	Prominent paints	Enamel	Signal red		51,338	5.1
RSA 04	Prominent paints	Enamel	Black		8.1	0.00081
RSA 05	Prominent paints	Enamel	White		8.4	0.00084
RSA 06	Prominent paints	Enamel	Green		10,671	1.1
RSA 07	Dekade	Super gloss enamel	Gold yellow	Label mentions "contains lead"	19,849	2
RSA 08	Dekade	Super gloss enamel	Black		3	0.00027
RSA 09	Dekade	Super gloss enamel	Deep blue		1,986.4	0.2
RSA 10	Dekade	Super gloss enamel	Windsor Green	Label mentions "contains lead"	45,152.3	4.5
RSA 11	Dekade	Super gloss enamel	White		3.4	0.00034
RSA 12	Dekade	Super gloss enamel	Orange		44,854	4.5
RSA 13	Dekade	Super gloss enamel	Signal red	Label mentions "contains lead"	48,814	5
RSA 14	Plascon	Super universal enamel	Black GZ	Label mentions "lead free"	12	0.00117
RSA 15	Plascon	Super universal enamel	Super white NY		506	0.05
RSA 16	Plascon	Super universal enamel	Midnight Blue	Label mentions "lead free"	6	0.00058
RSA 17	Plascon	Super universal enamel	Brilliant Green	Label mentions "lead free"	12.1	0.00121
RSA 18	Plascon	Enamel	Calypso	Label mentions "lead free"	4	0.0004
RSA 19	Plascon	Enamel	Medium yellow	Label mentions "lead free"	6.1	0.00061
RSA 20	Plascon	Enamel	Signal red	Label mentions "lead free"	3.4	0.00034
RSA 21	Dulux	Gloss enamel	Golden Yellow	Label mentions "lead free"	7	0.00066
RSA 22	Dulux	Gloss enamel	Signal red	Label mentions "lead free"	8.5	0.00085
RSA 23	Dulux	Gloss enamel	Brilliant white		3	0.00027
RSA 24	Dulux	Gloss enamel	Green	Label mentions "lead free"	10	0.001
RSA 25	Dulux	Gloss enamel	Kingfisher Blue		7	0.00067
RSA 26	Dulux	Gloss enamel	Black	Label mentions "lead free"	11	0.00108
RSA 27	Dulux	Gloss enamel	Orange		4.4	0.00044
RSA 28	SPRAYON	Spray paint	Tangerine	Label mentions "contains no lead"	102,625	10.3
RSA 29	SPRAYON	Spray paint	Sunshine yellow	Label mentions "contains no lead"	195,289	19.5

enamel) had lead levels higher than 90 ppm. The average concentration of lead was 19,862 ppm.

2. Some 62 percent had lead concentrations more than 600 ppm (0.1 percent).
3. Only some brands follow the code of practices of South African Paint Manufacturers Association (SAPMA) according to which SAPMA members must affix warning labels on paint cans that contain more than 0.15 percent lead.
4. Spray paints displayed their "lead free" claims, but were found to contain lead in high concentration.
5. The highest concentration of lead 195,289 ppm (19.5 percent) in paint was found in spray paint-sunshine yellow of SPRAYON brand that claimed 'contains no lead' on the label.

NIGERIA

Background

Nigeria manufactures about 40 million litres of decorative paints annually. The domestic market share of decorative paints is 60 percent, industrial paints 20 percent, refinishing 10 percent, and wood finishing and automotive five percent each. The Paints Manufacturers Association of Nigeria (PMA), a sub-sector of the Chemical and Pharmaceuticals group of the Manufacturers Association of Nigeria (MAN), is an association of companies engaged in the manufacturing of paints and allied products throughout Nigeria. The PMA, established in 1982 with membership of 18, now has more than 200 registered members in its fold.

Paints manufacturing in Nigeria commenced with the establishment of three paint companies in 1962: Askar Paints Nig. Ltd at Ibadan (a subsidiary of Haifa Paints Israel), British Paint (Berger Paints) and International Paints (IPWA).

Before 1962, the bulk of paints consumed in Nigeria were imported mainly from the United Kingdom and France. The 1980s saw growth of indigenous paint manufacturing outfits both registered and unregistered, especially in the household sector. The big multinationals are still the major players in the marine and auto sectors of the industry. The brands sampled were Chemstar, Portland, President, CAPL, Berger, and MEYER; Berger is the only multinational brand.

Nigeria has no standard for lead in paints. This leaves the general public at the mercy of paint manufacturers. Lead is used during the production stage as a drying agent for the preservation of paints. However, there are alternatives to lead as a drying agent in paint production, and this is recognised by the PMA. These include zirconium, metallic zinc, cobalt, and metallic calcium, among others. An interesting fact is that it would not require a change in technology to substitute any of these in paint production.

Paint manufacturers have blamed the rising cost of production partly on high prices of imported raw materials, which they say constitute 70 percent of their production inputs. Total investment in the industry is about N15 billion, with an installed capacity in excess of 150 million litres and employing about 10,000 people. In 1998, the estimated production and consumption of paints was 38 million litres or 25.33 percent capacity utilisation. In 2003, the average production level was about 30 million litres or 20 percent capacity utilisation.

Results

Lead concentrations of all paint samples from Nigeria with their respective description are given in Table 21. Table 22 shows the statistical measurements of lead concentrations in samples from Nigeria while distribution of lead concentrations is presented in Table 23.

Some of the main findings of the study of paint samples from Nigeria are:

1. The arithmetic mean of lead concentrations of all samples was 30,332.1 ppm (3 percent). Lead concentrations vary from 2,898.4 ppm (0.3 percent) to 129,837 ppm (13 percent).
2. For enamel paint the arithmetic mean of lead concentrations was 36,989.5 ppm (3.7 percent). The range of lead concentrations varied from 4,636 ppm (0.5 percent) to 129,837 ppm (13 percent).
3. For plastic paint samples, the arithmetic mean was 8,458 ppm (0.8 percent). The range varied from 2,898.4 ppm (0.3 percent) to 34,598 ppm (3.5 percent).
4. For all samples taken together, the median of lead concentrations was 13,394.2 ppm (1.3 percent), while for enamel paint samples the median was 23,866 ppm (2.4 percent). For plastic samples, the median was 4,560 ppm or 0.4 percent.
5. Some 30 samples, which included 23 enamel paints and seven plastic paints, were analysed for total lead concentrations. All samples, including enamel and plastic paint samples, had lead concentrations higher than 90 ppm.
6. The highest concentration of lead (13 percent) was found in a green colour enamel paint sample (sample no.: NJG 04).

Conclusion

The major conclusion of the study is:

1. All paint samples including enamel and plastic paint showed high lead concentrations exceeding 90 ppm limits.

Table 21. Lead concentrations in paint samples from Nigeria

Sample No.	Paint brand	Date of Purchase	Date of	Type of manufacturing	Colour of the paints paint-plastic/ enamel	Pb concentration (in ppm)	Pb concentration (in %)
NIG 01	Chemstar	22 Nov. 2008	6/11/2008	Enamel	Rich brown	49,545.2	5
NIG 02	Chemstar	22 Nov. 2008	8/10/2008	Enamel	Dark Grey	6,247.2	1
NIG 03	Chemstar	22 Nov. 2008	1/9/2008	Enamel	Jasmine Yellow	53,641	5.3
NIG 04	Chemstar	22 Nov. 2008	29/9/08	Enamel	National Green	129,837	13
NIG 05	Chemstar	24 Nov. 2008	2/10/2008	Plastic	Rich Brown	4,422	0.4
NIG 06	Portland	22 Nov. 2008		Enamel	White	5,832.2	0.6
NIG 07	Portland	22 Nov. 2008		Enamel	Black	7,892	0.8
NIG 08	Portland	22 Nov. 2008		Enamel	Bitter Chocolate	6,076	0.6
NIG 09	Portland	22 Nov. 2008		Enamel	Dark Grey	23,866	2.3
NIG 10	Portland	24 Nov. 2008		Plastic	Barley Cream	4,625.4	0.5
NIG 11	President	22 Nov. 2008		Enamel	Cream	14,581.4	1.4
NIG 12	President	22 Nov. 2008		Enamel	Rich brown	12,695.3	1.3
NIG 13	President	22 Nov. 2008		Enamel	Leaf Green	30,301.2	3.0
NIG 14	President	22 Nov. 2008		Enamel	Golden Yellow	66,666.5	7
NIG 15	President	24 Nov. 2008		Plastic	Cream	4,560	0.4
NIG 16	CAPL	22 Nov. 2008		Enamel	Fiesta Blue	4,636	0.5
NIG 17	CAPL	22 Nov. 2008		Enamel	Post Office RED	54,160.1	5.4
NIG 18	CAPL	22 Nov. 2008		Enamel	Black	6,337.4	0.6
NIG 19	CAPL	24 Nov. 2008		Plastic	Mobil Clove Grey	2,898.4	0.3
NIG 20	CAPL	24 Nov. 2008		Plastic	Celtel Red	4,874.2	0.5
NIG 21	BERGER	22 Nov. 2008		Enamel	Emrade Green	5,674.3	0.6
NIG 22	BERGER	22 Nov. 2008		Enamel	Golden Yellow	62,800	6.3
NIG 23	BERGER	22 Nov. 2008		Enamel	Post Office RED	66,224.1	7
NIG 24	BERGER	22 Nov. 2008		Enamel	Brilliant Blue	6004	0.6
NIG 25	BERGER	24 Nov. 2008		Plastic	Brilliant White	3228	0.3
NIG 26	MEYER	22 Nov. 2008		Enamel	Orange	50490	5.0
NIG 27	MEYER	22 Nov. 2008		Enamel	Red	126340	13
NIG 28	MEYER	22 Nov. 2008		Enamel	Black	46820.3	5
NIG 29	MEYER	22 Nov. 2008		Enamel	Pilot Blue	14093	1.4
NIG 30	MEYER	24 Nov. 2008		Plastic	Lagoon Blue	34598	3.4

Table 22. Statistical Measures of lead concentrations in paint samples from Nigeria

	All samples	Enamel samples	Plastic samples
Arithmetic mean	30,332.1	36,989.5	8,458
Standard deviation	34,572.5	36,614.2	11,551.1
Maximum concentration	12,9837	129,837	34,598
Minimum concentration	2,898.4	4,636	2,898.4
Median	13,394.2	23,866	4,560

Table 23. Distribution of samples having lead concentrations more than 90 ppm or 600 ppm

	No. of samples	No. of samples bearing more than 90 ppm of lead	No. of samples bearing more than 600 ppm of lead
Enamel paint samples	23	23 (100%)	23 (100%)
Plastic paint samples	7	7 (100%)	7 (100%)
All paint samples	30	30 (100%)	30 (100%)

SENEGAL

Background

The paint industry in Senegal is large with some brands being more popular than others. Details of these brands are given in Table 24.

Table 24. Some of the major paint brands in Senegal and their respective details

Industries	Brand	Types of paint	Usage	Quantity/price FCFA
Seigneurie	Tropix	Water	household	5Kg/2500
				10Kg/5000
				20Kg /9000
	Eurekaline	Water	household	5Kg/2500
				20Kg/9000
				22Kg /10000
	Email	Water	household	5Kg/2500
				20Kg/9000
				22Kg/10000
	ISA	Enamel	household	100Grs/500
	Autocolor	Auto	industrial	1kg/35000
	Sikkens	Auto	industrial	1L/35000
SAPEC	Peinture SAPEC	Water	household	5Kg/2800
				20Kg/10000
	SAPEC Plus	Water	household	5Kg/3000
				22Kg/10000
	PALLINAL	Auto	industrial	1Kg/29000
	Monopol	Auto	industrial	1Kg/35000
SENPAIC	Magic	Eanamel	household	100Gr/500
	Vinyl	Water	household	5Kg/2800
				20Kg/10000
	PPG	Auto	industrial	1Kg/12000
SENAC	Maestria	Water	household	5Kg/2500
				20Kg/9000
	Vinyl	Water	household	5Kg/2500
				20Kg/9000
				22Kg/10000
ASTRAL	Peinture Astral	Water	household	5Kg/2500
				10Kg/5000
				20Kg /9000
		Enamel	household	100Gr/500
NATIONAL	Peinture National	Anamel	household	1Kg/1500
				5Kg/7000
	National	Water	household	5Kg/2500
				20Kg/10000

The paint industry in Senegal is dependent upon import of raw materials (acrylic, autocryl, etc.) from Italy, Germany, France, Morocco, and Egypt. Imported paint brands are also sold in the stores in Dakar (see Table 25).

Table 25. Imported brands and their details

Brands	Types of paint	Usage	Quantity/Price FCFA	Country of importation
Suprême Opaco	Enamel	household	0.5L/3,000	Italy
Novemail	Enamel	household	100Gr/500	Germany
Rayon Atlas	Enamel	household	100Gr/700	Morocco
Vulkeol	Enamel	household	125ml/500	
Smalto Lucido	Enamel	household	125ml/500	Italy
Safrimex Email-synthetique	Enamel	household	80ml/500	Morocco
Smalto Extra	Enamel	household	50ml/500	Italy

There is no regulation concerning lead in paints or any other products. However, the government was forced to issue an ordinance after an incident in which people of Thiaroye (in Dakar area), who were involved in recycling old batteries, had to be hospitalised for lead contamination. Unfortunately, the ordinance is yet to be signed. The samples analysed included the following brands: SEN-PAIC Magic, Novemail-Flag, Peinture Aluminium/Rayon Atlas, Supreme Opaco, Seigneurie Email, Seigneurie ISA, Vulkeol, National, SENAC, Astral, SAPEC, SEN-PAIC, Smalto Lucido, Safrimex/Email, Synthetique and Smalto Extra.

Results

Table 26 shows levels of lead concentration in paint samples along with their description. Table 27 presents the statistical measurements of lead concentration in the paint samples. Table 28 shows the distribution of samples with more than 90 ppm lead concentration.

The broad observations of the study of Senegal samples are:

1. The arithmetic mean of lead concentration of all samples is 4,108.1 ppm. The median lead concentration is 1,615 ppm, which implies that 50 percent of all paint samples have lead concentration more than 1,615 ppm.
2. For enamel paint samples the arithmetic mean of lead concentration was 5,866.4 ppm with range varying from 0.6 ppm to 29,717 ppm (three percent). The median lead concentration for enamel samples was 2,771.4 ppm.
3. For plastic paint samples the arithmetic mean was 5.5 ppm with the range varying from 0.6 ppm to 29 ppm. The median lead concentration was three ppm.
4. A total of 30 paint samples, which included 21 enamel paint samples and nine plastic paint samples, were analysed for total lead concentration. Out of 21 enamel samples, 18 samples (86 percent) were found to have lead concentrations greater than 90 ppm, while 16 samples (76.2 percent) were found to have lead of more than 600 ppm.
5. None of the plastic paint samples showed lead concentration more than 90 ppm.
6. Enamel samples of the brands Peinture Aluminium/Rayon Atlas and Smalto Lucido showed lead concentrations of less than 90 ppm. Enamel samples of other brands showed lead concentrations of more than 90 ppm.
7. The highest concentration of lead (29,717 ppm or three percent) was found in the green colour enamel paint sample.

Conclusions

The major conclusions of the present study with respect to lead contents in paints collected from Senegal are:

1. Majority of enamel paint samples showed high lead concentrations. Some 86 percent of enamel paint samples had lead concentrations more than 90 ppm, while 76 percent of enamel paint samples had lead concentrations more than 600 ppm. The average lead concentration was 4,108.2 ppm. None of the plastic paint samples had lead concentrations exceeding 90 ppm.
2. Overall, 60 percent of paint samples exceeded lead concentrations of 90 ppm, and 53 percent exceeded 600 ppm of lead concentrations.
3. The highest concentration of lead was found in a green colour enamel paint sample.

Table 26. Lead concentrations (in ppm and %) in samples from Senegal

Sample no.	Paint brand	Type of paint-plastic / enamel	Colour of the paints	Pb concentration (in ppm)	Pb concentration (in %)
SEG 01	SEN-PAIC Magic	Enamel	Red	3,721	0.4
SEG 02	SEN-PAIC Magic	Enamel	White	2,646.1	0.3
SEG 03	SEN-PAIC Magic	Enamel	Green	2,972.5	0.3
SEG 04	Novemail- Flag	Enamel	Yellow	9,946	0.9
SEG 05	Novemail- Flag	Enamel	White	1,597.1	0.2
SEG 06	Novemail- Flag	Enamel	Black	2,656	0.3
SEG 07	Novemail- Flag	Enamel	Green	4,638	0.5
SEG 08	Novemail- Flag	Enamel	Red	2,771.4	0.3
SEG 09	Novemail- Flag	Enamel	Blue	572	0.1
SEG 10	Novemail- Flag	Enamel	Yellow	10,282.4	1.0
SEG 11	SEN-PAIC Magic	Enamel	Blue	1,632.2	0.2
SEG 12	Peinture Aluminium/ Rayon Atlas	Enamel	Gold colour	15.5	0.00155
SEG 13	Peinture Aluminium/ Rayon Atlas	Enamel	Grey	50	0.00498
SEG 14	Supreme Opaco	Plastic	Golden Yellow	1	0.0001
SEG 15	Supreme Opaco	Plastic	White	1	0.0001
SEG 16	Seigneurie Email	Enamel	White	2,135	0.2
SEG 17	Seigneurie ISA	Enamel	Green	29,717	3
SEG 18	Seigneurie ISA	Enamel	Yellow	5,966	0.6
SEG 19	Seigneurie Email	Enamel	Yellow	24,164.4	2.4
SEG 20	Vulkeol	Enamel	Black	472.4	0.04
SEG 21	Seigneurie Email	Plastic	White	1	0.00006
SEG 22	National	Plastic	White	5.3	0.00053
SEG 23	SENAC	Plastic	White	3.1	0.00031
SEG 24	Astral	Plastic	White	3	0.00027
SEG 25	SAPEC	Plastic	White	0.6	0.00006
SEG 26	SEN-PAIC	Plastic	White	7	0.00066
SEG 27	Smalto Lucido	Enamel	Dark Grey	0.6	0.00006
SEG 28	Safrimex/ Email Synthetique	Enamel	Brown	3,098	0.3
SEG 29	Astral	Enamel	Green	14,143	1.4
SEG 30	Smalto Extra	Plastic	White	29	0.00287

Table 27. Statistical measurements of lead concentrations in paint samples from Senegal

	All samples	Enamel samples	Plastic samples
Arithmetic mean	4,108.14	5,866.4	5.5
Standard deviation	7,160.2	7,970	9
Maximum concentration	29,717	29,717	29
Minimum concentration	0.6	0.6	0.6
Median	1,615	2,771.4	3

Table 28. Distribution of samples with more than 90 ppm or 600 ppm lead concentrations

	No. of samples	No. of samples bearing more than 90 ppm of lead	No. of samples bearing more than 600 ppm of lead
Enamel samples	21	18 (86%)	16 (76.2%)
Plastic samples	9	0	0
All samples	30	18 (60%)	16 (53.3%)

BELARUS

Background

There are more than 100 paint and varnish producers in Belarus. In 2007, some 91,434 tons of paint and varnish products were produced in Belarus (80,531 tons in 2006). In the first half of 2008, some 32,028 tons of paints and varnish were produced.

The major producers of paints and varnish products in Belarus are:

1. Lakokraska (Lida) (www.lidalkm.by)
2. Minsk Paint-and-Varnish Plant (Minsk) (www.mlkz.by)
3. Kondor (Brest) (www.condor.by)
4. Discom (Vitebsk) (www.caparol.by)
5. MAB (www.mav.by)
6. Esgit (www.esgit.by)
7. Zebra Color (www.zebracolor.by)

Some of these brands are local; some are international. Among the local brands are Lakokraska and Minsk Paint and Varnish Plant. Discom is a joint enterprise with German company Lacufa GmbH Lacke und Farben, which is a part of Caparol group. One of the most popular paint brands produced by Discom is Alpina, which is the only licensed paint produced in Belarus. Kondor is a member of Swedish holding Eskaro Group AB. The foreign enterprise Zebra Kolor, which produces paint and varnish products under the brand name Zebracolor, is owned by German company SMI GmbH. It uses raw materials procured from foreign producers like Forcit, Du Pont, Rohm&Haas, and Bayer.[17] The following brands were sampled for lead analysis: MAV-akav, Condor, Gamma, MAV-deko, Deep Prime, Sniezka, Cvetogamma, LIDA, Alpine (renova), AAT 'minski lakafarbovy zavod', Discom innenneiss, Zaria, Mogilov, Legenda 205 and Belosnejka.

In Belarus, the import of raw material and other components is an important factor that influences the market for paint and varnish products. Belarus does not require that indigenous raw materials be used in paint production, such as acrylic monomers, pigments and functional additives. This severely restricts Belarus' capacity to produce paints locally. The importing of raw materials also increases the prices of paint products. About half of the paint market is dominated by seven to eight major producers. The rest of the market belongs to about 100 mid-sized and small producers with capacity of 100 to 500 tons per year.[18]

A variety of paints are available in the Belarusian market. Major types are:

- Enamels, groundings, and putty on condensation resin-21,804 tons
- Varnishes on condensation resin-25,845 tons
- Varnishes, enamels, groundings, and putty on polymerization resin-11,067 tons
- Varnishes, enamels, groundings, and putty on cellulose ether-598 tons
- Solvents and washing-off liquids-2,108 tons
- Water-based paints-22,372 tons
- Heavy-bodied oil-based paints-976 tons
- Light-bodied oil-based paints-704 tons
- Drying oil-735 tons

Approximately half of these products are for household purposes.

Belarus stipulates that paint and varnish products must not exceed 0.005 mg/cm^2 of lead. In case technology requires the use of higher lead content in paints, it can be allowed under the condition that the quantity of lead in the paint dust in ambient air will

17. Main parametres of Belarussian paint-and-varnish market. Dmitriy Zhukov, magazine Stroitel'stvo I nedvizhimost' (Construction and Real Estate), 2008. (www.nestor.minsk.by/sn/2008/38/sn83815.html)
18. Belarussian market of paint and varnish materials for decoration works in construction. Evgeniya Ureckaya, magazine Architecture and Construction, 2007. (http://www.ais.by/content/view/1295/150/)

Table 29. Description of paint samples from Belarus

Sample no.	Paint brand	Date of purchase	Location of purchase	Date of manufacturing	Volume of paint samples	Price of the can in Belarusian rubbles	Type of paint-plastic / enamel	Colour of the paints
BLR 01	MAV-akav	22.12.08	OMA shop	14.11.2008	50 ml	5,820	Plastic	white
BLR 02	Condor	22.12.08	OMA shop	09.07.2008	50 ml	10,050	Plastic	white
BLR 03	Gamma	19.12.08	Art-Gallery	2.2008	40 cm3	2,930	Plastic	white
BLR 04	MAV-deko	22.12.08	OMA shop	8.2008	50 ml	9,580	Enamel	yellow
BLR 05	MAV-deko	22.12.08	OMA shop	7.2008	50 ml	9,240	Enamel	green
BLR 06	MAV-deko	22.12.08	OMA shop	6.2008	50 ml	9,270	Enamel	blue
BLR 07	Gamma	19.12.08	Art-Gallery	08.06.2008	50 ml	7,810	Enamel	red
BLR 08	MAV-deko	22.12.08	OMA shop	6.2008	50 ml	8,180	Enamel	red
BLR 09	Deep prime	22.12.08	OMA shop	05.12.2008	50 ml	9270	Enamel	orange
BLR 10	Deep prime	22.12.08	OMA shop	21.04.2008	50 ml	9,470	Enamel	blue
BLR 11	Deep prime	22.12.08	OMA shop	18.04.2008	50 ml	6,680	Enamel	red
BLR 12	Sniezka	22.12.08	market	18.11.2008	50 ml	10,000	Plastic	white
BLR 13	Cvetogamma	23.12.08	market	01.10.2008	50 ml	8,000	Enamel	yellow
BLR 14	Gamma	19.12.08	Art-Gallery	15.12.2007	50 ml	7,810	Enamel	blue
BLR 15	Cvetogamma	23.12.08	market	13.07.2008	50 ml	10,000	Enamel	blue
BLR 16	Cvetogamma	23.12.08	market	24.06.2008	50 ml	10,000	Enamel	red
BLR 17	Gamma	19.12.08	Art-Gallery	11.08.2008	50 ml	7,810	Enamel	yellow
BLR 18	LIDA	23.12.08	market	7.2008	50 ml	8,500	Enamel	blue
BLR 19	Alpina (renova)	24.12.08	Moazri Trejd shop	05.11.2008	50 ml	15,090	Plastic	white
BLR 20	LIDA	24.12.08	market	9.2008	50 ml	14,000	Enamel	orange
BLR 21	LIDA	24.12.08	market	6.2008	50 ml	19,000	Enamel	red
BLR 22	AAT "Minski Lakafarbovy zavod"	24.12.08	Moazri Trejd shop	08.10.2008	50 ml	10390	Enamel	yellow
BLR 23	AAT "Minski Lakafarbovy zavod"	24.12.08	Moazri Trejd shop	16.10.2008	50 ml	9,260	Enamel	dark red
BLR 24	AAT "Minski Lakafarbovy zavod"	24.12.08	Moazri Trejd shop	25.11.2008	50 ml	8,500	Enamel	blue
BLR 25	DISKOM innenweiss	24.12.08	Moazri Trejd shop	26.01.2008	50 ml	14,540	Plastic	white
BLR 26	Zaria, Mogilev	24.12.08	Moazri Trejd shop	03.07.2007	50 ml	9,420	Enamel	orange
BLR 27	Zaria, Mogilev	24.12.08	Moazri Trejd shop	07.08.2007	50 ml	9,830	Enamel	red
BLR 28	Zaria, Mogilev	24.12.08	Moazri Trejd shop	07.07.2006	50 ml	7,800	Enamel	blue
BLR 29	Legenda 205	24.12.08	Moazri Trejd shop	03.03.2008	50 ml	5,880	Plastic	white
BLR 30	Belosnejka	24.12.08	Moazri Trejd shop	2.2008	50 ml	7,580	Plastic	white

not exceed 0.01 mg/m^3. Belarus also has mandatory technical regulations regarding sanitary rules and requirements to paint and varnish products. However, these regulations have lower status than laws. According to Safety Rules During Painting Works, there is only one type of paint that contains lead: heavy-bodied whitewash MA-011 and MA-011-H-1[19] .

Belarus exported more than 20,000 tons of paint and varnish products in 2007, of this 15,000 tons was to Russia. In 2007, Belarus exported paint products to nine countries, and imported 28,000 tons of paint products from 21 countries. From January to June 2008, Belarus imported 8,900 tons of oil-based paints for USD 40.3 million and 18,300 tons of water-based paints for USD 67.8 million. [20]

Results

Description of samples analysed is given in Table 29. Table 30 shows lead concentrations in these samples. Table 31 presents the statistical measurements of lead concentrations in the samples, while distribution of paint samples bearing more than 90 ppm or 600 ppm of lead concentrations is given in Table 32.

The observations and analysis findings of the samples from Belarus are:

1. A total of 30 paint samples, which included 22

19. Safety Rules During Painting Works, 31.12.2002. Approved by the Decision # 166 of Ministry of Labour and Social Protection of Belarus.

20. "Paint" production: situation and perspectives of Belarusian paint-and-varnish market. Vera Bobrovnik, BSG, Stroitel'naya gazeta, 2008. (http://cnb.by/content/view/495/47/lang,russian/)

Table 30. Lead concentrations (in ppm and %) in paint samples from Belarus

Sample no.	Paint brand	Type of paint-plastic / enamel	Colour of the paints	Pb concentration (ppm)	Pb concentration (%)
BLR 01	MAV-akav	Plastic	White	1	0.0001
BLR 02	Condor	Plastic	White	2.4	0.00024
BLR 03	Gamma	Plastic	White	18.3	0.00183
BLR 04	MAV-deko	Enamel	Yellow	59,387.2	6
BLR 05	MAV-deko	Enamel	Green	1,650.5	0.2
BLR 06	MAV-deko	Enamel	Blue	1,992.1	0.2
BLR 07	Gamma	Enamel	Red	20	0.00197
BLR 08	MAV-deko	Enamel	Red	2,470.1	0.2
BLR 09	Deep prime	Enamel	Orange	2,637.2	0.3
BLR 10	Deep prime	Enamel	Blue	161	0.02
BLR 11	Deep prime	Enamel	Red	3708	0.4
BLR 12	Sniezka	Plastic	White	0.6	0.6
BLR 13	Cvetogamma	Enamel	Yellow	2,8468	3
BLR 14	Gamma	Enamel	Blue	1,974.3	0.2
BLR 15	Cvetogamma	Enamel	Blue	1705	0.2
BLR 16	Cvetogamma	Enamel	Red	57.2	0.00572
BLR 17	Gamma	Enamel	Yellow	6	0.0006
BLR 18	LIDA	Enamel	Blue	386	0.04
BLR 19	Alpina (renova)	Plastic	White	418.1	0.04
BLR 20	LIDA	Enamel	Orange	4019	0.4
BLR 21	LIDA	Enamel	Red	679.5	0.1
BLR 22	AAT "Minski Lakafarbovy zavod"	Enamel	Yellow	6984.4	0.7
BLR 23	AAT "Minski Lakafarbovy zavod"	Enamel	Dark red	0.6	0.6
BLR 24	AAT "Minski Lakafarbovy zavod"	Enamel	Blue	3,797.5	0.4
BLR 25	DISKOM innenweiss	Plastic	White	24	0.00237
BLR 26	Zaria, Mogilev	Enamel	Orange	462.4	0.04624
BLR 27	Zaria, Mogilev	Enamel	Red	889	0.0889
BLR 28	Zaria, Mogilev	Enamel	Blue	812.3	0.08123
BLR 29	Legenda 205	Plastic	White	0.6	0.6
BLR 30	Belosnejka	Plastic	White	0.6	0.6

Table 31. Statistical measurements of lead concentrations in paint samples from Belarus

	All samples	Enamel samples	Plastic samples
Arithmetic mean	4091	5,557.5	58.2
Standard deviation	11,681.5	13,416	145.7
Maximum concentration	59,387.2	59,387.2	418.1
Minimum concentration	0.6	0.6	0.6
Median	571	1,678	1.7

Table 32. Distribution of paint samples having more than 90/600 ppm of lead concentrations

	No. of samples	No. of samples bearing more than 90 ppm of lead	No. of samples bearing more than 600 ppm of lead
Enamel samples	22	18 (82%)	15 (68.2%)
Plastic samples	8	0	0
All samples	30	18(60%)	15 (50%)

enamel paint samples and eight plastic paint samples, were analysed for total lead concentrations.

2. The arithmetic mean of all of the paint samples was 4,091 ppm. For samples of enamel paints, the arithmetic mean was 5,557.5 ppm. For samples of plastic paints, the arithmetic mean was 58.2 ppm
3. In case of enamel paint samples, lead concentration ranged from 0.6 ppm to 59,387.2 ppm (6 percent). For plastic paint samples, the minimum lead content was 0.6 ppm and the maximum was 418.1 ppm.
4. The median lead concentration for enamel paint samples was 1,678 ppm, and for plastic paints, the median was two ppm.
5. Out of 22 enamel paint samples, 18 samples (82 percent) exceeded 90 ppm of lead concentrations, while 15 samples (68 percent) exceeded the 600 ppm of lead concentration.
6. None of the plastic paint samples was found to exceed 90 ppm of lead concentrations.
7. Taking all samples together, 60 percent of paint samples exceeded 90 ppm of lead concentration, while 50 percent exceeded 600 ppm of lead concentration.

8. The highest concentration of lead was found in a yellow colour enamel paint sample.
9. Enamel products of three brands, Cvetogamma, Gamma, and AAT "Minski Lakafarbovy zavod", showed lead concentrations of less than 90 ppm. Out of four enamel paint samples of lead concentration less than 90 ppm, three were of red colour. Other brands, such as Zaria Mogilev, LIDA, and Deep Prime showed lead concentrations less than 600 ppm.

Conclusions

The major conclusions of the study are:

1. The majority of enamel paint samples showed high concentrations of lead. Some 82 percent of enamel paint samples exceeded lead concentration of 90 ppm, while 68 percent exceeded 600 ppm of lead concentrations. Overall, 60 percent of paint samples exceeded 90 ppm of lead concentrations while 50 percent exceeded 600 ppm of lead concentrations.
2. None of the plastic paint sample had lead concentration exceeding 90 ppm.
3. The highest concentration of lead was found in a yellow colour enamel paint sample.

MEXICO

Background

According to the 2004 Economic Census[21] (based on 2003 data), production of paint and coating sector represented 0.52 percent of Mexican industrial production value. Paints and coatings production for year 2003 included 1,094,598,000 litres and 58,764.44 metric tons of powder and ceramic paints. A brief introduction of the major paint producers in household segment in Mexico is given below.

Comex Group is a major player in the Mexican paint market.[22] Comex is the fourth largest architectural paint manufacturer in the North and Central America and serves the diverse needs of the customers through over 3,300 retails from Canada to Panama. Comex's companies in the U.S. (Color, Wheel Paints, Frazee Paint, Kwal Paint, and Parker Paint) and Canada (General Paint) were formerly part of Professional Paint Inc. (PPI), which it acquired in October 2004.

Sherwin Williams, S.A. de C.V., is another major paint industry in Mexico. In 2007, Monterrey-based Sherwin Williams, a leading manufacturer and distributor of automotive after-market body fillers, putties, primer, and other vehicle refinish products, acquired the assets and business of important Mexican companies such as Flex Recubrimientos, S.A de C.V., and related companies (Flex Group). During the same year, Sherwin Williams also acquired Napko, a leading manufacturer and distributor of industrial maintenance coatings primarily for the government oil and power industries in Mexico.

Pintusayer ICI in Mexico is part of the Imperial Chemical Industries (ICI), which on 2 January 2008 became part of AkzoNobel.[23] Optimus Paints (Pinturas Optimus), Berel, and Contimex are Mexican companies that manufacture, market, and distribute enamel and water-based paints.[24, 25] DuPont operates in the industrial coatings and automotive paints segment of the market.[26] The National Association of Paint and Ink Manufacturers (Asociación Nacional de Fabricantes Pinturas y Tintas, ANAFAPYT) is the official and united face of the paint manufacturers in Mexico. Table 33 shows some of the members of this association. According to information in Table 34, around 97 percent of Mexican paint production is controlled by large companies.

As per the Industrial Census of 2003, 42 percent of national production corresponds to household plastic paints and 19 percent to household enamel paints. The remaining 39 percent corresponds to the industrial sector. Table 36 shows some of the regulations related to lead in paints in Mexico. According to regulation NOM-015/1-SCFI/SSA-1994, the limit for lead in materials used for manufacturing toys, instruments, school accessories, and graphic device paints is 100 mg/kg. Export-import figures related to paint industries in Mexico are given in Table 37.

Results

Lead concentrations with the descriptions of paint samples from Mexico are given in Table 38. Statistical measurements of lead concentrations (ppm) in paint samples for Mexico are given in Table 39, while Table 40 shows the distribution of samples having lead concentrations more than 90 ppm.

The major findings of the study with respect to Mexico are:

1. A total of 30 paint samples, which included 20 enamel paint samples and 10 plastic paint samples, were analysed for total lead concentrations.
2. One hundred percent enamel paint samples

21. http://me.economia.gob.mx:81/site/482/default.aspx
22. http://www.thecomexgroup.com/
23. http://www.icipaints.com/index.jsp
24. http://www.elpoderdelcolor.com/
25. http://www.berel.com.mx/
26. http://www2.dupont.com/Performance_Coatings/es_MX/index.html

Table 33. Companies affiliated with the National Association of Paint and Ink Manufacturers of Mexico

Members	Email	Location
Comercializadora Jasaquim	aaron.rayo@jasaquim.com.mx	San Pedro Xalostoc Ecatepec de Morelos
Pinturas Señalmex	amerinos@senalmex.com.mx	Parque Industrial Tenango del Valle C.P. 52300 Ed o. De Mex.
Typ de México	typmx@gamaquali.com	León, Guanajuato. C.P. 37540
Napko	alcocer@napko.com	Santa Catarina Nuevo León.
Pinturas y Polimeros Alsa	jvallejo@alsa.com.mx	Santa Ana Tepetitlán, Zapopan, Jalisco.
Alva Mex Química	mleonalva@hotmail.com	Tlalnepantla de Baz C.P. 54190
Pintumex	isis@pintumex.com.mx	Parque Industrial
Pinturas del Bajío	rzanella@pinturasdelbajio.com.mx	Querétaro, Querétaro.
Rectel	salvadoraguilarmendoza@hotmail.com	León Guanajuato C.P. 37350
El Aguila	holcolor@prodigy.net.mx	Venustiano Carranza, México, D.F.
Industrial Técnica de Pinturas	jesusgonzalez@pinturasacuario.com	Puente de Vigas. Tlalnepantla de Baz. Edo de México
Pintex de Mexico	adriangarza@forjacolor.com	Nicolás de los Garza, Nuevo León.
Hi-fil Pinturas	jhc@hi-fil.com	Los Reyes la Paz Edo. De México. C.P. 56400
Sayer Lack mexicana	jguerrero@gruposayer.com	Apaseo el Alto, Guanajuato.
Pinturas Doal	rtamez@pinturasdoal.com	Guadalupe, Nuevo León C.P. 67110

Table 34. Share of big and small industries in Mexico paint market

No. of enterprises*			Production (value in U.S. dollars)		
Big companies	Micro, small, and medium	Total	Big companies	Micro, small, and medium	Total
98	156	254	1,136,871,913	35,160,987	1,172,032,900
			97%	3%	

Paints and coatings Production in Mexico Economic Activity Class Number 325510
*Micro = 0-10 workers; Small = 21-30 workers; Medium = 31-100; Big = 101-1001 and more
Derived from: The Industrial Census http://www.inegi.org.mx/inegi/default.aspx?s=est&c=13394&pred=1

Table 35. Quantitative production of various paints and coatings in Mexico

Paint type	Quantity in thousand liters	Value in U.S. dollars*	% value
Household			61%
Water Based (no mineral and mineral added) acrylic and vinyl	335,393	488,482,300	42%
Oil Based (regular synthetics, acrylics, alkyildal, pigmented lacquer, transparent lacquer, and others	310,994	225,728,300	19%
Industrials			39%
High temperature, and glazy for ceramic; Lacquer: marine, oily-resin, regular, and synthetics; Others: anticorrosive, bituminous, and marine	448,211	369,269,800	31%
Other paints and pigments			
Paints (powder), Pigments (powder), Ceramic, Ceramic paste, and others	58,764,44 (in metric tons)	88,552,500	8%
Total	1,094,598	1,172,032,900	100%

Derived from: The Industrial Census and Annex 1, http://www.inegi.org.mx/inegi/default.aspx?s=est&c=13394&pred=1
*Data is calculated at rate of ten Mexican pesos for one U.S. dollar in 2004

were found to have lead concentrations more than 90 ppm.

3. None of the plastic samples was found to have lead concentrations higher than 90 ppm.
4. Taking all samples together, 67 percent samples showed high concentrations of lead exceeding 90 ppm limit.
5. The arithmetic mean of lead concentrations of all samples was 34,575.3 ppm. The range varies from 0.6 ppm to 163,812 ppm. The median concentration was 30,204.2 ppm.
6. The arithmetic mean of enamel samples was 51,860.1 ppm. For plastic samples it was six ppm. The range of lead concentrations in enamel samples was 22,758.5 ppm to 163,812ppm (16.4 percent), in plastic samples the range varied from 0.6 ppm to 16 ppm.

7. The median concentration for enamel samples was 45,614 ppm, while for plastic paint samples it was 4.4 ppm.
8. The highest concentration of lead (16.4 percent) was found in an orange colour enamel paint sample (MXC-11).

Conclusions

The major conclusions of the study are:

1. Lead is found in high concentration in all enamel paint samples-more than 90 ppm. One enamel paint sample, produced by a major U.S. multinational company, contained over 30,000 ppm lead.
2. All plastic paint samples were found to have lead in lower concentrations – lower than 90 ppm.
3. 67 percent of all samples were found to have lead concentrations more than 90 ppm.
4. The median for enamel samples was found to be five percent, which was quite high. In case of plastic samples, the median value was 4.4 ppm of lead.

Table 36. Mexican Official Rules (NOMs) on lead in paints

(NOMs according to its Spanish acronym, Norma official Mexicana)	Description
NOM-003-SSA1-1993 Public health. Requirements for labeling paints, inks, lacquers and enamels.	Establishes requirement to advise consumers about health hazards of exposure to lead solvents or lead compounds in paints.
NOM-004-SSA1-1993 Environmental Health. Limits and sanitary requirements related to the use of lead monoxide, PbO (litargirio), lead red oxide, Pb3O4 (minio), and basic lead carbonate 2PbCO3 Pb(OH)2 (albayalde). This rule was amended on August 12, 2004	Bans uses of basic lead carbonate as white pigment in paints, enamels, coatings, inks or any other products containing this compound. Bans use and commerce of lead monoxide, lead red oxide, and basic lead carbonate contained in the above mentioned products used for manufacturing pencils, pens, toys, cosmetics, plasticine, printing inks, furniture and home paints or any other products in contact with persons, as well as uses in pottery, ceramic and porcelain used in food and drink processes. Allows uses of lead red oxide in anticorrosive pigments and coatings used for ship paints, platform or any other objects in contact with marine or corrosive environment. This rule does not establish or determine any limit or value. Allows uses of basic lead carbonate in paints for mirror manufacturing. Again, this rule does not establish or determine any limit or value.
NOM-005-SSA1-1993, Environmental Health. Lead chromate and chromo molybdate pigments. Extraction and determination of soluble lead. Test Methods. Issued on November 17, 1994 NOM-006-SSA1-1993, Environmental Health.	Establishes and describes extraction and determination procedures for soluble lead test methods related to the above-mentioned lead compounds.
Preparation and acid extractions of dry paints and lacquer layers for determination of soluble lead. Test Methods. Issued on November 17, 1994	Establishes and describes extraction and preparation procedures for dry lead test methods in paints and lacquer.
NOM-015/1-SCFI/SSA-1994. Safety and commercial information related to toys and school accessories. Bioavailability limits of metals in coatings, paints and inks. Chemical specifications and test methods. Issued on November 17, 1994	Establishes specification and test methods to determine bio-availability of Sb, As, Ba, Cd, Cr, Pb, Hg, and Se in materials used for manufacturing toys, instruments, school accessories, graphic devices paints, and plasticine. Establishes limit for lead at 100 mg/kg.

Table 37. Exports-Imports figures from January 2008 to December 2008

HTS number	Imports in U.S. dollars	Imports in kg	Exports in U.S. dollars	Exports in kg	Net imports in U.S. dollars	Net imports in kg
32081001 Paints and lacquers	59,612,682	13,042,057	-13,388,350	3,082,490	46,224,332	9,959,567
32081099 Other polyester based paints	14,190,572	4,538,591	-1,253,643	300,415	12,936,929	4,238,176
32082001 Other paints except those in 3808002	64,147,824	9,805,175	-37,229,182	6,239,185	26,918,642	3,565,990
32082002 Acrylic and vinyl	409,849	138,932	-102	32	409,747	138,900
32082099 Acrylic polymer or vinyl	14,427,966	2,717,870	-4,099,346	1,823,976	10,328,620	893,894
based paints						
Total	152,788,893	30,242,625	-55,970,623	11,446,098	96,818,270	18,796,527

Source: http://www.economia-snci.gob.mx
(Consider 15 pesos for one U.S. dollar in March 2008)

Table 38. Lead concentrations in paint samples from Mexico.

Sample no.	Paint brand	Type of paint-plastic / enamel	Colour of the paint	Pb concentration (in ppm)	Pb concentration (in %)
MXC-01	Comex	Plastic	Yellow	16	0.00159847
MXC-02	Comex	Plastic	Red	10	0.00097465
MXC-03	Comex	Plastic	Green	0.6	0.00006
MXC-04	Pintusayer ICI	Plastic	Orange	4.4	0.00043986
MXC-05	Pintusayer ICI	Plastic	Blue	6.2	0.00061987
MXC-06	Optimus	Plastic	Orange	4.5	0.00044707
MXC-07	Optimus	Plastic	White	2	0.0001869
MXC-08	Sherwin W	Plastic	Yellow	4	0.00036136
MXC-09	Sherwin W	Plastic	Yellow	7.3	0.0007256
MXC-10	Berel	Plastic	Orange	2.3	0.00023285
MXC-11	Comex	Enamel	Orange	163,812	16.4
MXC-12	Comex	Enamel	Blue	27,171	3
MXC-13	Comex	Enamel	Black	50,521	5.0
MXC-14	Pintusayer ICI	Enamel	Yellow	70,531	7.0
MXC-15	Pintusayer ICI	Enamel	Red	73,968	7.4
MXC-16	Pintusayer ICI	Enamel	Blue	36,224	4
MXC-17	Pintusayer ICI	Enamel	Green	30,252.1	3.0
MXC-18	Optimus	Enamel	Yellow	39,159	4
MXC-19	Optimus	Enamel	Red	67,664.1	7
MXC-20	Optimus	Enamel	Blue	31,950.2	3.2
MXC-21	Optimus	Enamel	Black	28,591.7	3
MXC-22	Sherwin	Enamel	Yellow	30,156.4	3.0
MXC-23	Berel	Enamel	Yellow	56,537.1	6
MXC-24	Soriana	Enamel	Red	48,282.4	5
MXC-25	Soriana	Enamel	Blue	25,650.0	3
MXC-26	Soriana	Enamel	Green	71,064	7.1
MXC-27	Soriana	Enamel	Yellow	42,945	4.3
MXC-28	Contimex	Enamel	Blue	22,758.5	2.3
MXC-29	Contimex	Enamel	Green	50,609.4	5.106093592
MXC-30	Contimex	Enamel	Yellow	69,358.0	7

Table 39. Statistical measurements of lead concentrations (ppm) in paint samples from Mexico

	All samples	Enamel samples	Plastic samples
Arithmetic mean	34,575.3	51,860.1	6
Standard deviation	35,605	31,487.5	4.5
Maximum concentration	163,812	16,3812	16
Minimum concentration	0.6	22758.5	0.6
Median	30,204.2	45614	4.4

Table 40. Distribution of samples having lead concentrations more than 90/600 ppm

	No. of samples	No. of samples bearing more than 90 ppm of lead	No. of samples bearing more than 600 ppm of lead
Enamel paint samples	20	20 (100%)	20 (100%)
Plastic paint samples	10	0	0
All paint samples	30	20 (67%)	20 (67%)

BRAZIL

Background

Brazilian paint market is among the five biggest markets of the world. Its own consumption however is very small – the annual per capita consumption is 5.5 litres. There are around 300 manufacturers and 17,000 direct employees engaged in this sector. The production volume for 2008 was 864 million litres worth USD 5.4 billion. The housing paints represent about 77 percent of the total volume. [27]

Out of 800 million litres, 328 million litres (41 percent) of economic paint line, 299 million litres (37 percent) of paint premium line, and 173 million litres (12 percent) of standard line housing paints are sold in Brazil market. According to industry experts, the profits are declining, and the trend is towards the consolidation of big companies. [28]

Some of the major paint companies operating in Brazil include: BASF S/A (Suvinil brand); Dacar Quimica do Brasil S/A (Dacar brand); Eucatex Quimica e Mineral Ltda.; Sherwin Williams do Brasil; Coral; Killing S/A; Renner Sayerlack S/A (Renner); and AkzoNobel Ltda. (Coral paints). Of these companies, only Dacar, Eucatex, and Lukscolor are Brazilian, the others are multinationals. The paint brands that were sampled included Dacar, Coral/Coralamine, Suvinil, Sherwin Williams Novacor, Renner, Coral-Coralit, and 3 RM.

According to law no. 11762 published on 4 August 2008,[29] the maximum limit of lead in the manufacture of housing paints and those for children's products and schools, varnish and similar materials is 0.06 percent by weight, expressed as metallic lead, determined in dry basis or total non-volatile content. This law will come into effect one year after its publication. The Federal Environment Agency, Ibama, will be legally responsible for the enforcement of this law. This law does not apply to paints, varnishes and similar materials of surface coating used in:

1. Agricultural and industrial equipment
2. Industrial, agricultural, and commercial metallic structures
3. Painting-based anticorrosive treatment
4. Traffic and safety signalling
5. Auto-motors, airplanes, ships, and rail vehicles
6. Graphic arts
7. Housing gadgets and metallic furniture
8. Exclusive-use artistic paints and similar materials
9. Graphic paints

Results

Description of paint samples from Brazil is given in Table 41. Lead concentrations in the samples are given in Table 42. Table 43 shows the statistical measurements of lead concentrations in Brazil paint samples, while distribution of samples having lead concentrations more than 90 ppm is shown in Table 44.

The major findings of the study are:

1. A total of 31 paint samples, which included 24 enamel paint samples and seven plastic paints, were analysed for total lead concentrations.
2. Out of 24 enamel paint samples, ten samples (42 percent) were found to have lead concentrations more than 90 ppm, while nine samples (37 percent) had lead concentrations exceeding 600 ppm. The average concentration was 15,000 ppm.
3. None of the plastic paint samples was found to have lead concentration more than 90 ppm.
4. Overall 32 percent of samples showed lead concentrations more than 90 ppm, and 28 percent had lead higher than 600 ppm.
5. The arithmetic mean of lead concentrations of all samples was 11,618.3 ppm; for enamel samples, 15,004.1 ppm; and for plastic samples, 9.8 ppm.
6. Lead concentrations for enamel samples varied from 0.6 ppm to 170,258.4 ppm (17 percent). For plastic samples, the lead concentrations ranged from 0.6 ppm to 14.4 ppm. The median for enamel paint samples was 40 ppm.

27. http://www.abrafati.com.br/bn_conteudo.asp?cod=94
28. http://maquina.com.br/revista/qd469/tintas.html
29. http://www.planalto.gov.br/ccivil_03/_Ato2007-2010/2008/Lei/L11762.htm

7. All enamel samples of Sherwin Williams Novacor and Coral-Coralit had lead concentrations less than 90 ppm.
8. Brands such as Renner, Dacar, and Suvinil had some enamel samples showing lead concentrations less than 90 ppm. Lead contents seem to depend upon colour of enamel samples of these brands. Enamel samples of white, black and in some cases blue colour of these brands showed lead concentrations lower than 90 ppm.
9. The highest concentration of lead (17 percent) was found in a yellow colour enamel sample from Renner (BRZ 14).

Conclusions

1. Plastic paint samples have low lead concentrations, lower than 90 ppm
2. Some 42 percent of enamel samples had lead contents lower than 90 ppm, while 37 percent of enamel samples had lead contents lower than 600 ppm.
3. All enamel paint samples of brands, such as Sherwin Williams Novacor and Coral-Coralit, had lead concentrations lower than 90 ppm.
4. Not all samples of other brands showed lead concentrations lower than 90 ppm.

Table 41. Description of paint samples from Brazil

Sample no.	Paint brand	Date of purchase	Location of purchase	Expiration Date	Volume of the paint samples	Price of the can in Reals	Type of paint-plastic/ enamel	Colour of the paints
BRZ 01	DACAR	31/12/08	Rei das Tintas, Curitiba City	Nov-10	80ml	17.00	Plastic	Green
BRZ 02	DACAR	31/12/08	Darka, Curitiba City	Oct-10	80ml	10.00	Plastic	Blue
BRZ 03	Coral / Coralamine	30/12/08	Diprotec Curitiba City	Sep-10	80ml	15.00	Plastic	Yellow
BRZ 04	Coral / Coralamine	30/12/08	Diprotec, Curitiba City	Sep-10	80ml	15.00	Plastic	Green
BRZ 05	Suvinil	30/12/08	Tintas Guarize, Curitiba City	Sep-11	80ml	13.12	Plastic	Blue
BRZ 06	Suvinil	30/12/08	Tintas Guarize, Curitiba City	Jul-11	80ml	15.64	Plastic	Orange
BRZ 07	Suvinil	30/12/08	Tintas Guarize, Curitiba City	Sep-11	80ml	17.33	Plastic	Red
BRZ 08	Sherwin Williams Novacor	30/12/08	Buchholtz, Curitiba City	Jan-10	225ml	5.00	Enamel	Yellow
BRZ 09	Sherwin Williams Novacor	30/12/08	Buchholtz, Curitiba City	Apr-11	225ml	5.00	Enamel	Red
BRZ 10	Sherwin Williams Novacor	30/12/08	Buchholtz, Curitiba City	Feb-11	225ml	5.00	Enamel	Blue
BRZ 11	Sherwin Williams Novacor	30/12/08	Buchholtz, Curitiba City	Jun-11	225ml	5.00	Enamel	Black
BRZ 12	Renner	18/12/08	Condor, Curitiba City	Jul-10	225ml	6.92	Enamel	Red
BRZ 13	Renner	18/12/08	Condor, Curitiba City	Nov-09	225ml	6.92	Enamel	Blue
BRZ 14	Renner	30/12/08	Condor, Curitiba City	May-10	225ml	5.00	Enamel	Yellow
BRZ 15	Dacar	30/12/08	Tintas Guarize, Curitiba City	Oct-11	225ml	4.30	Enamel	White
BRZ 16	Dacar	30/12/08	Tintas Guarize, Curitiba City	Feb-12	225ml	4.30	Enamel	Green
BRZ 17	Dacar	30/12/08	Tintas Guarize, Curitiba City	Aug-11	225ml	4.30	Enamel	Black
BRZ 18	Dacar	30/12/08	Tintas Guarize, Curitiba City	Nov-11	225ml	4.30	Enamel	Red
BRZ 19	Dacar	23/12/08	Mercado das Tintas, Curitiba	Feb-11	225ml	4.00	Enamel	Blue
BRZ 20	Dacar	23/12/08	Mercado das Tintas, Curitiba	Nov-10	225ml	4.00	Enamel	Orange
BRZ 21	Suvinil	30/12/08	Tintas Guarize, Curitiba City	May-09	225ml	5.60	Enamel	Red
BRZ 22	Suvinil	30/12/08	Tintas Guarize, Curitiba City	Nov-10	225m	5.60	Enamel	Yellow
BRZ 23	Suvinil	30/12/08	Tintas Guarize, Curitiba City	Aug-11	112,5ml	3.10	Enamel	White
BRZ 24	Suvinil	2/1/2009	Casa Haisi, Curitiba	Jan-12	225ml	8.25	Enamel	Black
BRZ 25	Coral-Coralit	30/12/08	Diprotec, Curitiba	Nov-09	225ml	4.90	Enamel	Yellow
BRZ 26	Coral-Coralit	30/12/08	Diprotec, Curitiba	Sep-10	225ml	4.90	Enamel	Green
BRZ 27	Coral-Coralit	30/12/08	Diprotec, Curitiba	Apr-12	225ml	4.90	Enamel	Black
BRZ 28	Coral-Coralit	30/12/08	Diprotec, Curitiba	Jul-11	112,5ml	3.90	Enamel	Red
BRZ 29	Renner	2/1/2009	Tintas Darka, Curitiba	Jul-10	225ml	5.50	Enamel	Green
BRZ 30	3RM	30/12/08	Cia. Brasileira de Distribuiçao	Nov-10	225ml	5.99	Enamel	Black
BRZ 31	3RM	30/12/08	Cia. Brasileira de Distribuição	Sep-10	225ml	5.99	Enamel	White

Table 42. Lead concentrations (ppm and %) in paint samples from Brazil

Sample no.	Paint brand	Type of paint-plastic/ enamel	Colour of the paints	Pb concentration (in ppm)	Pb concentration (in %)
BRZ 01	DACAR	Plastic	Green	0.6	0
BRZ 02	DACAR	Plastic	Blue	7	0.00068
BRZ 03	Coral/Coralamine	Plastic	Yellow	12.4	0.00124
BRZ 04	Coral/Coralamine	Plastic	Green	14	0.00136
BRZ 05	Suvinil	Plastic	Blue	13.4	0.00134
BRZ 06	Suvinil	Plastic	Orange	14.4	0.00144
BRZ 07	Suvinil	Plastic	Red	7.5	0.00075
BRZ 08	Sherwin Williams Novacor	Enamel	Yellow	53	0.0053
BRZ 09	Sherwin Williams Novacor	Enamel	Red	16.4	0.00164
BRZ 10	Sherwin Williams Novacor	Enamel	Blue	22	0.0022
BRZ 11	Sherwin Williams Novacor	Enamel	Black	9.5	0.00095
BRZ 12	Renner	Enamel	Red	5,633.2	0.6
BRZ 13	Renner	Enamel	Blue	12.4	0.00124
BRZ 14	Renner	Enamel	Yellow	170,258.4	17.0
BRZ 15	Dacar	Enamel	White	26.3	0.00263
BRZ 16	Dacar	Enamel	Green	7,665.5	0.7
BRZ 17	Dacar	Enamel	Black	25	0.00247
BRZ 18	Dacar	Enamel	Red	19,081	2
BRZ 19	Dacar	Enamel	Blue	573.2	0.05
BRZ 20	Dacar	Enamel	Orange	60,713.1	6.1
BRZ 21	Suvinil	Enamel	Red	20,957.1	2.1
BRZ 22	Suvinil	Enamel	Yellow	66,126	7
BRZ 23	Suvinil	Enamel	White	55.4	0.00554
BRZ 24	Suvinil	Enamel	Black	4.3	0.00043
BRZ 25	Coral - Coralit	Enamel	Yellow	10	0.00096
BRZ 26	Coral - Coralit	Enamel	Green	6	0.00059
BRZ 27	Coral - Coralit	Enamel	Black	0.6	0.00006
BRZ 28	Coral - Coralit	Enamel	Red	8.2	0.00082
BRZ 29	Renner	Enamel	Green	12	0.00119
BRZ 30	3RM	Enamel	Black	4935.5	0.5
BRZ 31	3RM	Enamel	White	3896.1	0.4

Table 43. Statistical measurements of lead concentrations in paint samples from Brazil

	All samples	Enamel samples	Plastic samples
Arithmetic mean	11618.3	15004.1	10
Standard deviation	33564	37635.1	5.1
Maximum concentration	170258.4	170258.4	14.4
Minimum concentrations	0.6	0.6	0.6
Median	16.4	40	12.4

Table 44. Distribution of paint samples having lead concentrations more than 90/600 pm

	No. of samples	No. of samples bearing more than 90 ppm of lead	No. of samples bearing more than 600 ppm of lead
Enamel paint samples	24	10 (42%)	9 (37.5%)
Plastic paint samples	7	0	0
All samples	31	10 (32.2%)	9 (28.1%)

INDIA

Background

The size of the paint market is estimated at Rs 110 billion, with organized sectors accounting for 65 percent of the market and unorganised sectors 35 percent. India produces both decorative and industrial paints. Decorative paints can further be classified into premium, medium, and distemper segments. Premium decorative paints are acrylic emulsions used mostly in the metropolitan areas. The medium range segments consist of enamels, which are popular in smaller cities and towns. Distempers are economy products demanded in the suburban and rural markets. Nearly 20 percent of all decorative paints sold are distempers, in which the unorganised sector has the dominance. Industrial paints include powder coatings, high performance coatings, and automotive and marine paints. Two-thirds of the industrial paints produced in India are automotive paints. The decorative paint segment accounts for 70 percent of the sector and the industrial paints segments 30 percent. Other sub-segments are marine paints, powder coatings for large appliances such as like refrigerators and washing machines, and industrial coatings.

Market share of various decorative paint products[30]

Enamels	50%
Distemper	19%
Emulsions	17%
Exterior Coatings	12%
Wood Finishes	2%

Market share of various industrial paint products

Automotive Paints	50%
High Performance Coating	30%
Powder Coating	10%
Coil Coating	5%
Marine Paints	5%

Goodlass and Asian Paints are the leading OEM players. Berger and Goodlass lead in the solid powder coating segment used for decoration and protection of large appliances, electronic equipment, and auto components. ICI and Asian Paints lead the segment of solvent based paints for sheets. Shalimar and Bombay Paints are the major players in these anti-corrosive, underwater marine paints used for ships and containers. Asian Paints dominates the decorative segment with a 38 percent market share. GNPL is number two in the decorative segment with a 14 percent market share. Berger and ICI have nine percent and eight percent shares, respectively, in this segment, followed by J&N and Shalimar with one and six percent shares, respectively. GNPL dominates the industrial paints segment with 41 percent market share.

India does not have any mandatory regulation for lead limits in paints. The issue is only addressed in a voluntary portion of the government's Eco Mark Scheme, which suggests that lead should not be more than 0.1 percent in certain types of paints. A previous study by Toxics Link had found that 84 percent of enamel paint samples had lead concentrations in excess of 600 ppm (Kumar and Gottesfeld, 2008). The study had also found that except one brand (ICI Dulux), enamel paint samples of all other brands, (Asian Paints, Kansai Nerolac, Goodlass Nerolac, Berger, Bombay Paints, Jenson & Nicholson, and Shalimar Paints) had lead concentrations of more than 600 ppm. All plastic samples were found to have lead concentrations of less than 25 ppm.

Results

As a part of this study, a total of 26 paint samples, which included four varnish samples, were analysed for total lead concentrations. Table 45 gives the description of paint samples collected from India. Table 46 shows the lead concentrations in the paint samples. Table 47 shows the statistical summary of lead concentrations of paint samples. Distribution of paint samples with more than 90 ppm or 600 ppm of lead concentrations is given in Table 48.

30. http://www.managementparadise.com/forums/archive/index.php/t-72869.html

Table 45. Description of paint samples from India

Sample no.	Paint brand	Date of purchase	Location of purchase	Date of manufacture	Volume of the paint samples	Price of the can in Rs.	Type of paint- plastic/enamel	Colour of the paints
IND 01	Kansai Nerolac	15/01/09	New Delhi	2008 Aug	1 l	237	Synthetic Enamel Hi-Gloss finish	P.O. Red
IND 02	Kansai Nerolac	15/01/09	New Delhi	2008 Aug	1 l	208	Synthetic Enamel Hi-Gloss finish	N. Bus Green
IND 03	Kansai Nerolac	15/01/09	New Delhi	2008 Oct	500 ml	112	Synthetic Enamel Hi-Gloss finish	Brill White
IND 04	Kansai Nerolac	15/01/09	New Delhi	2008 Sep	1 l	208	Synthetic Enamel Hi-Gloss finish	Oxford Blue
IND 05	ICI Dulux	15/01/09	New Delhi	2008 Sep	1 l	247	Premium Gloss Enamel paint	Bus Green
IND 06	ICI Dulux	15/01/09	New Delhi	2008 Mar	1 l	192	Premium Gloss Enamel paint	P.O. Red
IND 07	ICI Dulux	15/01/09	New Delhi	2008 Mar	500 ml	95.60	Premium Gloss Enamel paint	Golden Yellow
IND 08	ICI Dulux	15/01/09	New Delhi	2008 Oct	500 ml	116	Premium Gloss Enamel paint	Blazing white
IND 09	Berger	15/01/09	New Delhi	2008 Sep	500 ml	116.4	Luxol Hi-Gloss enamel	Bus Green
IND 10	Berger	15/01/09	New Delhi	2008 Mar	500 ml	88.8	Luxol Hi-Gloss enamel	Oxford Blue
IND 11	Berger	15/01/09	New Delhi	2008 Aug	500 ml	101.4	Luxol Hi-Gloss enamel	Snow White
IND 12	Berger	15/01/09	New Delhi	2008 Jun	500 ml	110.9	Luxol Hi-Gloss enamel	P.O. Red
IND 13	Berger	15/01/09	New Delhi	2008 May	500 ml	96.6	Luxol Hi-Gloss enamel	G Yellow
IND 14	Shalimar	15/01/09	New Delhi	2008 Sep	100 ml	31	Superlac Hi-gloss enamel	Golden Yellow
IND 15	Asian Paints	15/01/09	New Delhi	2008 Jul	100 ml	33	Premium Gloss Enamel	BLZ. White
IND 16	Asian Paints	15/01/09	New Delhi	2008 Oct	100 ml	35	Premium Gloss Enamel	P.O. Red
IND 17	Asian Paints	15/01/09	New Delhi	2008 Aug	100 ml	35	Premium Gloss Enamel	Oxford Blue
IND 18	Asian Paints	20/1/09	New Delhi	2008 Jul	200 ml	58	Premium Gloss Enamel	BLZ. White
IND 19	Asian Paints	20/1/09	New Delhi	2008 Jun	200 ml	58	Premium Gloss Enamel	Golden Yellow
IND 20	Asian Paints	20/1/09	New Delhi	2008 Jul	200 ml	59	Premium Gloss Enamel	P.O. Red
IND 21	Asian Paints	20/1/09	New Delhi	2008 Oct	200 ml	61	Premium Gloss Enamel	OX Blue
IND 22	Asian Paints	20/1/09	New Delhi	2008 May	100 ml	29	Premium Gloss Enamel	Bus Green
IND 23	Nerolac	26/2/09	New Delhi	2007-Oct	1 L	170	Full gloss hard drying synthetic clear varnish	
IND 24	Asian Paints	26/2/09	New Delhi	2008-Oct B. No. 174	500 ml	103	Clear sunthetic Enamel VA	
IND 25	Shalimar	26/2/09	New Delhi	2008-Feb B. No. SL9538	500 ml	80	Superlac Hi-gloss enamel Synthetic clear Varnish	
IND 26	Honda 29/110, Vishwas Nagar, Delhi-32	26/2/09	New Delhi		1 L	90	Pale Copal Varnish City Paints	

The major findings of the study of Indian paint samples are:

1. Some 26 enamel paint samples, which were analysed for total lead concentration, belonged to four brands, namely Kansai Nerolac, ICI Dulux, Berger, and Asian Paints, and one sample of Shalimar Paints.
2. While all enamel samples of Kansai Nerolac and ICI Dulux had lead concentrations lower than 90 ppm, some enamel samples of Asian Paints showed lead concentrations higher than 90 ppm.
3. All enamel samples of Berger Paints showed lead concentrations higher than 90 ppm.
4. None of the varnish sample showed lead concentrations higher than 90 ppm.
5. Out of 22 enamel samples, eight samples (36 percent) showed lead concentrations higher than 90 ppm. Overall 31 percent of samples showed lead concentrations higher than 90 ppm.
6. The arithmetic mean of lead concentrations of all samples was 7,966.3 ppm with the range varying from 0.6 ppm to 49,593 ppm. The arithmetic mean of enamel samples was 9,411 ppm with lead concentration ranging from 8.1 ppm to 49,593 ppm (five percent)
7. The median lead concentration for enamel samples was 25 ppm.
8. The highest concentration of lead, five percent, was found in a bus green colour enamel paint sample of Berger Paints.

Conclusions

The major conclusions of the study with respect to Indian Paints are:

1. Some 36 percent of enamel paint samples and 31 percent of total samples were found to have more than 90 ppm of lead.
2. None of the varnish samples were found to have lead contents exceeding 90 ppm.
3. ICI Dulux continues to have low lead concentrations in their enamel paints.
4. In the previous study done by Toxics Link (Kumar and Gottesfeld, 2008), 38 percent of all samples, including plastic and enamel types, contained lead at levels above 600 ppm. All enamel paint samples of Kansai Nerolac that were manufactured from 2003 to 2005 were found to have high lead concentrations

exceeding 600 ppm. In the present study, the enamel samples of the same brand, manufactured in the year 2008, have shown low lead concentrations, not exceeding 90 ppm.

5. Asian Paints continues to have lead concentration of more than 90 ppm in some of its enamel paints. Its average lead level is 7,966.4 ppm.
6. Enamel samples of Shalimar Paints and Berger Paints continue to have high lead concentrations.

Table 46. Lead concentrations in paint samples from India

Sample no.	Paint brand	Type of paint-plastic/ enamel	Colour of the paints	Pb concentration (in ppm)	Pb concentration (in %)
IND 01	Kansai Nerolac	Synthetic Enamel Hi-Gloss finish	P.O. Red	23	0.00228
IND 02	Kansai Nerolac	Synthetic Enamel Hi-Gloss finish	N. Bus Green	8.1	0.00081
IND 03	Kansai Nerolac	Synthetic Enamel Hi-Gloss finish	Brill White	11.1	0.00111
IND 04	Kansai Nerolac	Synthetic Enamel Hi-Gloss finish	Oxford Blue	12	0.00119
IND 05	ICI Dulux	Premium Gloss Enamel paint	Bus Green	8.1	0.00081
IND 06	ICI Dulux	Premium Gloss Enamel paint	P.O. Red	13.4	0.00134
IND 07	ICI Dulux	Premium Gloss Enamel paint	Golden Yellow	13	0.00128
IND 08	ICI Dulux	Premium Gloss Enamel paint	Blazing white	11	0.00106
IND 09	Berger	Luxol Hi-Gloss enamel	Bus Green	49,593	5
IND 10	Berger	Luxol Hi-Gloss enamel	Oxford Blue	22,274	2.2
IND 11	Berger	Luxol Hi-Gloss enamel	Snow White	15,206	1.5
IND 12	Berger	Luxol Hi-Gloss enamel	P.O. Red	20,520	2.0
IND 13	Berger	Luxol Hi-Gloss enamel	G Yellow	41,381.3	4.1
IND 14	Shalimar	Superlac Hi-gloss enamel	Golden Yellow	31,630.1	3.2
IND 15	Asian Paints	Premium Gloss Enamel	BLZ. White	13,626	1.4
IND 16	Asian Paints	Premium Gloss Enamel	P.O. Red	12,535	1.2
IND 17	Asian Paints	Premium Gloss Enamel	Oxford Blue	26.4	0.00264
IND 18	Asian Paints	Premium Gloss Enamel	BLZ. White	23	0.0023
IND 19	Asian Paints	Premium Gloss Enamel	Golden Yellow	13	0.00129
IND 20	Asian Paints	Premium Gloss Enamel	P.O. Red	66	0.00657
IND 21	Asian Paints	Premium Gloss Enamel	OX Blue	14	0.0014
IND 22	Asian Paints	Premium Gloss Enamel	Bus Green	28.1	0.00281
IND 23	Nerolac	Full gloss hard drying synthetic clear varnish	30.2	0.00302	
IND 24	Asian Paints	Clear sunthetic Enamel VA		0.6	0.00006
IND 25	Shalimar	Superlac Hi-gloss enamel Synthetic clear Varnish	52	0.0052	
IND 26	Honda	Pale Copal VarnishCity Paints		9	0.00087

Table 47. Statistical summary of lead concentrations in paint samples from India

	All samples	Enamel samples	Plastic samples
Arithmetic mean	7,966.3	9411	23
Standard deviation	14,161.2	14,984.4	23.1
Maximum concentration	49,593	49,593	52
Minimum concentration	0.6	8.1	0.6
Median	25	25	19.5

Table 48. Distribution of paint samples having lead concentrations more than 90/600 ppm

	No. of samples	No. of samples bearing more than 90 ppm of lead	No. of samples bearing more than 600 ppm of lead
Enamel paint samples	22	8 (36.4%)	8 (36.4%)
Varnish paint samples	4	0	0
All paint samples	26	8 (31%)	8 (31%)

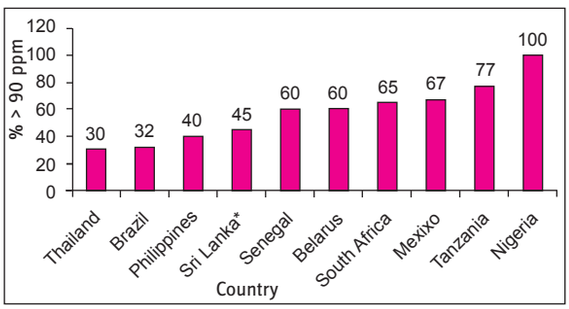
ALL SAMPLES

Table 49 shows the statistical summary of lead concentrations of all samples taken together, while the distribution of samples having lead concentrations greater than 90 ppm is given in Table 50. Table 51 depicts the lead concentration in the multinational brands, which were sampled from different source countries. There are four multinational paint brands for which samples were taken from more than one country, i.e., ICI Dulux, Sherwin Williams, Coral, and Asian Paints (Berger International in Thailand and Nigeria).

The major findings of the study are:

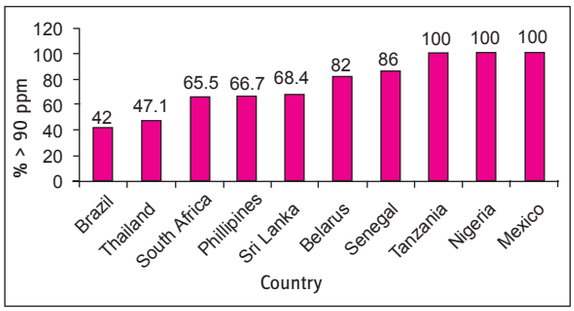
1. Overall 317 paint samples, which included 232 enamel samples, 78 plastic samples and seven varnish samples, were analyzed for lead concentrations.
2. Taking all samples together, 53 percent of samples were found to contain more than 90 ppm of lead, while 50 percent samples had lead concentrations of more than 600 ppm.
3. Some 68.5 percent of enamel samples had lead concentrations of more than 90 ppm, while 65 percent of enamel samples had lead concentrations of more than 600 ppm.
4. Only 10 percent of plastic paint samples had concentrations more than 90 ppm.
5. The overall average of lead concentrations was 18,220.3 ppm, while for enamel samples the average was 23,707.1 ppm. For plastic samples the average was 1,508.5 ppm.
6. Taking all samples together, 50 percent of samples had lead concentrations of more than 1,541.2 ppm. In the case of enamel samples, the median lead concentration was 3,914.2 ppm. In the case of plastic paint samples, the median lead concentration was nine ppm, which implied that 50 percent of plastic samples had lead concentrations of more than nine ppm.
7. Lead concentrations in samples ranged from 0.6 ppm to 505,716 ppm (51 percent).
8. Multinational paint brands, brands used in more than one country, showed variation in lead concentrations for samples sourced from different countries.
   (a) Of the 54 paint companies with products containing lead concentrations greater than 90 ppm, six were subsidiary companies of U.S. corporations. An additional eight paint companies were subsidiaries of European or Japanese companies.
   (b) At least three of the paint companies with products containing lead concentrations above 90 ppm have ISO 14001 Certification in the country in which the paints were purchased. An additional seven companies claim to adhere to ISO 14001.
   (c) In addition, 10 companies are subsidiary companies or market licensed brands of larger companies that are ISO 14001 certified.

Figure 1: Percentage of paint samples with more than 90 ppm of Lead



The above figure depicts percentage of paint samples bearing lead concentration in excess of 90 ppm. Out of the 10 countries from where paint samples were collected and analysed for total lead contents, two countries, Nigeria and Tanzania, showed very high percentage of samples containing more than 90 ppm of lead. Nigeria and Tanzania were followed by Mexico, South Africa, Belarus, and Senegal. Thailand had the lowest percent of paint samples containing lead in excess of 90 ppm.

Figure 2: Percentage of enamel paint samples with more than 90 ppm of lead



The figure above shows the percentage of enamel paint samples from the 10 countries containing more than 90 ppm of lead. It is evident that all enamel paint samples from Tanzania, Nigeria, and Mexico contained more than 90 ppm of lead, followed by Senegal (86 percent) and Belarus (82 percent). Brazil had the lowest percent of enamel paint samples containing more than 90 ppm of lead.

Conclusions

Major conclusions drawn from the study of paint samples from 10 countries around the globe are:

1. With a few exceptions, all plastic paint samples had low lead concentrations, often below 90 ppm
2. Majority of enamel paint samples had lead concentrations higher than 90 ppm or 600 ppm.
3. Presence of small amount of lead in a majority of plastic samples may be due to the impurities in the raw materials as significant percentage of samples had lead less than 20 ppm. Out of 317 samples of plastic paints, 101 samples (32 percent) had less than 20 ppm of lead.
4. There is a little difference in the percentage of samples having lead concentrations greater than 90 ppm and those with more than 600 ppm.
5. It is obvious that alternatives to lead in paints exist, as a number of brands from various countries show consistently low lead concentrations even in their enamel products. Cleaner substitutes for lead based pigments, like titanium dioxide, have been in use for some time now.
6. There is a general lack of awareness on the whole issue of lead in a majority of countries that participated in the present study.
7. In the absence of any mandatory standard for lead in paints, industries, big and small, are using lead without regard for its environmental and health impacts.

Table 49. Statistical measurements of lead concentrations of all samples

Countries	Samples	Arithmetic mean (ppm)	Maximum lead concentration (ppm)	Minimum lead concentration (ppm)	Median (ppm)
Sri Lanka	All	15,927	137,325	4	34.4
	Enamel	25,210	137,325	4	5,137.4
	Plastic	4,177	45,743.1	6	18
Philippines	All	17,016.4	189,163.5	0.6	40.2
	Enamel	28,354	189,163.5	3.4	3,199
	Plastic	11	40.2	0.6	9
Thailand	All	38,970.5	5,05716	0.6	2.2
	Enamel	61,893	5,05716	0.6	35
	Plastic	3	15	0.6	0.6
Tanzania	All	11,187.3	120,862.1	13	3,631.5
	Enamel	14,537	120,862.1	193.2	4,130.5
	Plastic	22.2	40.2	13	19
South Africa	All	19,862	195,289	3	11
	Enamel	19,862	195,289	3	11
	Plastic				
Nigeria	All	30,332.1	129,837	2,898.4	13,394.2
	Enamel	36,989.5	129,837	4,636	23,866
	Plastic	8,458	34,598	2,898.4	4,560
Senegal	All	4,108.1	29,717	0.6	1,615
	Enamel	5,866.4	29,717	0.6	2,771.4
	Plastic	5.5	29	0.6	3
Belarus	All	4091	59,387.2	0.6	571.
	Enamel	5,557.5	59,387.2	0.6	1,678
	Plastic	58.2	418.1	0.6	2
Mexico	All	34,575.3	163,812	0.6	30,204.2
	Enamel	51,860.1	163,812	22,758.5	
	Plastic	6	16	0.6	
Brazil	All	11,618.3	170,258.4	0.6	16.4
	Enamel	15,004.1	170,258.4	0.6	
	Plastic	10	14.4	0.6	
India	All	7,966.3	49,593	0.6	25
	Enamel	9,410.6	49,593	8.1	
	Plastic				
All	All	18,220.3	505,716	0.6	1,541.2
	Enamel	23,707.1	505,716	0.6	
	Plastic	1,508.4	45,743	0.6	

Table 50. Samples with lead concentrations more than 90 ppm or 600 ppm

Countries	Samples	Number of Samples	Percentage of samples bearing more than 90 ppm of lead	Percentage of samples bearing more than 600 ppm of lead
Sri Lanka	Total (including three varnish samples)	33	45	45
	Enamel	19	68	68
	Plastic	11	10	10
Philippines	Total	25	40	36
	Enamel	15	67	60
	Plastic	10	0	0
Thailand	Total	27	30	30
	Enamel	17	47	47
	Plastic	10	0	0
Tanzania	Total	26	77	73
	Enamel	20	100	95
	Plastic	6	0	0
South Africa	Total	29	65	62
	Enamel	29	65	62
	Plastic	0		
Nigeria	Total	30	100	100
	Enamel	23	100	100
	Plastic	7	100	100
Senegal	Total	30	60	53
	Enamel	21	86	76
	Plastic	9	0	0
Belarus	Total	30	60	50
	Enamel	22	82	68
	Plastic	8	0	0
Mexico	Total	30	67	67
	Enamel	20	100	100
	Plastic	10	0	0
Brazil	Total	31	32	28
	Enamel	24	42	37
	Plastic	7	0	0
India	Total			
	(including four	26	31	31
	varnish samples)			
	Enamel	22	36	36
	Plastic	0		
Total	Total	317	53	50
	Enamel	232	68.50	65
	Plastic	78	10.20	10.20

Table 51 Lead concentrations in the Multinational Paint Brands

Country	Multinational paint brands	Pb concentration (ppm)	Avg. Pb concentration (ppm)
Sri Lanka	CIC (ICI)	4	11.02
		4.1	
		8	
		9	
		8	
		10.2	
		21.2	
		14.3	
		20.4	
Philippines	Olympic	26,897*	
	Davies	ND	1,599.5
		3,199	
	Dutch Boy	189,163.3*	
Thailand	Berger (part of Asian Paints)	ND	22
		ND	
		ND	
		35	
		ND	
		8.5	
	Nippon	77,637	199,213.5
		505,716	
		14,287.4	
	Rust Oleum	43,042	133,666
		333,695	
		24,260	
Tanzania	Goldstar	19.3	3,219.2
		40.2	
		3,651	
		3,612.2	
		2,522	
		11,360	
		3,387	
		4,188	
		193.2	
	Sadolin	17.1	6,209.2
		2,219	
		26	
		2,670.2	
		3,914.2	
		31,581	
		4,073.1	
		9,841	
		1,541.2	
	Coral	18	161,722.1
		13	
		44,068.5	
		7,602	
		5,484	
		7,722	
		120,8621	
		20,248	
South Africa	Prominent	11.2	19,469.1
		54,778	
		51,338	
		8.1	
		8.4	
		10,671	
	Dulux	8.5	7.3
		7	
		3	
		10	
		7	

Table 51 Lead concentrations in the Multinational Paint Brands

Country	Multinational paint brands	Pb concentration (ppm)	Avg. Pb concentration (ppm)
		11	
		4.4	
Nigeria	Berger		
	(part of Asian Paints)	5,674.3	28,786.1
		62,800	
		66,224.1	
		6,004	
		3,228	
Senegal	Seigneurie	2135	15496
		29717	
		5966	
		24,164.4	
	National	5.3*	
Belarus	Nil		
Mexico	Comex	16	40,255.1
		10	
		0.6	
		163,812	
		27,171	
		50,521	
	Pintu sayer ICI	4.4	35,164.3
		6.2	
		70,531	
		73,968	
		36,224	
		30,252.1	
	Sherwin Williams	4	10,056
		7.3	
		30,156.4	
Brazil	Coral	12.4	8.5
		14	
		10	
		6	
		0.6	
		8.2	
	Sherwin Williams Novacor	53	25.2
		16.4	
		22	
		9.5	
	Renner	5,633.2	43,979
		12.4	
		170,258.4	
		12	
	3RM	4,935.5	4,416
		3,896.1	
India	Kansia Nerolac	23	17
		8.1	
		11.1	
		12	
		30.2	
	ICI Dulux	8.1	11.2
		13.4	
		12	
		11	
	Asian Paints	13,626	2926
		12,535	
		26.4	
		23	
		13	
		66	
		14	
		28.1	
		0.6	

* Indicates the Pb concentration of only one sample

Recommendations

Recommendations include the following:

Regulations

Lead use in paints is not regulated in developing countries. Health effects of lead are well recognized in most developed countries and many governments have taken stringent actions against it. Lead poisoning is the most serious environmental disease among children in developing countries. Therefore, it is imperative to enact mandatory national regulations for limiting lead concentrations in paints. The use of paints with lead, such as industrial paints, should be reduced to a minimum.

Monitoring

For effective implementation of the lead standards, a proper monitoring plan should be devised to ensure that the industry complies with the standards. The government agencies in collaboration with non-government organisations can play a key role in monitoring the presence of lead in paints. Before 2012, a follow-up paint sampling from these 10 countries could be conducted to monitor possible markets phase-out of lead in paint or market shifts.

Household Exposures

Only limiting the lead contents in new paints would not be enough. A programme has to be developed to determine the sources of lead contamination of household dust, which is a prime exposure route for children.

Legacy Issues

The paint industry and health care professionals should set guidelines to reduce exposure to lead while removing old paints or recoating with new ones.

Public awarenes

Public awareness on lead toxicity is extremely low in developing countries. A mass campaign should be launched to educate and make people aware (especially painters, architects, and the paint industry) of the hazards associated with lead. Such a campaign should comprise programmes for an aggressive implementation of preventive measures. Support of important stakeholders, like the governments, industry, public health professionals, public interest groups, etc., must be elicited to prevent lead poisoning.

Labelling

The paint industry should include a lead-free paint symbol on products, as well as guidelines for use including for home decorative or industrial and commercial.

Partnerships

Concerted efforts should be made to evolve partnerships among the civil society organisations and other stakeholders in the developing region of the world in order to ensure that lead is eventually eliminated from paints worldwide. Also a coordinated and organised network of NGOs and civil society organisations will help in achieving the targets.

Global Efforts

The Global Partnership on Lead In Paints formed under UNEP and WHO at the May 2009 ICCM2 is an example of global efforts. All stakeholders, particularly national governments and industry, must support this effort. Further, industry through its global outreach and partnerships of various sorts must work to eradicate this problem.

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Appendix I

IFCS Resolution for Eliminating Lead in Paints

The following resolution was adopted by the delegates of the IFCS, Forum VI, at its meeting in Dakar, Senegal, 15-19 September, 2008:

- Recognise that lead in paints poses serious risks to human health and the environment, especially to the health of children
- Take into account that most children exposed to lead live in developing countries and countries with economies in transition
- Recognise that household paints sold in developing countries contain lead
- Aware that safer and affordable alternatives for lead in paints already exist
- Affirm that many consumers, especially in developing countries, are unaware of the dangers posed by lead in paints
- WSSD POI paragraph 56 (b) supports the phasing out of lead in gasoline
- Applaud the important work of the Partnership for Clean Fuels and Vehicles (PCFV) in its implementation of WSSD POI paragraph 56 (b)
- Acknowledge that much progress has been made towards achieving a global phase out of lead in automotive fuels
- Recognise that the WSSD POI, in paragraph 57, calls for the phasing out of lead in paints and other sources of human exposure. It calls for work to prevent children's exposure to lead, and to strengthen monitoring and surveillance efforts and the treatment of lead poisoning.

The meeting decided that a global partnership to promote the implementation of the measures contained in WSSD POI paragraph 57 is essential, especially for developing countries and countries with economies in transition.

Support the phase out of lead in paints

The Forum Standing Committee suggested setting up an ad-hoc Working Group to prepare a draft Terms of Reference, to be submitted to the ICCM-2, for a global partnership to consider taking a decision to support the concerted action in the implementation of the measures contained in WSSD POI paragraph 57.

It suggested a role for the governing bodies of the relevant intergovernmental organisations, including UNEP, WHO, and other IGOs to support and participate in such an initiative.

It Invited the UNEP Governing Council at its 25th Session to consider providing support for such concerted action.

Appendix II

Sampling Protocol

This study is designed for analysing lead concentration in household paints. Paints can broadly be classified as industrial and decorative paints. Industrial paints are automotive and marine paints and those used for specific purposes. Decorative paints are those used to paint houses. Decorative paints are further classified on the basis of solvents used as water-based plastic or latex paints and oil-based enamel paints. Water-based paints are used to paint walls of houses while oil-based paints are primarily meant for coating wooden surfaces, iron grills etc. However, it must be kept in mind that paints are often found to be used differently from their intended purposes.

The total number of decorative paint samples meant for household use that should be purchased is 25 to 30. Out of which 10 should be water-based plastic paints, while the rest should be oil-based enamel paints. Samples may include the following colours: yellow, orange, blue, green, red, black, and white. One may choose different shades of these colours. Samples should consist of all or most of the popular brands in the country, including those from unorganised small-scale industrial sectors. The total number of samples from each country must not exceed 30. In case there are more than four popular brands, samples should be so chosen that together they make for more than 80 percent of market share. The above-mentioned seven colours may be chosen from across the brands. Samples should be purchased in lowest available amount, such as 25/50 ml cans. Sometimes, the smallest packaging of plastic paints is of one litre. The cans should not be tampered with, including the seal and labelling and other information. After being purchased, the samples should be given a unique number using a permanent marker and transparent adhesive tape should be stuck on it so that the marking does not fade during the can's shipment.

All relevant information about the samples should be noted down as per the attached sample catalogue form. Samples with their seals and all labelling information should be couriered to Toxics Link office along with a copy of sample catalogue.