Study of Lead in Paints in Nepal

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SSNC
Toxics Link
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CEPHED would like to acknowledge the contribution of various stakeholders: government institutions such as Department of Custom, Mr. Ram Krishna Regmi for their help by making published information and publications available to us on import and export of heavy metals including mercury, lead and cadmium; individual expert; paint dealers and retailers; Kathmandu Metropolitan City and Solid Waste Management and Resource Mobilization Center to allow us to take leachate samples form Sisdol Landfill Site; hospitals and academic institutions; laboratory Delhi Test House, New Delhi, India, for testing lead in paints, dolls and ladies hand bag samples. ENPHO for analyze mercury in leachet sample from landfill site.

About Center For Public Health and Environmental Development (CEPHED)

Center For Public Health and Environmental Development (CEPHED) is an environmental NGO established in the year 2004, by and through the contribution, coordination from a group of activist and experienced people from medical, environment and public health sectors. CEPHED focus is to serve Nepalese people and communities in the field of public health and environment. CEPHED has adopted the vision of bridging people with the science and technology for healthy leaving and environmental safety and taken a mission to act as bridging forum between people with science and technology to make access new scientific knowledge, technology and safety measures of environment and public health sector through research, coordination, capacity building and policy dialogue, etc.

CEPHED is working with and also willing to work with group and organization around the country with an understanding that this will help to bring the experience from the ground to the concerned authorities' notice that leads to more meaningful and sustainable solutions. From past five years CEPHED has been engaged mainly on research, awareness raising, capacity building, policy influence especially in the area of chemical management, pesticide, obsolete pesticide, healthcare waste, Persistent Organic Pollutants (POPs), heavy metals like mercury, lead and cadmium. With its growing interest and engagement with various environmental issues of national and international importance, it became an active participating organization of several global networks working in the area of public health, environment and toxic free future. CEPHED is member organization of Toxic Link, International POPs Elimination Network (IPEN), Global Alliance for Incinerator Alternatives (GAIA), Healthcare Without Harm (HCWH) Collaborative on Health and The Environment (CHE) and Zero Mercury Working Group (ZMWG).

EXECUTIVE SUMMARY

Use of lead is worldwide and is continuously used in different brand and types of decorative and industrial paints. Paint is also an important source of lead exposure, and most vulnerable group is children of 0-6 age group.

A study conducted by Toxics Link, India, to determine lead in decorative paints in ten countries, results the high content of lead in paints of our neighboring countries such as India and Sri Lanka, it has been felt necessary to test the level of lead content in the decorative paints available in Nepalese market. This is done in order to initiate campaign to phase out lead from paint as well as raise awareness among the people and other end users about lead menace and its adverse impact on human health.

A total of 24 paint samples of different international, multinational and national brands of different types, such as distemper, emulsion, enamel, varnish and touch wood were collected from Nepalese markets and prepared glass slides for drying the paint. Dried sample were sent to the laboratory for lead analysis.

The laboratory analysis results showed the presence of lead in all samples in varying concentration. The range of lead concentration was varies from 3.98 ppm to 73966.4 ppm The average lead concentration in all 24 paint samples was found to be 6574.71 ppm which is about 73 times higher than the US standard i.e., 90 ppm for lead in paint.

Both distemper samples contained least amount of lead. All seven emulsion paints sample contained less quantity of lead. The average lead content of all emulsion samples was 10.81 ppm.

Total 84.6 percent (11 out of 13) of enamel paint sample were found to be contained high amount of lead which was ranges from 5.49 ppm to 73966.4 ppm. This is about 822 times higher than US standard i.e., 90 ppm for lead in paints. The average lead content of all 13 enamel sample was 12113.92 ppm which is about 134.6 times higher than the US standard of 90 ppm for lead in paints.

All NS marked paints found very high level of lead. Lead in NS marked Enamel paints ranges from 2070.99 ppm (23 times higher than standard) to 73966.4 ppm (822 times higher than US standard). The average value of lead on NS marked enamel paint samples was 14345.54 ppm which is 159.4 times higher than US standard of 90 ppm for lead in paints.

The study is indicative of the fact that Nepal is still a thriving ground for paint industry to dump leaded paints. International brands such as Berger and Asian Paints still take refuge in the lax lead standards as shown by high amount of lead present in their enamel brands. Other enamel brands such as Sangrila, Gauri, Shawallow, Nepal Shalimar and Always also showed quite high (~ 1800 ppm to over 55,000 ppm) amount of lead.

The only solace though is that Nerolac across types of paints exhibit lead content much below the international threshold standard.

However, the overall results are alarming as about half of the samples tested exhibited quite high amount of lead in them in comparison to the best possible standards (90ppm, CPSC, USA). The serious issue is brands like Berger, Asian Paints and other brands sell readily in the market and thus posing health threat to a large number of residents, especially children in Nepal.

It is therefore urgent that Government of Nepal thinks about regulating deadly lead in decorative paints and making the enforcement much stricter. By that time, it is imperative for the paint industries to be responsible and call back leaded paints and impose voluntary moratorium on using lead in their products in future.

The study is also indicative and it is recommended that regulatory authorities and policy makers jointly ascertain the lead levels in other products of direct household utility and improve standards.

The ultimate aim is to phase out lead from every possible product in close vicinity of us citizens and progress towards chemically safer regime.

CONTENTS

1.0 Introduction

The World Health Organization (*WHO*) has recognized lead as prime toxic. It impacts over 40 million children worldwide, over 97 percent of whom live in developing countries. Lead is a metal with no known biological benefit to humans (*WHO*). Blood lead levels as low as 5µg/dL in children were found to be associated with reduced academic performance, **Hence medically there is no safe level of blood lead level.** 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 fetus.

Lead causes nervous system damage, hearing loss, stunted growth, and delayed development. It can cause kidney damage and affects every organ system of the body. It also dangerous to adults, and can cause reproductive problems for both men and women.

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.

As early as 1935, countries in Europe had banned the use of lead in household paints, while the United States did so in 1971.The federal Consumer Products Safety Commission (CPSC) has issued recalls for many different kinds of products in 2007, 2008 and 2009 that pose a risk for serious injury or death.

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.

However, in most developing countries including Nepal, the governments have failed to perceive the threat lead paints can pose to our future generations.

In this connection Center for Public Health and Environmental Development (CEPHED) has taken initiative to address the chemical safety and management issues in Nepal and currently implementing two programs: Research, Capacity Building and Awareness Rising for Heavy Metals (Hg, Pb, Cd) in Nepal and Participating in regional (South Asia) campaign on lead-free paints and generating baseline information on heavy metals for Nepal. Under which the lead in paint, cadmium in toxic toys and mercury in health care facility and other uses are aimed to be addressed and studied.

The study is a part of larger camping on chemicals safety in South Asia technically and financially supported by Toxics Link, India and Swedish Society for Nature Conservation, (SSNC) Sweden.

2.0 Rationale of the Study

Several recent studies have indicated that the presence of lead in high concentration in new decorative enamel paints available for purchase by the public in almost all neighboring countries of Nepal. Most of the paints used in Nepal are producing within the country and some International brand paints are imported from India, Thailand, China and U.S.A. Considering the dangerous affects of lead on human health several countries enacted laws to regulate the lead

concentration in paints. As early as 1935, countries in Europe had banned the use of lead in household paints, while the United States did so in 1971.The federal Consumer Products Safety Commission (CPSC) has issued recalls for many different kinds of products in 2007, 2008 and 2009 that pose a risk for serious injury or death. USA recently revised the maximum allowable concentration of lead in new paints from 600 ppm to 90 ppm.

Phasing out of the use of lead in gasoline has substantially reduced human exposure. Lead in paint, however, remains one of the largest sources of exposure globally. Exposure can occur during manufacture and use of lead-containing paint, during renovation, repair and demolition activities, and from the dust created during normal wear of lead paint. Children, particularly younger children, may also ingest lead paint chips from flaking walls, windows and doors.

The International Conference on Chemicals Management at its second session (ICCM-2, Geneva, 11-15 May 2009) endorsed the establishment of a global partnership to promote the phase-out of the use of lead in paint. The United Nations Environment Programme (UNEP) and the World Health Organization (WHO) along with the other Global Alliance has mandated phase out lead from paints.

2.1 Objective of Study

The present study ought to determine lead levels in paints available in Nepal and initiate a campaign in favour of lead free paints. It is also to spread awareness among various stakeholders and initiate policy dialogue on chemicals safety. The intermediate goal however is to prevent Nepalese children's exposure to lead via paints containing lead, and to minimize occupational exposures to lead in paint. The broad objective is to phase out the manufacture and sale of paints containing lead and eventually to eliminate the risks from such paints.

3.0 Import and Usage Policy of Heavy Metals and their Compound in Nepal

Heavy metals including Mercury, Lead and Cadmium are not extracted in Nepal but lead has good potential deposit in *Ganesh Himal* in Northern Himalayan region of Nepal. All these heavy metals are imported from other countries in different quantity, form and under different trade provisions in Nepal.

The Department of Custom is the responsible body for regulating the import of all kinds of goods including heavy metals in elemental forms, compound forms and also the product forms in Nepal. They allow all dealers, wholesalers or even retailers to import these heavy metals or their compounds or containing material freely. Department of Custom, Government of Nepal categories Lead and its compound as a hazardous chemical but there is no any specific laws and policy regulating the import of these chemical till date. Neither any one requires any permission/ license to import, sale, distribute and even use of the lead. However, the business community who import of azo-dying need to produce the certificate that entails about not containing any hazardous chemicals at the point of entry. **Unfortunately, Nepal does not have any testing and monitoring facilities in place and hence need to rely on the company's certification.**

Department of Nepal Bureau of Standards and Meterology (NBSM),Government of Nepal provides the Nepal Standard (NS) mark to some paints industries not having any specification limit of lead and monitoring system. Therefore it is an urgent need spread awareness in the masses about the toxic affect of lead and develop regulatory mechanism in the country.

The details of the legal requirements to import of these heavy metals and their compounds are listed in below tables.

Table 1: Legal Provision of the Import of the Heavy Metal Lead

S.No.	Chemicals	Category	Permission required or not
1	Lead	Hazardous	Not required
2	Lead monoxide	Hazardous	Not required
3	Lead oxide	Hazardous	Not required
4	Lead chloride oxide	Hazardous	Not required
5	Lead chloride hydroxide	Hazardous	Not required
6	Lead Iodide	Hazardous	Not required
7	Lead iodide oxide	Hazardous	Not required
8	Lead Sulphide	Hazardous	Not required
9	Lead sulphate	Hazardous	Not required
10	Lead thiosulphate	Hazardous	Not required
11	Lead perchlorate	Hazardous	Not required
12	Lead carbonate	Hazardous	Not required
13	Lead Silicate	Hazardous	Not required
14	Lead Borate	Hazardous	Not required
15	Lead Aluminate	Hazardous	Not required
16	Lead Chromate	Hazardous	Not required
17	Lead Molybdate	Hazardous	Not required
18	Lead Titanate	Hazardous	Not required
19	Lead Antimonate	Hazardous	Not required
20	Lead Arsenite	Hazardous	Not required
21	Lead Arsenate	Hazardous	Not required
22	Lead Azide	Hazardous	Not required
23	Lead Acetate	Hazardous	Not required
24	Lead stearate	Hazardous	Not required

Source: Department of Custom, Government of Nepal, 2007

NOTE: The Department of Custom has made the provision of producing certificate of not containing any hazardous AZO DYIENG while importing coloring material at the point of entry. However we do not have any testing facilities for such certification within the country that certify the products.

Table 2: Legal Provision of the Import of the Heavy Metal Cadmium.

S.No.	Chemicals	Category	Permission required or not
1	Cadmium Oxide	Hazardous	Not Required
2	Cadmium Hydroxide	Hazardous	Not Required
3	Cadmium Sulphide	Hazardous	Not Required
4	Cadmium Sulphate	Hazardous	Not Required
5	Cadmium Nitrate	Hazardous	Not Required
6	Cadmium Borate	Hazardous	Not Required
7	Cadmium Potassium Iodide	Hazardous	Not Required
8	Cadmium Amalgam	Hazardous	Not Required

Source: Department of Custom, Government of Nepal, 2007

Table 3: Legal Provision of the Import of the Heavy Metal Mercury

S.No.	Chemicals	Category	Permission required or not
1	Mercury	Hazardous	Not required
2	Mercuric Oxide	Hazardous	Not required
3	Mercuric Chloride	Hazardous	Not required
4	Mercurous Chloride	Hazardous	Not required
5	Mercuric Iodide	Hazardous	Not required
6	Mercurous Iodide	Hazardous	Not required
7	Mercuric Sulphide	Hazardous	Not required
8	Mercuric Sulphate	Hazardous	Not required
9	Mercurous Sulphate	Hazardous	Not required
10	Mercuric Nitrte	Hazardous	Not required
11	Mercurous Nitrate	Hazardous	Not required
12	Mercuric Cynide	Hazardous	Not required
13	Mercuric Cynide Oxide	Hazardous	Not required
14	Mercuric Fluminate	Hazardous	Not required
15	Mercuric Thiocynate	Hazardous	Not required
16	Phenyl Mercury acetate	Hazardous	Not required
Source: Department of Custom, Government of Nepal 2007			

Though Department of Custom had adopted global harmonization code, they are not able to entirely adopt the data entry and documentation according to harmonizing code in all its branch offices in the bordering area. Thus it is very difficult to compare the data from one year to another year to access the trends of import. Sometimes the data entered has been clumped together in some year, whereas entered separately in another years classified according to harmonizing code. Different sets of data were obtained from the custom department and also published books were thoroughly reviewed. The best estimates based on the available data were done.

3.1 International Laws and Standard of 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 Labor Conference of the League of Nations recommended the banning of white lead for interior use (AJPH, 1923).

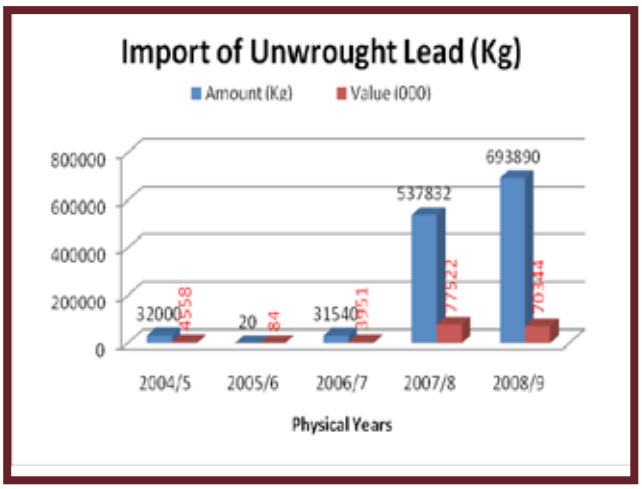
In 2008, the U.S. Congress lowered the standard for lead in residential paints and paints on products. The United States recently revised the maximum allowable concentration of lead in new paints from 600 ppm to 90ppm.

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). Recently, Bagladesh and Sri Lanka are in the process of formulating standards of lead in paints & Plastic toys.

4.0 Import of Heavy Metal (Lead) in Nepal

Lead is being imported in the county in different forms like refined and unwrought lead excluding refined and antimony. In addition, lead is also being imported as unwrought lead containing antimony and other forms of lead bars, rods, profiles, wires, lead sheet, strips, foils, plates, powders, flakes, lead tubes, pipes, pipe fittings etc.

Refined lead and other forms of lead are being imported in Nepal from India, Malaysia, Taiwan, South Korea, Singapore, Austria, China, Germany and overseas under different mode of business such as DPR and bank guarantee etc (Dept. of Custom 2006/7).



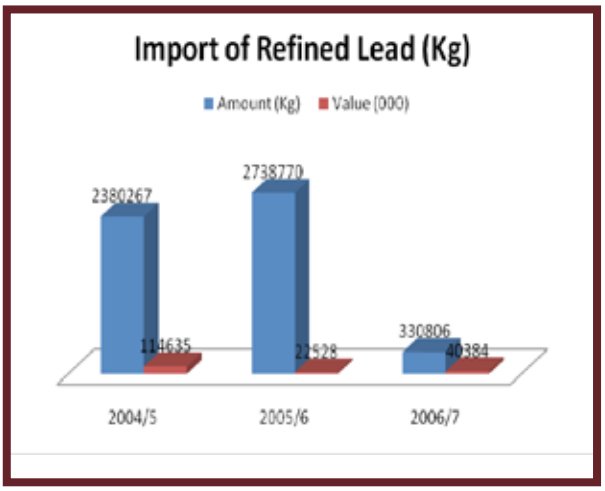


Table 4: Import of Lead in Nepal

Import of Other Form of Lead	Countries	Year 2005/6	Value (000)	Year 2006/7	Value (000)
Unwrought lead containing antimony as the principle other element	India			148 kg	10
do	Malaysia			59495 kg	6066
do	Taiwan			23453 kg	3424
Lead bars, rods, profiles and wire	India			906 kg	69
Lead sheets, strip and foil, nes	India			332 kg	22
Lead plates, lead sheets, strip and foil, nes	India			842 kg	74
Powders and flakes of lead	India			20 kg	0
Lead tubes, pipes and tube or pipe fittings	India			237 kg	20
Other articles of lead, nes	India	2709 kg	254	620 kg	24

Source: Dept. of Custom, 2006/7

5.0 Use of Lead

Lead is used mainly in Lead-acid battery extensively as a car batteries, Coloring element in ceramic glazes, polyvinyl chloride (PVC) plastic, projectile for firearms and fishing sinkers, sound deadening layer, shielding in X-ray rooms, electrodes in the process of electrolysis. Lead is also used in soldering for electronics, making statues and sculptures, paints, component of toys, bullets for slings, preservative for food and drink. Lead-based semiconductors, such as lead telluride, lead selenide and lead antimonide are finding applications in photovoltaic (solar energy) cells and infrared detectors. Lead is widely used as a base metal of organ pipes, mixed with tin to control the tone of the pipe. Lead, in the form of strips, or tape, is used for the customization of tennis

rackets. Lead has many uses in the construction industry and also added to brass to reduce machine tool wear.

SYMPTOM AND SIGNS, BLOOD LEAD LEVEL

- For each 1 µg/dl increase, the IQ decrease is 0.25 to 0.5
- For each 10 µg/ DL increase, height decreases by 1 cm
- BLL > 45 µg/dl, abdominal pain(coilic, porphyria-like)

6.0 Health Impacts of Lead

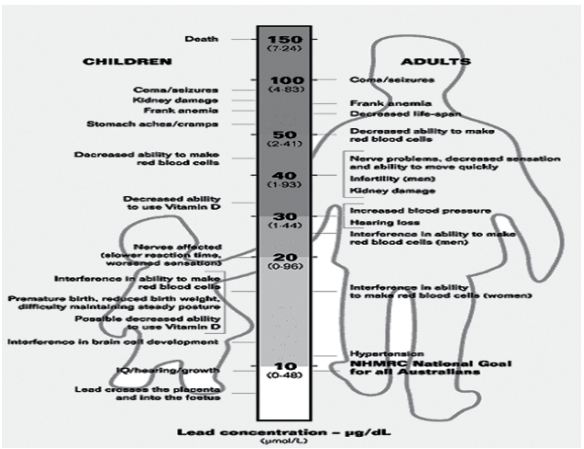
Lead is a poisonous metal that can damage nervous connections (especially in young children) and cause blood and brain disorders. Lead poisoning typically results from ingestion of food or water contaminated with lead but may also occur after accidental ingestion of contaminated soil, dust, or lead based paint.

Symptoms associated with Blood Lead Levels in Children and Adult

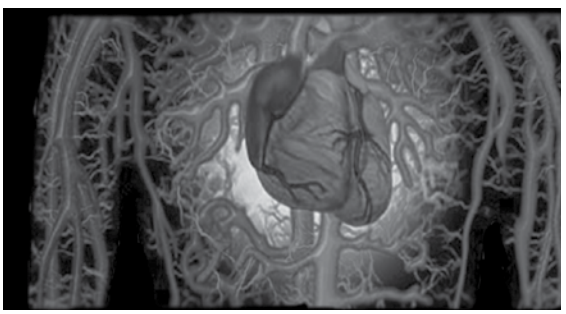
Effect in Children	Pb-Blood level (µg/dl)	Effects in Adults
Mortality	150	
	100	Encephalopathy
Encephalopathy		
Nephropathy		
Anaemia		
Abdominal Pain		
	50	Decease in haemoglobin synthesis
Decrease in haemoglobin Synthesis	40	Infertility (men) Nephropathy
Diminished Vitamin D Metabolism	30	Hearing loss
	20	
	10	Hypertension
Hearing loss		Miscarriage
Reduced growth		

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

Health Impacts of LEAD



Long-term exposure to lead or its salts (especially soluble salts or the strong oxidant PbO2) can cause nephropathy, and colic-like abdominal pains. It may also cause weakness in fingers, wrists, or ankles. Lead exposure also causes small increases in blood pressure, particularly in middle-aged and older people and can cause anemia. Exposure to high lead levels can severely damage the brain and kidneys in adults or children and ultimately cause death.



In pregnant women, high levels of exposure to lead may cause miscarriage. Chronic, high-level exposure in men can damage the organs responsible for sperm production. Lead is a heavy metal that is toxic at very low exposure levels and has acute and chronic effects on human health.

It is a multi-organ system toxicant that can cause neurological, cardiovascular, renal, gastrointestinal, hematological and reproductive effects. Organo-lead compounds, such as tri-alkyl-lead and tetra-alkyl-lead compounds, are more toxic than inorganic forms of lead. Childhood lead exposure adversely affects cognitive and behavioral development. **No level of lead in blood is considered safe.**

6.1 Exposure Pathways

Exposure to lead occurs mainly through inhalation of dust and air and ingestion of foodstuffs, water and dust and dermal contact. Most exposure occurs through ingestion or inhalation. Lead exposure is a global issue as lead mining and lead smelting are common in many countries. Most countries have stopped using lead-containing gasoline by 2007.

Lead paint is the major source of lead exposure for children. As lead paint deteriorates, it peels, pulverizes and then enters into the body through hand-to-mouth contacts or through contaminated food, water or alcohol.

Ingesting certain home remedy medicines may also expose people to lead or lead compounds. Lead can be ingested through fruits and vegetables contaminated by the high levels of lead in the soils. Soil is contaminated due to the lead in pipes, lead dust from old paints and residual lead from gasoline with lead that was used before.

Table 5. Symptom and Effect of Lead Poisoning

Symptoms of Lead Poisoning	Effect of Lead Poisoning	Precaution
• Headache • Irritability • Abdominal Pain • Vomiting • Anemia • Weight loss • Poor attention span • Noticeable learning difficulties • Slowed Speech development • Hyperactivity	• Reading and learning disability • Speech and Language handicaps • Lowered IQ • Neurological Deficit • Behavioral Problem • Mental Retardation • Kidney disease • Heart disease • Stroke • Death	• Remove and cover all known lead hazards in and around in your home • Frequent hand washing • Damp dusting and moving a floor • Increase Iron, Calcium and Vitamins C food supplement to help your children to fight Pb poisoning.
Source: Attorney Gorden` S Johnson, Jr. (http:// lead-info.com)		

Inhalation is the second major pathway of exposure, especially for workers in lead-related occupations. Almost all inhaled lead is absorbed into the body, the rate is 20-70% for ingested lead; children absorb more than adults.

Dermal exposure may be significant for a narrow category of people working with organic lead compounds, but is of little concern for general population. The rate of skin absorption is also low for inorganic lead. Lead remains in the body for long periods in mineralizing tissue (i.e., teeth and bones). The stored lead may be released into the bloodstream, especially in times of calcium stress (e.g., pregnancy, lactation, osteoporosis), or calcium deficiency, and is of particular risk to the developing fetus.

The primary source of lead exposure among children is from **lead-based paints** and lead-contaminated dust and soil that are found in and around old, deteriorating buildings. Lead is added to paints to speed drying, increase durability, retain a fresh appearance, and resist moisture that causes corrosion.

Decorative paints are usually more practiced in our surrounding environment like building and furniture as well as different kinds of colorful material. 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/molybadates (ILZSG, 2004). Lead carbonate was historically used for wall paint in households and still is a significant source of lead exposure. Lead chromates, molybadates and sulphates are also widely used. They are inorganic pigments for bright and opaque yellow, red and orange colors in paints. There are, however, readily available substitute for all these lead compounds.

6.2 Substitute of Lead in Paints

Paint manufacturers replaced white lead with a less toxic substitute, titanium white (based on the pigment titanium dioxide) which was first used in paints in the 19th century. The titanium white used in most paints today is often coated with silicon or aluminum oxides for better durability. Titanium white has been criticized for leading to "chalkiness" when mixed with colors, and the possibility of decreased permanence of organic pigments mixed with it due to its high refractive index.

Another additive considered as Zinc white which is less opaque than titanium white, and is often seen as a superior white for lightening other pigments in mixtures. Although zinc white is the standard white for the watercolor medium it has long been of debatable permanence in oils. Critics of the pigment argue that its use leads to excessive cracking and delaminating, even when very sparingly mixed with other pigments such as lead white.

7.0 Lead in Paint Study

7.1 Highlights from Global Paint Study Conducted by Toxics Link, India and IPEN in 2009

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 color. Lead has been recognized as prime toxic at household level.

Lead based paint in older houses has long been associated with elevated blood lead in children residing.

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, 19991; Clark et al, 20062; Adebamowo et al, 20073; Kumar and Gottesfeld, 20084). 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. 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 remolding.

A total of 317 paint samples (India, Sri Lanka , Philippines , Thailand, Tanzania, South Africa , Nigeria, Senegal, Belarus , Mexico , Brazil), were further processed for lab analysis. Samples were analyzed 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)

- 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.
- 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.

- Only 10 percent of plastic paint samples had concentrations more than 90 ppm.
- 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.
- 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.

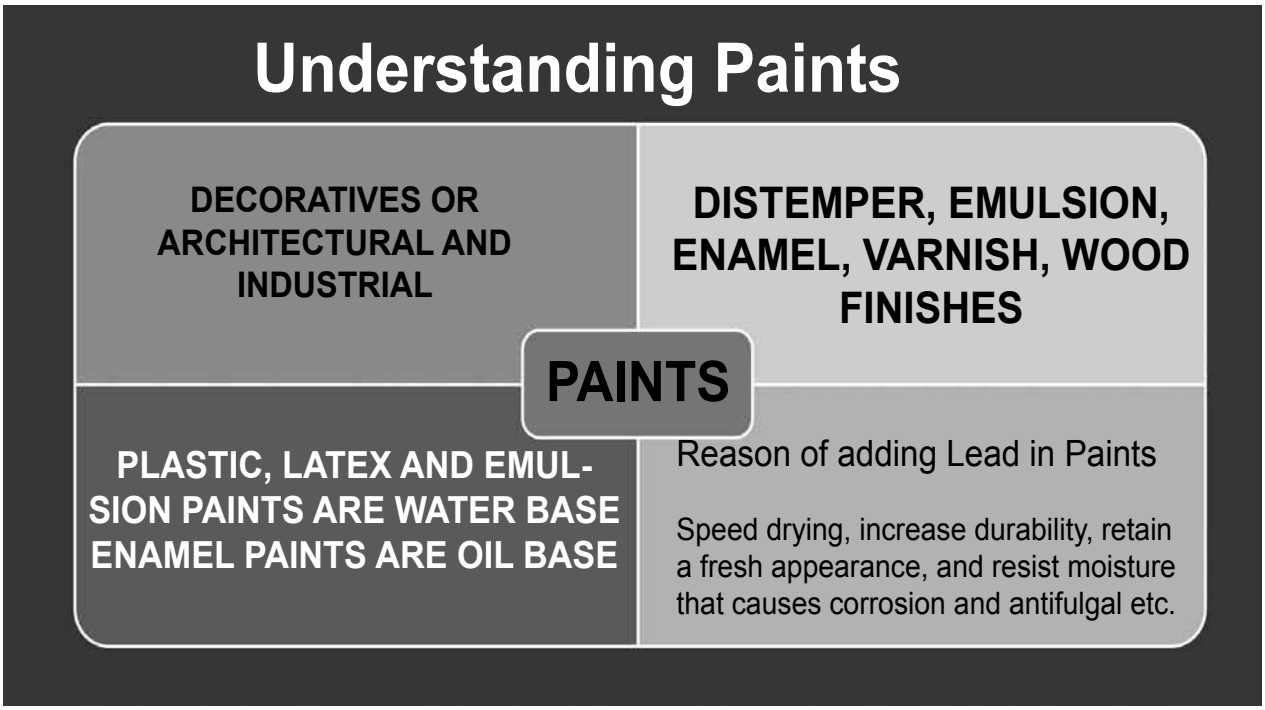
7.2 Lead in Decorative Paints in Nepal

Details literature review and market survey has been made to understand the availability of paints in the market as well as types of industries and their products are being marketed in Nepal. While doing so, dealers and retailers have also been asked about their knowledge on the issues of lead in paints. Most of the dealers and retailers did not have any knowledge about the lead in paints, most of them have not even heard of the issue. However, some of the dealers who are engaged in paint business have been found to be having fair understanding of the lead issue.

To carry out the lead in paint study, following activities were performed.

- Market Survey
- Meeting and Discussion with Dealer and Retailers.
- Communication and Advocacy with paints industries.
- Desktop study (literatures, publications and so on)
- Sample designing and Sampling
- Sample preparation (Dry Samples)
- Laboratory analysis and Result Analysis
- Reporting and Releasing of preliminary finding

One can understand the types of paints being imported, sold, distributed and used in Nepal (box below)



8.0 Materials and Methods

8.1 Sampling Design

Sampling from all the brands (international, multinational and national) and types of paints such as distemper, emulsion, enamel and varnish were obtained from the Nepalese markets. As some of the international brand have labeling of Lead Free (for example on Nerolac) and some of the Nepalese products have awarded Nepal Standard (NS) quality standards have been also included into the samplings.

Table 6. Sampling Design

Brand Type	National	Multinational	International	Trade Mark of out of Total	Total
Distemper		1	1		2
Emulsion	2	2	3		7
Enamel	8	2	3	**7 NS Mark**	13
Varnish		1			1
Touch Wood		1			1
Lead Free out of Total			**3 Lead Free**		
Total	10	7	7		24

All paint samples

NS Mark paint samples

Similarly some five doll samples of plastic toy have been also collected from market and one ladies hand bag were collected and sent them to analyze for lead in them.

Table 7: Toy and Ladies hand bag Samples

S.No.	Description of Samples	Colour
1	Doll Girl	Pink and Red
2	Cat Doll	Orange
3	Teether	Transparent
4	Ball	Red
5	Frog Doll	Green
6	Ladies Hand bag	Red

8.2 Study Objectives

- To determine the total lead (Pb) concentration in new decorative paints available in Nepalese markets.
- To understand the different dimensions of lead in paint issues – toxicity, standards, labelling etc.
- To spread awareness about lead in paints and initiating policy dialogue on it
- To join hand with global partners on the campaign for eliminating lead in paints and set the stage to phase out lead from other products.

8.3 Sampling Procedure

All together 24 paints samples were collected from the markets of Kathmandu Valley, Nepal. There are different brand of paints e.g., International, Multinational and Nepalese brand which are heavily produced, sale, marketed and used as decorative paints and industrial paints in Nepal. There is general absence of proper labelling of paints marketed in the country except international brand.

Samples were obtained from different dealers & retailers on the basis of predesigned sampling strategy.

8.4 Dry Sample Preparation for the Lab Tests

Wet paint samples were applied on to individual clean glass plates (one sq. feet) using different brushes for each sample to avoid any cross contamination. Samples, thus applied were left to dry for a minimum of 72 hours.

- After drying samples were scraped off from glass surfaces using sharp and clean knives. Same knife was not used again for other samples to avoid any contamination.
- 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 further analysis. Delhi Test House (DTH) is accredited by National Accreditation Board for Testing and Calibration Laboratories (NABL).

8.5 Laboratory Methods

Following steps and methods were applied in laboratory:

- Scraped samples were 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.
- 0.3 g of each paint samples was taken on glass slide and placed in an oven at 120^{O}C for 2 hours to remove any moisture.
- 0.1 g of each of the dried paint samples was then accurately weighed into a closed Teflon vessel and then digested/ extracted.
- Standards were also prepared similarly.

8.6 Digestion Procedures & Laboratory Analysis

Digestion of samples were completed with following steps:

- 3 ml. of concentrated HNO_3 were added into Teflon vessels and then placed in an oven at 150^{0}C for 1 hour.
- Vessels were then allowed to cool to room temperature.
- Solution along with any precipitate was transferred to a 25 ml volumetric flask.
- Flask was diluted to volume with deionized water and mixed well. Precipitate if any was allowed to settle and then the solution was filtered.
- Sample blanks were also prepared similarly.

Samples were analysed as 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 (US EPA, 2001)

Digested samples were then analyzed for total lead (Pb) in AAS fitted with 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.

9.0 Results

Laboratory analysis report shown that out of 13 enamel samples,11 samples contain high concentration of lead which is ranges from 5.49 ppm to 73966.44ppm. One out of three sample labeled with Lead Free also reported higher concentration of Lead NP2 817.29ppm. Distemper and Emulsion sample also contains lead but in very small quantity.

Lead is also found in the plastic toy samples and ladies hand bag sample. No proper labelling is found in multi-national and national brand paints.

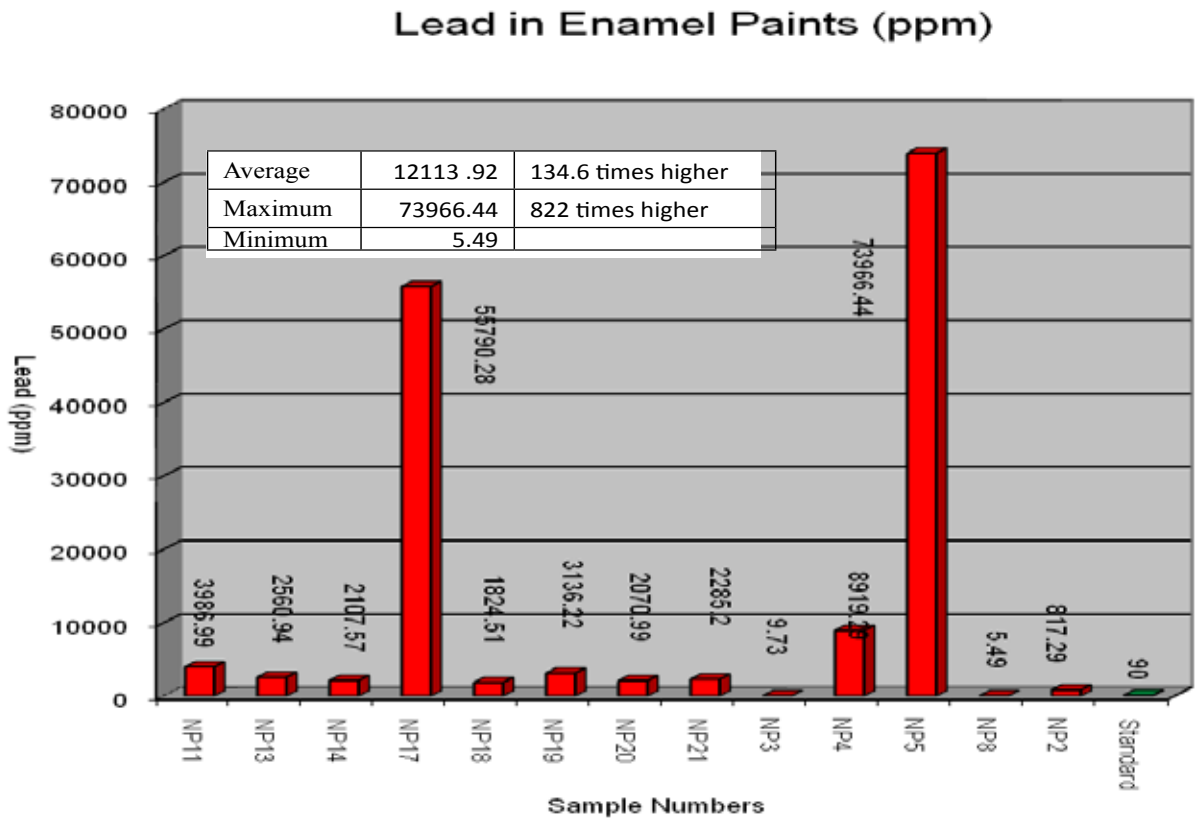
Table 8: Result of Lead in Paints

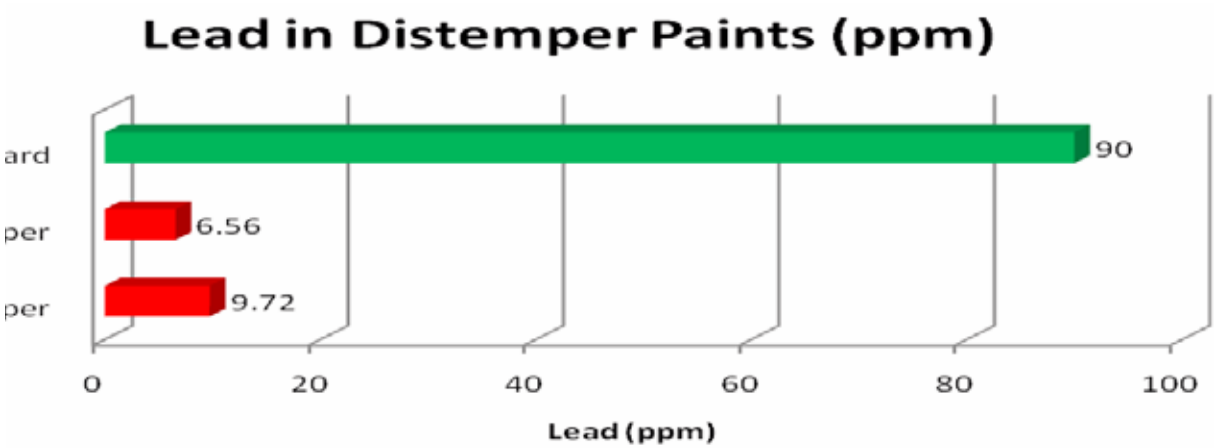
Sample No	*Paint Company/ Manufacturer*	*Paint Brand*	*Type of Paints*	*Lead (ppm)*	*Color of Paints*	*Categories*	*Remarks*	*Higher Than US Standard*
NP1	ICI, DULUX, USA	Dulux	Exterior Latex	3.98	Green	International	Lead Free	
NP2	Red Belt Paint Co. Ltd, USA	Red Belt	Enamel	817.29	Red	International	Lead Free	9 times
NP3	Premier, USA	PREMIER	Enamel	9.73	Aquamarine	International		
NP4	Berger Jenson and Nicholson, Nepal (P) LTD	Berger	Enamel	8919.29	Red	Multinatiaonl		99 times
NP5	Asian Paints Nepal P (LTD)	Asian Paints	Enamel	73966.44	Orange	Multinatiaonl	NS Mark	822 times
NP6	Kansai Nerolac Paints Limited, Mumbai	Nerolac	Emulsion	33.67	Yellow	International		
NP7	Berger Jenson and Nicholson, Nepal (P) LTD	Berger	Emulsion	10.37	Yellow	Multinatiaonl		
NP8	Kansai Nerolac Paints Limited, Mumbai	Nerolac	Enamel	5.49	Black	International	Lead Free	
NP9	Asian Paints Nepal P (LTD)	Asian Paints	Emulsion	4.78	Mild Green	Multinatiaonl		
NP10	Shalimar Paints Ltd, India	Shalimar	Emulsion	5.49	Deep Yellow	International		
NP11	Reliance Paints Industries LTD	Sangrila	Enamel	3986.99	Ox-ford Blue	Nepali		44 times
NP12	Kansai Nerolac Paints Limited, Mumbai	Nerolac	Distemper	9.72	White	International		
NP13	Yeti Paints Nepal, (P) LTD	Yeti Paints	Enamel	2560.94	Nepal Red	Nepali	NS Mark	28 times
NP14	Nepal Shalimar Paints (P) LTD	Nepal Shalimar	Enamel	2107.57	Smoke Grey	Nepali	NS Mark	23 times
NP15	Nepal Shalimar Paints (P) LTD	Nepal Shalimar	Emulsion	9.55	Platino Mgre	Nepali		
NP16	Nepal Paints Industries (P) lTYD	Shwallow	Emulsion	7.83	Pale cream White	Nepali	Korean Techical	
NP17	Nepal Paints Industries (P) lTYD	Shwallow	Enamel	55790.28	Bus Green	Nepali	Korean Techical	620 times
NP18	Gaurishankar Paints Industries	Gauri	Enamel	1824.51	Firoza Blue	Nepali		20 times
NP19	Pashupati Paints	Nepolite	Enamel	3136.22	Leaf Brown	Nepali	NS Mark	35 times
NP20	Jasmin Paints (P) Ltd	Always	Enamel	2070.99	Black	Nepali	NS Mark	23 times
NP21	Rukmini Chemical Industries	Super Lac	Enamel	2285.20	Blue	Nepali	NS Mark	25 times
NP22	Asian Paints Nepal P (LTD)	Tractor Asian	Distemper	6.56	Sky Blue	Multinatiaonl		
NP23	Asian Paints Nepal P (LTD)	Touch Wood	Clear Glossy	177.75	Watery	Multinatiaonl		2 times
NP24	Asian Paints Nepal P (LTD)	Varnish	Clear Varnish	42.41	Watery	International Collaboration	NS Mark	

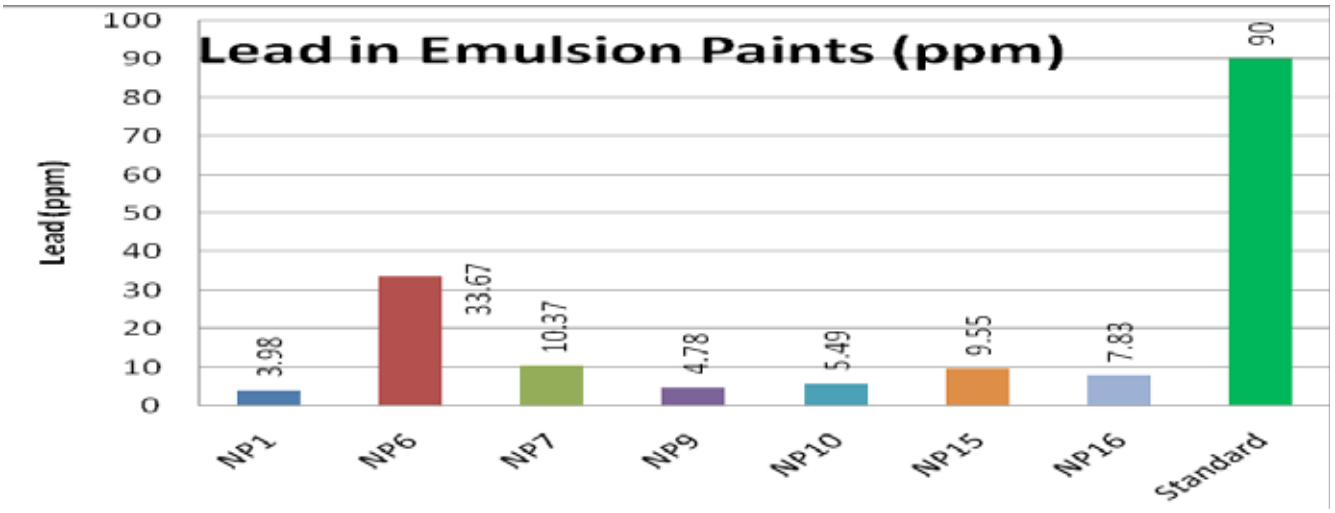
Source: Laboratory Test result from Delhi Test House , March 2010.

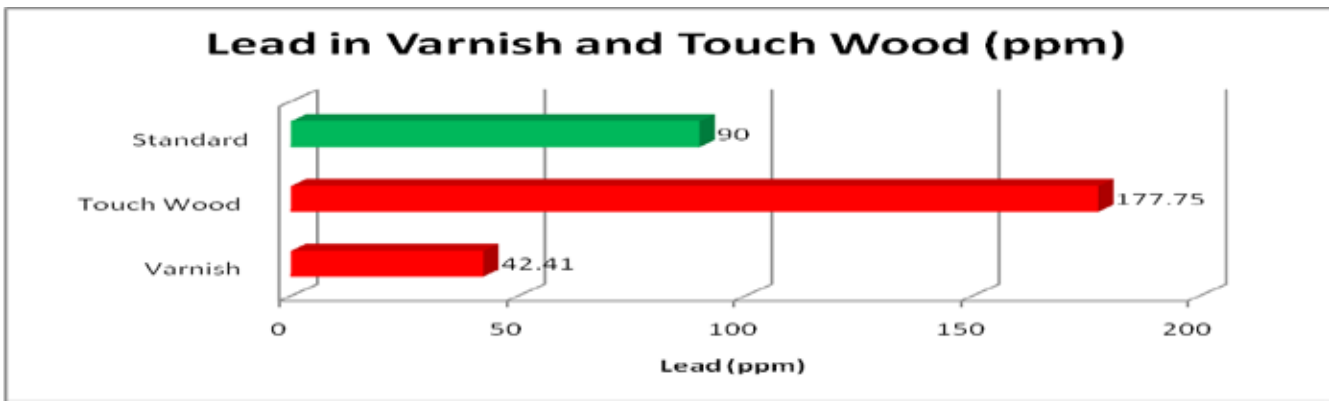
Table 9: Result of Lead in Toy and Ladies hand bag

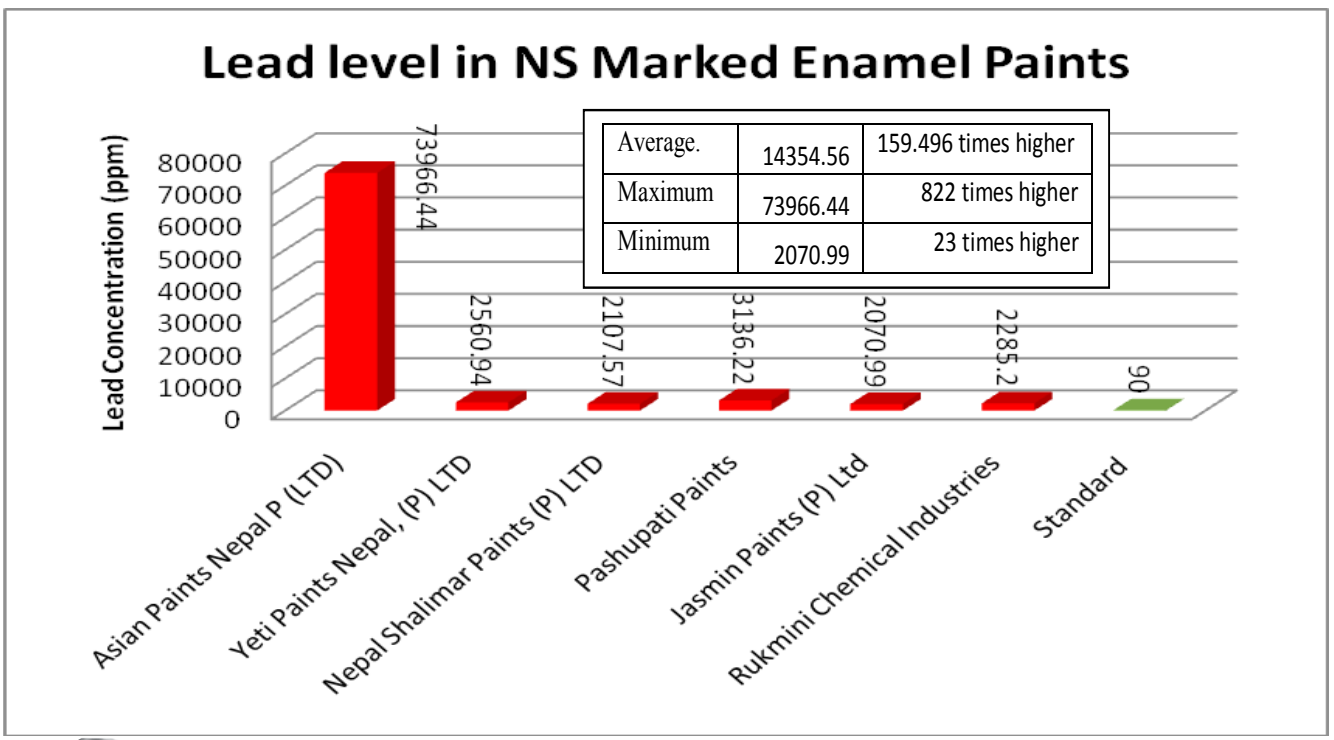
S.N.	*Description of Toy/ladies bag*	*Colour*	*Lead concentration (ppm)*
1	Doll girl	Oink and rad	1.63
2	Cat Doll	Orange	1.05
3	Baby teether	Transparent	1.48
4	Ball	Red	Not detecyed
5	Frog Doll	Green	0.76
6	Ladies Bag	Red	338.11






Lead in Emulsion Paints (ppm)
Lead (ppm)
100
90
80
70
60
50
40
30
20
10
0
3.98
33.67
10.37
4.78
5.49
9.55
7.83
90
NP1
NP6
NP7
NP9
NP10
NP15
NP16
Standard


Lead in Varnish and Touch Wood (ppm)
Standard
Touch Wood
Varnish
90
177.75
42.41
0
50
100
150
200
Lead (ppm)


Lead level in NS Marked Enamel Paints
Lead Concentration (ppm)
80000
70000
60000
50000
40000
30000
20000
10000
0
73966.44
2560.94
2107.57
3136.22
2070.99
2285.2
90
Average. 14354.56 159.496 times higher
Maximum 73966.44 822 times higher
Minimum 2070.99 23 times higher
Asian Paints Nepal P (LTD)
Yeti Paints Nepal, (P) LTD
Nepal Shalimar Paints (P) LTD
Pashupati Paints
Jasmin Paints (P) Ltd
Rukmini Chemical Industries
Standard

9.1 Analysing Results

1. In general, all brands (international, multinational and national) and all types (distemper, emulsion, enamel, varnish and touch wood) of paints available in Nepal contains lead.
2. Average lead content of all 24 samples is found to be 6574.71 ppm (73 times higher than USA standard for lead in paints.
3. Maximum value of lead in paints in all samples is 73966.4 ppm (822 times higher than USA Standard for lead in paints. Minimum value is 3.98 ppm much below than USA standard.
4. The 84.6 percent (11 out of 13) of enamel samples are found to be contained highest amount of lead ranges from 5.49 ppm to 73966.4 ppm. Maximum concentration of lead in enamel samples is about 822 times higher than US standard of 90 ppm for lead in paints. The average lead content of all 13 enamel samples are 12113.92 ppm which is about 134.6 times higher than the US standard of 90 ppm for lead in paints.
5. All seven emulsion paints samples contain less quantity of lead. The average lead content of all emulsion samples are 10.81 ppm.
6. Both the distemper paints sample also contains very less amount of lead. The maximum value of lead in distemper paints sample is 9.72 and minimum amount of lead is 6. 56 ppm.
7. Touch wood paint sample of Asian Paints contain higher amount of lead (177.75 ppm) where as Varnish contains less lead (42.41 ppm).
8. All three lead free labeled paint samples contain lead but in very less amount
9. All 6 Enamel paints samples with Nepal Standard marked paints contain very high amount of lead. Lead in NS marked Enamel paints ranges minimum of 2070.99 ppm (23 times higher than standard) to maximum up to 73966.4 ppm (822 times higher than US standard). The average value of lead on NS marked enamel paint samples is 14345.54 ppm which is 159.4 times higher than US standard of 90 ppm for lead in paints.
10. Lead is also found in plactic toys much less than USA standard
11. Lead in and ladies hand bag found upto 338.1 ppm which is about 4 times higher than USA standard.
12. Labelling of national and multinational paints are found to be very poor.

10.0 Conclusion

From the study following major conclusions can be drawn.

- The study shows that Nepalese population is still at high risk of health and environmental hazards due to presence of high level of lead in decorative housebound paints. Childrens are thus at greater risk
- Famous international Brands like Asian Paints and Berger still flaunt the global paint standards on lead which is a serious issue
- Enamels samples generally exhibited large quantity of lead in it which is a dangerous trend because of its extensive use in houses and household products of a variety of range.
- Some International brands like Nerolac is adhering to the international standards across brands which is welcome.
- Nepal Standard Marked paints too are found to be containing very high quality of lead which is alarming.
- There is no proper labeling of Paints products of multinational and national companies. However the international brand has clear labeling of lead, chromium, cadmium etc along with details warning and disposal guidance.
- Plastic toys and ladies hand bag also contain lead.

However, the overall results are alarming as about half of the samples tested exhibited quite high amount of lead in them in comparison to the best possible standards (90ppm, CPSC, USA). The serious issue is brands like Berger, Asian Paints and other Nepalese brands sell readily in the market and thus posing health threat to a large number of residents, especially children in Nepal.

It is therefore very much urgent that Nepal thinks about regulating deadly lead in decorative paints and making the enforcement much stricter. By that time, it is imperative for the paint industries to be responsible and call back leaded paints and impose voluntary moratorium on using lead in their products in future.

11.0 Recommendations

1. There is an immediate action need for recall of paints brands and types that do not adhere to internationally approved standards;
2. There is an immediate need to regulate lead in paints. The standards in such cases should be mandatory and not voluntary as in some of the countries;
3. Massive awareness and information dissemination programs need to be launched and sponsored from all concerned and especially from the concerned government agencies like Ministry of Health and Population, Ministry of Environment, Ministry of Information and Communication, Ministry of Education and Ministry and Industry, Commerce and Supplies etc;
4. Reducing consumption of raw materials and products that include lead as an impurity;
5. Industries should looking at some of the safer paint alternative such as containing titanium-white;
6. Controlling lead releases through low-emission process technologies and cleaning of off-gases and wastewater;
7. The health ministry should establish systems to check as many children for lead poisoning as possible. The network of government hospitals much come into action
8. Management of lead-containing waste is a task for future
9. Consumers should use of lead-free paint in homes and must ask for label description before purchase
10. The study is also indicative and it is recommended that regulatory authorities and policy makers jointly ascertain the lead levels in other products of direct household utility and enact standards.

12.0 References

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ACRONYMS

AAS	Atomic Absorption Spectroscopy
CEPHED	Center for Public Health and Environmental Development
CPSC	Consumer Product Safety Commission
DPR	Diplomatic Relation
DTH	Delhi Test House
ENPHO	Environment and Public Health Organization
EPA	Environment Protection Agency
IFCS	International Federation of Chemical Safety
NABL	National Accreditation Board for Testing and Calibration Laboratories
NBSM	Nepal Beaure of Standard and Metrology
Pb	Symbol of Lead
POPs	Persistent Organic Pollutants
ppm	parts per million
SSNC	Swedish Society for Nature Conservation
USA	United State of America
USEPA	United State Environment Protection Agency