EXECUTIVE REPORT-2009

Evaluation of lead based paints manufacturing in India covering three large, three medium and two small manufacturing companies in India

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Compiled by

NRCLPI - St. John's

National Referral Centre for Lead Poisoning in India (NRCLPI)
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1.0. EXECUTIVE SUMMARY

Lead based paint in older house has long been associated with elevated blood lead in children residing within them (Clark et al., 1985). In one of the studies on lead in paints and soil, Clark, et al., (2005) concluded that lead paint should be considered as significant potential source of lead poisoning in India. Interestingly lead which is present in the paint cannot be recycled back unlike lead used in batteries and that poses even more danger as it remains in the environment forever. Children are more susceptible of lead poisoning because of paint chips/flakes/dust in homes, playground, schools, transport vehicles viz. school buses, vans, cars and we often see children do more ***'Hand to Mouth'*** activity and resulting in a very high exposure of ingestion of lead in the body. Lead in paint dust contaminates the air, water, soil in the vicinity and children often become the victims of such activity.

Lead is found in imported consumer products including vinyl and metal toys, toy jewelry, children's furniture, candy, folk and traditional medicines, ceramic dinnerware etc. Lead affects every organ in our body, the most common affected organ being the kidneys and most sensitive target being the nervous system.

The organs affected by lead are as follows:

I. Haematopoietic system

II. Renal system

III. Cardiovascular system

IV. Digestive system

V. Neuromuscular system

VI. Skeletal system

VII. Hepatic system

VIII. Immune system

IX. Reproductive system

X. Carcinogenic effect

Caution: Lead being a toxic poison and affecting most of the organ systems, it needs to be removed from the paint and there is an urgent need for production of lead free paint in India.

According to the Centre for Disease Control and Prevention significant increase in a single parameter that is increased Blood Lead Level (BLL) is evident of Lead poisoning. Using this parameter the level of lead poisoning was assessed in the paint industry.

Our NRCLPI team surveyed and found that the major paint companies viz. Berger, ICI and Asian paints has switched over to lead free paints to meet the demand from industrial sector. The views shared by small players were also in the line of major players and they look forward to work closely with Government to phase out lead in lead based paints. Small players are expecting subsidies/tax rebates on their paint products which are lead free. Many certification bodies came forward to certify these lead free paint products so that these products can be marketed internationally. Also paint manufacturers view is that the organic pigments based colours should match the quality of shades as that of inorganic lead chromate based pigments but for colour yellow/orange and red there is no good hiding effect but not for other colours. Yellow/orange and red lead chrome based compounds are in greater demand because of good hiding effect and bright shade. Some of the paint manufacturers are using iron oxide and/or alloxides but it

gives a buffy colour. Also one can use cobalt and manganese in place of lead for good hiding effect. For quick drying purposes lead can be replaced by zirconium and calcium based compounds. Most of our decorative paints do not have lead contents except few enamel paints with selective shades yellow and orange and lead content is minimal.

About 90% of the entrepreneurs in the paint industry are not technically qualified about the paint manufacturing process and lack of awareness about the environmental issues pertaining to using lead based compounds in paints and its effects at large in the society. Therefore lack of awareness, minimal demand of lead free paints from consumers, cost of organic pigments and absence of any strict environmental regulation lead is continue to use in paints even though substitutes are available. A massive awareness programme to paint and pigment manufacturing industries coupled with government intervention specially to set up research and developmental work in association with American and European commissions to see options for lead free paints over lead based paints. Indian paint manufactures view is that they can manufacturer lead free paints if there is a greater demand from the consumers and also if cost of organic pigments can be reduced. As of now paint manufacturers are asking for a time line for five years to go for lead free paints over lead based paints.

Recommendations for immediate action:

I. Task force broad based multi-stakeholders committee for the implementation of the contents of the white paper at both National and state level to be constituted by CII.

II. Phasing out of lead and other toxic heavy metals over a period of time agreed upon by the industry is to be accepted and not exceeding the time limit beyond March 31st 2011.

III. This phasing out of lead and other toxic heavy metals in paints and coatings to be made voluntary to begin with immediate effect through public notification.

IV. Willingness from the organized sector of paint manufacturers to shift from lead based to lead free paint to be encouraged in phase wise manner and to be supported by the Government.

V. Possible incentives such as eliminating octroi and tax benefit for the lead free paint manufacturers (which is already in existence through refund of tax to lead free paint component) to be considered.

VI. Prominent signage to appear on all paint containers indicating the acceptable and graded unacceptable levels of lead used for various purposes covering architectural, industrial, automotive and specialty paints with immediate effect.

VII. All lead based paints with unacceptable levels of lead to appear on every paint container with the precautionary measures to be taken by the end user.

VIII. CII to take prominent initiative to communicate and monitor that the IPA complies with the contents of the white paper

IX. Indian Paint manufacturer Association (IPA) and other paint related association such as SSPMA to own the total responsibility to communicate the intent.

X. Pigment, dye and other raw material manufacturers and suppliers to be informed about the hazards of the lead based pigments and the availability of the alternate non-lead pigment.

XI. Voluntary standard for the best manufacturing practices for the paint industry to be prepared by QCI involving multi-stake holders by the end of 2009 for the purpose of accreditation to the paint industry.

XII. The lead phase out plan to have at a minimum:

a) To limit the lead content in all paint manufactured in India, to a upper limit of 1% by weight by 31st December 2009 as agreed up on by IPA.

b) To limit the lead content in all paint manufactured in India, to a maximum of 0.1% by weight by 31st December 2011 as recommended by BIS 5411, 5410, 428, 164 for certain paints.

XIII. During the transition period to insist on a prominent warning labelling on the cans/containers with internationally accepted signage.

XIV. After the proposed cut off date, declare it illegal to manufacture, stock, and sell paints with lead content higher than the specified levels.

XV. Alternate non-lead pigments to be made available to the paint industry during the transition period.

XVI. Paint industry to upgrade and adopt the technology appropriate during the transition period.

XVII. Government to provide necessary encouragement and support to the paint industry to accomplish the phasing out of lead based paint to lead free paint.

XVIII. Strict legal measures to be implemented to defaulters through appropriate legislations.

XIX. Centralized and accredited laboratory testing facilities to certify the quality of the paint and its lead content.

It is requested that the above recommendations to be communicated to the concerned ministries.

2.0. STATUS FOR RECOMMENDATION

During the study after evaluating the production capacities of various paint manufacturers in India for different purposes which amounts to over 12,000 crores, the lead content in these paints were found to be unacceptable and high when compared to global standards. Hence the alternate non-lead and other heavy metal pigments were looked into during the study. Industry willingness was also explored through several meetings with the industry representatives in various parts of our country. This study with only organized sector which accounts for around 40% of the total paint manufactured in our country (over 91% of the paint manufactured in our country contains large amount of lead) was accompanied by the on site evaluation of the blood lead levels of the workers involved. With this in background the committee was specially constituted for the purpose of developing a recommendation as detailed in the white paper. The study has found the willingness of the paint industry to go in for the lead-free paints.

3.0. REASONS FOR DECISION

Lead affects every organ in our body, the most common affected organ being the kidneys and most sensitive target being the nervous system.

The organs affected by lead are as follows:

I. Hematopoietic system
II. Renal system
III. Cardiovascular system
IV. Digestive system
V. Neuromuscular system
VI. Skeletal system
VII. Hepatic system
VIII. Immune system
IX. Reproductive system
X. Carcinogenic effect

3.1. Lead and Haematopoietic system (ZPP formation)

Fluorescence studies of whole blood initiated in early 1970`s identified ZPP as the predominant fluorescent species in erythrocytes, with metal-free protoporphyrin being a minor component. Subsequent research from several laboratories characterized ZPP as a metabolite that forms in developing erythrocytes during states of limited iron availability. ZPP Circulates in erythrocytes largely bound to globin. An abnormal accumulation of ZPP reflects a state of relative iron-deficient erythropoiesis; that is, ZPP reflects the rate

that iron is delivered vis-à-vis the rate that the protoporphyrin is produced during heme synthesis

3.2. Lead and Renal functions

Occupational exposure to lead has been proven to be linked to a high incidence of renal dysfunction. This alteration in kidney function usually preceded the development of hypertension. Nephrotoxicity results because the kidney is the main route of elimination of lead.

It has been difficult to prove conclusively that an excess body burden of lead is linked to chronic renal failure, because renal disease is manifested years after acute symptoms. Some studies have shown that in workers chronically exposed to lead, there were no deficient renal functions. Moderate exposure to lead (blood lead level<62µg/dl) did not alter the renal function in industrially exposed lead workers employed for a mean of 13.2 y. In addition Omae et al who performed a cross-sectional study on 165 male lead-exposed workers whose mean bll was 36.5µg/dl and who were exposed to lead 0.1-26.3, did not detect any lead-related changes in serum creatinine concentration. But most studies showed that there was significant association between elevated blood lead levels and reduced renal function. The increase in mortality rate due to chronic kidney disease among a cohort of lead smelters was also reported.

3.3. Lead and Cardiovascular system

Hypertension due to lead were well recognized by clinicians by the late 19th century. In most of the studies, blood lead has been more often associated with increase in systolic blood pressure. Though it is shown that increase in recent circulating dose of lead as estimated by blood lead level was associated with increase in both systolic

and diastolic blood pressure, associations were larger with systolic, rather than diastolic blood pressure.

3.4. Lead and Digestive system

Effects on the gastrointestinal tract have been observed especially in workers exposed to high dose exposure. Lead causes inflammation of the stomach walls (gastritis) and colic, with severe abdominal pain, cramps, nausea, vomiting, constipation, anorexia and weight loss. Excessive ingestion of lead containing food causes deposit of lead in the gums near the base of the teeth. This is visible which is seen in some individuals as **"blue line".**

3.5. Lead and Neuromuscular system

Lead poisoning is usually associated with slight reduction in nerve conduction velocity. Lead acts directly on the muscle and causing damage to nerve leading to lead palsy. The neurotoxic effect of lead include apoptosis, excito-toxicity, influence on neurotransmitter storage and release processes, influence on mitochondria, second messenger, cerebrovascular endothelial cells, and both astrocytes and oligodendrocytes.

Lead affects the neurological development of growing child leading to behavioural changes is of greatest concern. It appears to act by inhibiting neural differentiation, pathway development and learning abilities. Canfield et al measured the relationship between blood lead levels and IQ in children and revealed that blood lead levels were inversely associated with the decline in IQ at the age of 3 years and 5 years. This decline in IQ was about 7.4 points for every 10μg rise in blood lead levels. Recently

WHO suggested the safe level of blood lead reduced to <10µg/dl for the reason that lead acts on the nervous system of the children even at very low levels.

3.6. Lead and Skeletal system

Bone is the largest depository of the body burden of lead. Approximately 90-95% of the lead is stored in calcium-dependent skeletal pools with slow turnover. Human bone appears to have at least two kinetically distinct lead compartments. Skeletal lead is mobilized during a number of physiological and pathological conditions involving increased bone turnover such as age, endocrine status, osteoporosis, menopause, renal diseases and in particular during pregnancy and lactation. This lead when mobilized moves into the blood compartment and exerts its toxic effects. Lead may directly or indirectly alter several aspects of bone cell function by changing the circulation levels of the hormones, particularly 1, 25-dihydroxy cholecalciferol (Vitamin D3), which is involved in the stimulating the synthesis of osteocalcin leading to alteration of bone cell function by perturbing the ability of bone cells to respond to hormonal regulation .

The uptake and metabolism of calcium is modified by lead toxicity. Blood lead level and dietary calcium has been showed to be inversely correlated in children as well as in adults. Though lead replaces calcium it does not have the function of calcium.

3.7. Lead and Hepatic system

The liver is composed of highly active metabolic tissue containing a huge complement of detoxification machinery referred to as phase I and phases II enzyme systems that ideally serve to guard other physiological system from the toxic effects of xenobiotic compounds. Earlier studies have shown alterations in hepatic xenobiotic

metabolism, cholesterol metabolism, liver cell proliferation and DNA synthesis indicative of lead induced hepatic hyperplasia. Recently accumulation of significant amounts of lead in liver tissue was implicated in induction of an oxidative stress response in liver.

3.8. Lead and Immune system

Most of the studies of immunotoxic effects of lead have been limited to animal experiments and studies done on long-term exposure to inorganic lead leading to harmful effects on immune system have not well been studies. Studies have that the environmental lead exposure can cause impaired immune function of T lymphocytes and erythrocytes. Studies also showed post natal exposure on cell-mediated immune function in rats to be decreased thymic weights, suppression of responsiveness of lymphocytes to mitogen stimulation and reduced delayed hypersensitivity responsiveness. Results of this study indicates that chronic low-level lead exposure causes suppression of cell-mediated immune function along with significant increase in serum tumour necrosis factor α (TNF-α) and decrease in number of (Cluster Differentiation 4-Thymic cells) CD4 T-cells (85).

3.9. Lead and the Reproductive System

Men

In men occupational exposure may decrease sperm count and increase abnormal sperm frequencies. Effects usually begin at the blood lead levels of 40µg/dl. Lead has been associated with decreased libido, premature ejaculation, erectile dysfunction, decreased number of sperm shape and size and reduced semen volume. Assennato et al showed high semen lead in lead acid battery workers and direct toxic effect of increased lead absorption on sperm production or transport in man.

Women

Higher lead level has usually seen with adverse pregnancy outcomes. An increase frequency of miscarriage and still births among women working in lead based organization were reported. Severe lead intoxication was associated with sterility, miscarriage, stillbirth and effects upon the fetus, premature rupture of membranes, pre-term delivery and decreased birth weight. Wu et al reported that blood lead even at relatively low levels were significantly associated with delayed attainment of menarche and pubic hair among US girls. Studies conducted by Yang et al suggested that exposure to lead during the gestational period is sufficient to cause long-term learning/memory deficits in young adult offspring.

3.10. Lead and Cancer

The possible mechanism of lead cancer is shown to be either direct or indirect DNA damage, clastogenicity or inhibition of DNA synthesis or repair. Lead which is shown to generate reactive oxygen radicals causes oxidative damage to DNA. Vaglenov et al in their study found a positive correlation between blood lead level and genotoxicity in storage battery plant workers.

3.11. Lead and Dental caries

Lead causing dental caries has been reported. The National Health and Nutritional Environmental Survey (NHANES III) showed a significant association of blood lead with the number of affected surfaces and in the estimated population, attributable risk of lead exposure was found to be 13.5% and 9.6% of dental caries occurring in 5-17 years exposed to high and moderate levels respectively.

3.12. Lead and Auditory system

Hearing threshold was found to be significantly increased with blood lead levels. A study of Hispanic Health and Nutritional Environmental Survey confirmed a relationship between blood lead levels and elevated hearing thresholds. The relationship appeared to continue at blood lead < 10µg/dl. They noticed that an increase in blood lead from 6µg/dl to 28µg/dl was associated with a 2 dB loss in hearing at all frequencies and 15% of children had hearing thresholds that were below the standard at 2000 Hz.

3.13. Treatment and management of Lead Poisoning

Since the potential health hazards of lead poisoning still exist and are rising, continuous efforts are needed to deal with the problem. This can be tacked only through proper awareness and education. Though lead poisoning is treatable, it becomes expensive if ignored and may require a longer course of chelation therapy once it becomes chronic disease especially for the subjects of occupational exposure. These are the people who are ignored and in the long run require expensive and long term treatment.

Lead being a toxic poison and affecting most of the organ systems,

it needs to be removed from the paint and there is an

urgent need for production of lead free paint in India.

4.0. RISK ASSESSMENT

According to the Centre for Disease Control and Prevention significant increase in a single parameter that is increased Blood Lead Level (BLL) is evident of Lead poisoning. Using this parameter the level of lead poisoning was assessed in the paint industry.

Table 1: Guidelines required for the treatment of Lead poisoning:

Type of class	BLL (µg/dl)	Treatment actions
Class I	≤9	Acceptable Levels
Class II	10-19	Provide lead education and referrals; diagnostic testing within 3 months and follow up testing within 2-3 months; Children should receive community-wide lead poisoning prevention
Class III	20-44	Provide lead education and referrals; clinical evaluation and management; diagnostic testing from within 1 month to within 1 week and follow-up testing every 1 to 2 months, aggressive environmental intervention.
Class IV	45-69	Provide lead education and referrals; clinical evaluation and management within 48 hours; aggressive environmental intervention, diagnostic testing within 24-48 hours and follow up testing in accordance with chelation therapy, at least once a month
Class V	≥70	Medical Emergency; Hospitalization and immediate chelation therapy. Other follow ups as above.

5.0. BACKGROUND INFORMATION

The Indian Paint Industry has been witnessing a consistent growth of 13 to 15% over the last five years. Multinationals are coming to India to tap the growing market in the country. The enlightening point of this growth is that both the decorative and the industrial paintings are showing equal percentage increase. Constant innovation with a pulse on the customer requirement can create an environment conducive to rapid growth in domestic and export market. With Paint and Coating industry becoming increasingly competitive, there has been a dramatic change in the area of quality, cost, delivery, service as well as an enhanced awareness about safety and environmental issues/concerns. In this highly challenging global marketplace, the key driver of the future will be the ability to innovate – whether it is technology, process, plant, equipment or facilities to sustain and develop market position.

The Indian paint industry is over 100 years old. Its beginning can be traced with the setting up of a factory by Shalimar Paints in Kolkata in 1902. The paints and allied products industry mainly comprise: paints, enamels, varnishes, pigments, printing inks, synthetic resins, etc. They play a vital role in the economy by way of protecting national assets from corrosion. The industry in India mainly comprises of two segments—decorative segment and industrial paints segment. While the industrial paints are used for protection against corrosion and rust to steel structures on vehicles, white goods and appliances; decorative paints, on the other, are used in protecting valuable assets like building.

Lead is added to paint to impart colour, speed drying, increase durability, retain a fresh appearance, and resist moisture that causes corrosion. It provides longevity to coatings on walls, woods and metals. A number of compounds of lead viz. lead oxide, lead carbonate (White lead) and lead chromates and lead molybdates can be used as pigments in paints (ILZSG, 2004). There are readily available substitutes for lead based compounds in paint including titanium oxide, barium sulfate, and silicon or aluminium oxides used to increase durability (Rabin, 1989). Lead in paints in relatively at low level can become a hazard at the time of construction or renovation activities because a significant amount of paint is removed. Exposure may also occur when lead based paints

during sanding, scrapping and remodeling. Use of lead in paints is many products have caused world-wide concerns (Nriagu et al., 1997; Kumar and Pastore, 2007). The US Centres for Disease Control and Prevention (CDC) consider blood lead levels in children greater than or equal to 10μg/dl as the beginning level of concern (CDC, 1991) because of intellectual impairment at this low level.

5.1. Current status of Paint Industry in India

The total market size of Indian Paint industry is about US$1400 million. The organized sector constitutes about 55% and unorganized sector 45%. The organized sector dominates by large players and unorganized sector comprising about 2500 units manufacturing various categories of paints. The total amount of paint requirement per annum is about **600,000 million tons**.

The organized sector can be divided into 2 distinct segments viz. Industrial Segment growing at 15% (US$ 230 million) and Architectural Segment growing at 8% (US$ 500 million) and overall growth is 10 to 12%. The basic of competition in Industrial Segment is with respect to access to technology and technical Servicing

The Organized Sector:

(A) Market Snapshot:

a) Market growth of about $200 - $400 million per year.

b) Per capita consumption of paint in India is 750 grams compared to 15-25 kg in developed countries.

c) Growth sector in the organized sector expected to be 15-17% per annum.

d) Unprecedented boom in Housing sector to fill demand for over 30 million mew homes.

(B) Market Characteristics:

a) Decorative paints:

- Caters to the housing sector
- Premium decorative paints are acrylic emulsions used mostly in the metros. The medium range consists of enamel, popular in small cities and

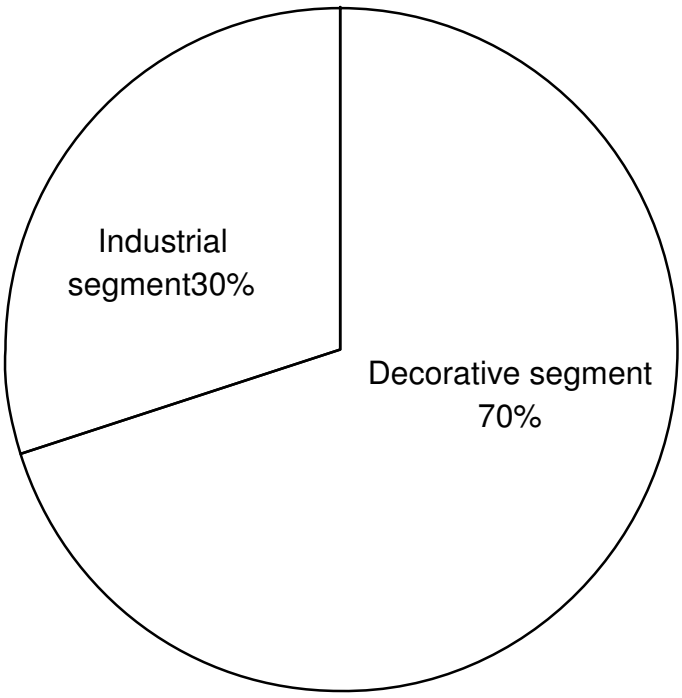
towns. Distempers are economy products demanded in the suburban and rural markets.

- Nearly 20 % of all decorative paints sold in India are distempers.

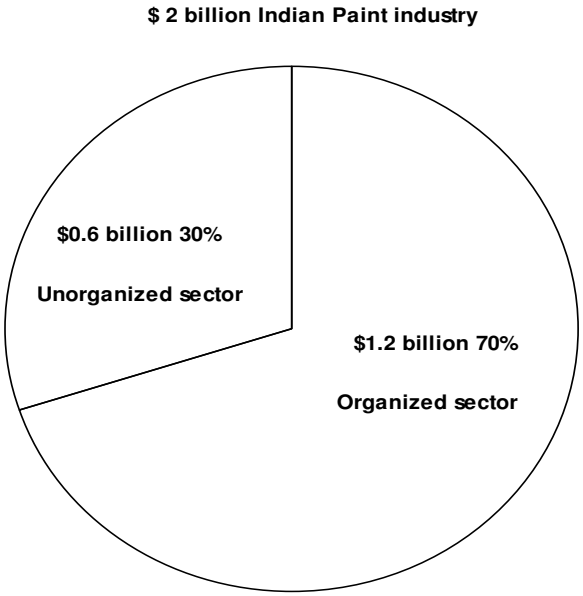
b) Industrial paints:

- Include powder coating, high performance coating and automotive and marine paints
- Two-thirds of the industrial paints produced in the country are automotive paints.
- Technological superiority and tie-up with automobile manufacturers.

Distribution of Sale - Decorative vs Industrial



Source: HDFC Securities Analyst Report



Source: HDFC Securities Analyst Report

(C) Major Indian paint industry player:

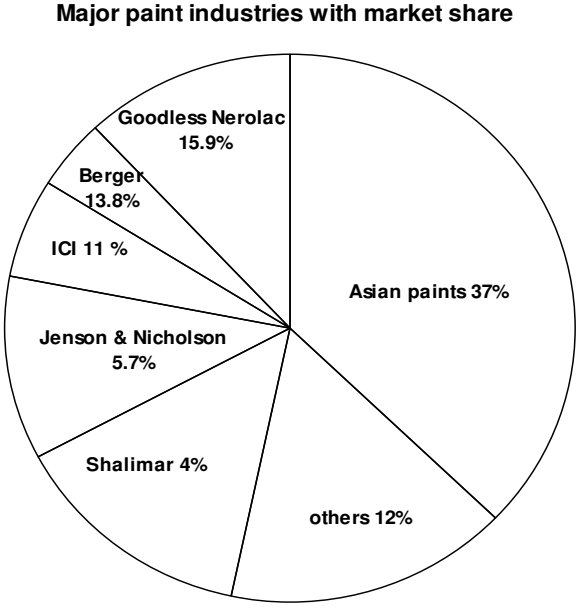


Table 2. Company wise trends in market shares: 2000-2001 to 2005-2006(%)

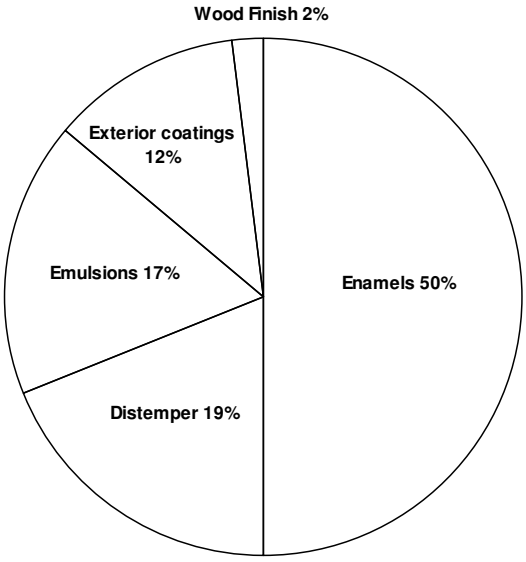
Name	2000-2001	2001-2002	2002-2003	2003-2004	2004-2005	2005-2006
Asian paints	33.32	33.76	35.52	36.73	35.84	38.05
Kansai Nerolac Paints ltd.	16.36	15.37	16.24	17.39	16.98	17.43
Berger paints India ltd.	13.62	13.27	13.98	14.73	15.29	16.05
ICI India Ltd.	9.43	8.4	9.1	9.83	10.2	10.49
Shalimar Paints Ltd.	3.28	3.05	3	2.53	3.52	3.57
Bombay Paints Ltd.	1.2	0.84	0.42	0.33	0.41	0.42
Jenson & Nicholson (India) Ltd.	3.6	2.78	1.39	0.35	0.3	0.33

Table 3. Industrial details about the paint sector

	2002-2003	**2001-2002**	**2000-2001**	**1999-2000**
Number of factories	814	790	737	783
Factories in operation	808	774	726	738
Income(in Rs. Lakhs)	114259	119363	109966	58802
Profit (in rs. Lakhs)	73606	77585	72607	30731

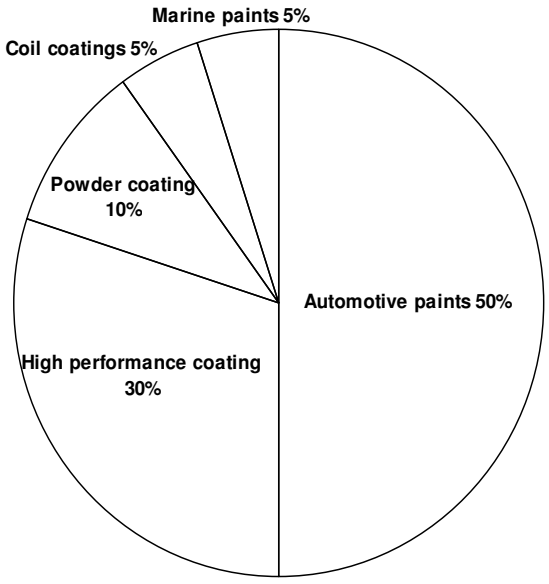
Source: Industry: Market size & shares, Centre for monitoring Indian Economy

i) Decorative Sector Composition



Decorative Paints

ii) Industrial Sector Composition



Industrial Paints

i) Decorative Sector Features

- Enamels Steady growth
- Emulsions Shift from distemper and enamels to emulsions. High growth area
- Distempers High growth in low priced low quality distempers as consumers are upgrading from lime wash
- Exteriors emulsion fastest growing segment in the Indian Paint market.

ii) Industrial Sector Composition

a) Automotive Sector: High growth sector with a number of new entrants like Mercedes Benz, Mitsubishi, Daewoo, Hyundai, Honda, Fiat, General Motors, Ford. However, recently there is some slackness in Auto demands. Two wheeler markets are booming due to demand from large Indian middle class.

b) Powder Coatings

Increase growth due to increased sales of white goods and auto ancillaries.

c) High Performance Coatings

Steady growth due to increase investments in refinery segment and power sectors, particularly Thermal and Nuclear.

5.2. Changing dynamics (Organized vs. Unorganized sector)

The Indian Paint Industry has witnessed remarkable growth over the last few years in terms of volumes, quality and also technological development. The paint companies have started with novel marketing initiatives such as paints helplines, providing ready-made colour combinations, colour consultants, providing total colour solutions, designer colour schemes, colour tinting at the dealer's shop etc. Also organized players have continued to concentrate on aggressive brand building and enhancing brand visibility through increased advertising. Another area where the industry is witnessing a change is the market share of organized & unorganized players. In the last couple of years there has been a slow but persistent trend of organized big players capturing market

share from the small-scale sector. The main reason behind this change can be enumerated as follows:

- Rising input prices making the smaller players difficult to compete on price.
- Ability of the big players of keeping prices competitive despite rising raw material costs.
- Big players capitalizing on their R&D expertise, branding, big marketing drives and extensive reach through dealership networks.
- Shifting demand towards better quality paints from traditional whitewash etc. due to rising disposable incomes and increasing awareness.

The focus on urban and rural housing increases the demand for paint companies in India. Also, lower custom duty on chemicals is likely to ease some pressure on profitability by paring the pressure on cost of inputs. We expect the paint sector to grow at two time's long-term GDP growth in the future. With GDP growth expected to around 8% to 9% per annum, the major players are likely to clock above industry growth rates. Market leaders like Asian Paints, Kansai Nerolac and Berger Paints benefited from increased spending on rural and urban housing. These companies will benefit in terms of lower custom duties on raw materials like chemicals.

The Paint industry is looking for following incentives from government side

i) Increase in the rate of abatement from the MRP (minimum retail price) to 50% from 40% at present.

ii) Reduction of duty on import of raw materials used in the paints industry to 8% from the current 16%, while retaining the rate of import duty on finished products at 16%.

iii) Continued impetus to the housing industry as the revival of the same boosts the growth of the general economy and thereby the paint industry

iv) The government should give incentives to companies that invest money in R&D activities by way of weighted deductions for revenue spends and accelerated depreciation rates for investment in R&D equipments. This will help the Indian paint industry to become globally competitive.

5.3. Export of Indian paints

India's exports of paints and allied products in the year 2005-2006 registered a growth of 30.10 percent over the previous year when the same reached a level of Rs.3,739.35 crores as against Rs. 2874.22 crores (Source: Compiled from the DGCI & S, "Monthly statistics of Foreign Trade of India", Volume 1, Exports, march 2004, 2005 and 2006 issues, Kolkata). Country wise exports trends during the period 2003-2004 and 2005-2006 shows that USA continues to be the largest market for India's exports of paints and paint based products.

Table 4. India's exports of paints and paint based products (In crore Rs only)

Country	2003-2004	2004-2005	2005-2006	% growth
USA	213	404.86	559.78	38.27
Japan	105	131.72	135.37	2.77
UAE	46	49.88	77.01	54.39
Germany	48.48	`82.04	68.84	(-)16.09
Kenya	17.56	19.44	42.19	117.03
Netherland	17.87	31.62	40.22	27.2
China	41.64	53.19	39.03	(-)26.62
Belgium	37.19	40.66	35.78	12
Iran	15.75	14.5	33.83	133.31
France	29.14	41.95	33.6	(-)19.9
Italy	49.54	40.97	32.25	(-)21.28
UK	30.21	33.18	31.75	(-)4.31
Indonesia	30.63	27.18	31.48	15.82
Malaysia	18.38	20.74	28.74	38.57
Egypt	25.75	29.79	28.29	(-)5.04
Total	3108.56	2874.22	3739.35	30.1

5.4. Global Status of lead in paints with special reference to Indian paints.

A number of compounds of lead viz. lead oxide, lead carbonate (White lead) and lead chromates and lead molybdates can be used as pigments in paints (ILZSG, 2004). Some of the 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. In fact, titanium dioxide is considered safe enough to use as a food coloring and in toothpaste, and is a common ingredient in sunscreen. The titanium white used in most paints today is often coated with silicon or aluminum oxides for better durability. For artists, zinc white is less opaque than titanium white, and is better for misty glazes and adding aerial perspective. Some art- manufacturers supply a "lead white hue," a mixture, usually of titanium and zinc white, which attempts to imitate the hue of genuine lead paint without the toxicity. It does not, however, have the desirable structural (physical) properties of lead white.

For many years by now the dangers represented by lead paint manufacturing and application led by many countries' enacting bans or restrictions on the use of white lead for interior paints. With respect to the existing US standard for lead in new paints, the Consumer Product Safety Commission (CPSC) of US states, "that paint and similar surface-coating materials for consumer use that contain lead or lead compounds and in which lead content is in excess of 0.06 percent of the weight of the total nonvolatile content of the paint or the weight of the dried paint film (which paint and similar surface-coating materials are referred to hereafter as "lead-containing paint") are banned hazardous products under sections 8 and 9 of the Consumer Product Safety Act (CPSA), 15 U.S.C. 2057, 2058.

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

Table 5: Standards for lead (Pb) in new paints in some countries (Abhay & Gottesfeld, 2008)

USA	**Australia**	**China**	**Singapore**		**India**	
New paints				**ISI voluntary standard (IS 15489:2004)**	**Eco-Mark (Optional under the same ISI voluntary standard)**	**Intended for defence purposes (as PbO)**
600 ppm (0.06%)	1000ppm (0.1%)	90ppm(0.009%)	600 ppm (0.06%)	No limit exist	1000ppm (0.1%)	50000ppm (5%)

In a recent study, Clark et al. 2006 reported that 100 percent of new paint samples from India exceeded 600 ppm and 83 percent samples had more than 5000 ppm of lead contents whereas Abhay & Gottesfeld, 2008 reported that 83.87 percent of enamel paints sampled have lead concentrations greater than 600 ppm and 61.3 percent of samples have more than 5000ppm. Also interestingly Clark et al., 2006 found that lead content in paints depended upon the regulations. The same brand has different contents of lead in different countries depending upon whether any regulation existed or not.

Table-6 Comparison of Clark et al. 2006 and Abhay & Gottesfeld, 2008

Paints	**Clark et al., 2006**	**Abhay & Gottesfeld, 2008**
Yellow	159200ppm*	90000ppm
Green	39200ppm	21250ppm
Brown	10980ppm	-
All samples Median value	16720ppm	7800ppm (average = 26131ppm)
No. of paints having more than or equal to 600ppm	100(n = 17)	83.87 (n = 31), 38 (n = 69)**
Maximum	187200ppm	140000ppm
	* of 2 samples (187200 and 131300ppm)	** Taking into account all samples

6.0. METHODOLOGY

6.1. Multi-stakeholders Meetings and Reconnaissance Survey

Meetings in Delhi on 17th October 2008 and in Bangalore on 26th November 2008 were attended by representatives from government, paint industries, medical fraternity, consumer groups, academicians and civil society representatives to eliminate lead from paints.

All stakeholders were discussed about some recent developments including the IFCS resolution to eliminate lead from paints worldwide and Bureau of Indian Standards (BIS) revised 27 Indian Paint standards and its 3 categories such as A, B and C. For paints under category A, the limits for lead content is less than 0.03 %; for B the lead limit is between 0.03 % to 0.1 % and for paints under category C the limit is between 0.1 % to 4.18 %. BIS has accordingly prepared a revised draft of standards and sent for wider circulation for comments.

In Delhi meeting, Dr. B. Sengupta, Member Secretary, CPCB agreed with the assessment that lead was a confirmed toxic metal, which necessitated its elimination from gasoline. Before it's elimination from gasoline, blood lead levels in children in India were higher than the safe limits. He also expressed CPCB's intent to eliminate lead from all sources wherever feasible. Dr. Abhay Kumar, Toxics Link made a presentation on "Lead in paints: An invisible Poison" and his presentation included a research study on levels of lead in paints of various brands and colours. Dr. Ashish Mittal of OHS-MCS made a presentation on health impacts of lead, in which he talked about the health impacts of lead and its treatment. Dr. Arvind Taneja, Head of Pediatrics, Max Healthcare made a presentation on "Colouring Children' World Could be Dangerous". Dr. Taneja, while giving a historical perspective of lead poisoning, discussed in details the impacts of lead poisoning in children, exposure routes and treatment line by showing typical cases of lead poisoning from his professional experiences. He repeatedly stressed that prevention of exposure was the best option. After these presentations house was thrown open for discussion and questions in Delhi meeting.

Mr. Rajeev Batra representing both Indian Paints Association and Asian Paints while broadly agreeing with the main points of presentations declared that Asian Paints has decided to eliminate lead from decorative paints (one used for decorating houses). While water-based paints had no added lead, the oil-based decorative paints manufactured by Asian Paints will not have any added lead after 1st April 2008. He said that cost was an issue that the industry was doing it despite incurring losses. He also said in the absence of lead in paints consumers might have to compromise with the quality especially in terms of the durability of paints. He also lamented the fact that the government has not taken any note of the plan to eliminate lead from paints, which was shared with various ministries and departments of the government. He was also of the view that given the large market share of unorganized sector within the paint industry it was imperative that government must share some of the costs especially of developing infrastructure for testing formulations. While the organized sector was capable of bearing this cost, in the absence of any financial support from the government the unorganized sector was not capable of phasing out lead from paints.

Mr. D.S. Satpute of Kansai Nerolac also declared that their oil based enamel products for decorative purposes will be lead free (no added lead) after 1 July 2008.

Dr. Arvind Taneja asked paint representatives about the cost of children's health and could that not be taken into account while evaluating the cost-benefits of shifting to lead-free paints?

Dr. B. Sengupta while sharing this concern also said that awareness on health hazards associated with lead is a big issue in our society. He also said that only enforceable standard can work effectively. Upon requests from participants, Dr. Sengupta agreed to write to various departments and ministries such as Railways to urge them to include lead-free paints as a mandatory requirement in all procurement tenders for paints.

Mr. Rajan Gandhi believed that merely eliminating lead from decorative paints was not enough as lead-based paints applied on home appliances and on swings in school playgrounds may be the source of lead poisoning.

Dr. Indu Sidhwani wondered if lead free alternatives were available then industry has taken so long in removing lead given its toxicity to children. She also wanted a mass awareness campaign on the issue of lead.

Dr. Abhay Kumar also said that the world experiences prove that eliminating lead from one type of paints has never yielded desired results as paints manufactured for one use ultimately end up in different products.

The discussion ended with following decisions in Delhi:

1. Legislation for a globally accepted and enforceable standard was the only way to deal with the issue effectively.

2. Lead should be removed from all other kinds of paints.

3. A mass awareness campaign on the issue of lead is needed as that sometimes works as the catalyst for change.

In Bangalore meeting, Dr. Venkatesh Thuppil, Principal Advisor(QCI) and Director of NRCLPI expressed for an urgent need to go for lead free paints by the Indian paint manufacturers to save IQ of our children because they are the future of this country. He also lamented the huge economic damage that country is going to face if we will not think now. Prof. Verrapa Chetty, Professor in Boston School of Medicine & Public Health stressed on long-term consequences of economic damage and look forward to all paint companies to cooperate to make a lead safe society. Mr. Shivram, Managing Director, Supercoat Paints briefly highlighted the organized and unorganized paint sector and also discussed problems facing by unorganized sectors to go for lead free paints. He was expressing great concern about the high cost of organic pigments compared to inorganic pigments and also about lack of public awareness including paint companies. Mr. A.S. Gandotra, Managing Director, Gem Paints Limited welcomes this important issue and but had a great concern about achieving this in a country like India. He was expressing a time line of five years to see Indian Paint manufacturers actually go for lead free paints including small scale units.

The following outcome came from Bangalore meeting:

1. A government intervention is needed in research and development to address this issue and subsidy from Government to small players to manufacture lead free paints.

2. Lead should be removed from all kinds of paints but we have to educate industry and consumers.

3. Pigment manufacturers (Organic and Inorganic) should be included in the study as they are the main suppliers of lead chrome based pigments.

Based on reconnaissance survey in selected paint companies in the initial phase and outcome of meetings held in Delhi and Bangalore, we identified three large scale paint manufacturers **(Asian paints, Berger Paints and ICI)**, three medium scale paint manufacturers **(Varna paints/Mysore paints, Agsar paints/Shalimar paints, ISPAT/INDOCEM paints)** and two small scale paint manufacturers **(Seema paints/Rainbow and Supercoat paints).**

6.2. Estimation of Lead in Paints

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)

Sample preparation

1) Wet paint samples were applied on to individual clean glass surfaces (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.

2) 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.

3) Thus scraped, samples were collected in polyethylene bags and sent to

4) Delhi Test Hous e , A- 62/3, G.T. Karnal Road, Industrial Area,Opposite Hans Cinema,Azadpur,Delhi-110033

5) For further analysis . Delhi Test House (DTH) is accredited by National Accreditation Board for Testing and Calibration Laboratories(NABL).

Laboratory Methods:-

1) 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.

2) 0.3 g of each paint samples was taken on glass slide and placed in an oven at 120ºC for 2 hours to remove any moisture.

3) 0.1 g of each of the dried paint samples was then accurately weighed into a closed Teflon vessel and then digested/extracted.

4) Standards were also prepared similarly.

Digestion Procedures:-

a) 3 ml. of concentrated HNO3 were added into Teflon vessels and then placed in an oven at 1500C for 1 hour.

b) Vessels were then allowed to cool to room temperature.

c) Solution along with any precipitate was transferred to a 25ml volumetric flask.

d) Flask was diluted to volume with deionized water and mixed well. Precipitate if any was allowed to settle and then the solution was filtered.

e) Sample blanks were also prepared similarly.

f) Digested samples were then analysed for total lead (Pb) in AAS fitted with GF of make GBC, Mode l 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 1.25ppm.

6.3. Blood Lead Estimation using by Anodic stripping voltammetry

Principle:

When a sufficiently large negative potential is placed on an electrode, lead ions in solution are plated on mercury electrode. After fixed plating time, potential is made less negative to strip metal off the electrode. The observed current during stripping process is integrated and is directly proportional to concentration of lead in the sample

Specimen required: 2ml EDTA/ Heparin vacutainers.

Specimen Collection and Storage: Store at -20°C for longer storage.

Reagents/Instruments:

1. ESA model 3010 B lead analyzer
2. Met Exchange reagent-
    a. Chromium chloride-1.07% by weight
    b. Calcium acetate- 1.43% by weight
    c. Mercury Ion-0.0028% by weight
    d. Acids and buffers for pH control
3. Hi calibrators→ 60±4µg/dl

    Lo calibrators→ 5±2µg/dl
4. Lead level I → 4.1-10.1 µg/dl

    Lead level II → 19.8-27.8 µg/dl

    Lead level III → 39.9-49.9 µg/dl

(Note: 100µl of whole blood is added to 2.9ml of metexchange reagent. Samples are allowed to react in metexchange for at least 24 hours prior to be analyzed. Samples are of unknown origin or condition. Therefore an extended time is allowed to properly exchange lead from the blood.)

STEP- I:

1. All electrodes are wet.
2. Reference electrode compartment contains buffered salt solution approximately 2/3rd full.
3. Sufficient salt crystals or salt powder is added to ensure appropriate level is maintained.

Control module check out

Led`s to be lit are:

a. Gain → 2
b. Plate time→ 2
c. Motor → Auto
d. Conc.
e. Cell

EI	-980±5mv
EF	-175±5mv
SR	100±1mv/sec
RSP	-700±5mv
ISP	-470±20mv
Plate Time	1 min
Gain	2
Attenuation	B

STEP-II:

Setting of Integrated Set Point potential (ISP) at which integration is to be turned on during an analysis.

1. Hi calibrator is placed on the cell
2. Plate time is set to 3 minutes started.
3. When the ready light is relit plate time is returned to 1 minute. ISP is adjusted to a value slightly +ve than value typically used for analysis (usually at -450mv)
4. The start key is depressed again and value on digital meter when is recorded when ready light is illuminated again.
5. ISP is changed to value 10 mv more negative than previous setting.
6. Steps 4 and 5 are repeated until value on digital display has peaked and has just begun to drop. Potential that gives the highest value is the value used for ISP.

STEP III- Method of calibrating analyzer

1. Blank dial set to 50

   Calibrate dial set to 70

   For blood lead level switches on rear should be

   Integration window → 1.2 sec

   Attenuation → B
2. Concentration button is pressed and the electrode is rinsed using an used Lo calibrator
3. A fresh Lo calibrator is inserted on the cell tower
4. Start button is pressed
5. After 1 minute motor stops stirring. After additional 20 seconds strip light will be illuminated. The lead ion, which was plated on electrode, will be stripped from electrode. The value of digital display is noted, which is the concentration of Lo calibrator.
6. Steps 3, 4 and 5 are repeated using a fresh cuvette of Lo calibrator from same lot.

   Formula for adjusting is:

$V_{set} = V_{true} - V_{avg} + V_{last}$

V_{set} is the value that should be set using proper dial

V_{true} is the value assigned by ESA to the calibrator

V_{avg} is the average of Lo calibrator run sequentially

V_{last} is the value of last sample that was run and value currently on display

7. To adjust the value, blank vernier dial on control panel is unlocked and the dial is turned until digital display presents the "Corrected lead" concentration for Lo calibrator $\{V_{set}\}$

   When the digital display indicates appropriate value, the vernier dial is relocked again.
8. Process is repeated using Hi calibrators
9. Using same formula

$$V_{set} = V_{true} - V_{avg} + V_{last}$$

10. To adjust the value the calibrate vernier dial is unlocked on control panel and dial is turned till display presents the corrected lead concentration that is V_{set}
11. Rinsing in between is done with a used Lo calibrator if not with a fresh one.

Temporary shut down/Refurbishing of reference electrode

This was done regularly or if

a. Expected values of lead levels I, II and III were not within the range.
b. ISP values fell below -440mv
c. The values of Lo calibrators and Hi calibrators were not giving expected value as on the kit.

Quality Control:

All the results were validated against commercially available Quality control material

Lead level I → 4.1-10.1 µg/dl

Lead level II → 19.8-27.8 µg/dl

Lead level III → 39.9-49.9 µg/dl

Advantages

This has been the method of choice for the analysis of blood lead over the last two decades because of its high sensitivity at low concentration, good precision and accuracy, high selectivity, simple operation, requirement of small blood volume, minimum sample pre-treatment and potential contamination problems and is independent of matrix effects and chemical interference.

Reference Range:

Occupational exposed adults Unexposed→9µg/dl

Allowable Safe→ upto 42µg/dl

Maximum allowable→ 53µg/dl