



Paints

Colours discolouring lives

Paints add colour to our lives. They are an everyday part of our surroundings. We paint our walls, our furniture, our cars, our buildings, our bridges. We use paints to make our surroundings more attractive. Paints protect wood from rotting and metals from corroding. Paints tend to communicate through their colours and finish. What remains uncommunicated, however, is the potential environmental and health effects these colourful paints can have.

Types of paints

Depending upon the nature of their usage, paints can be categorised as decorative or industrial. Decorative paints are primarily

used for households, as interior or exterior paints, emulsions, enamels, varnishes, wood finishes and distempers. Industrial paints find their use in automobile coatings, marine coatings and other high-performance coatings. About 30 per cent of the Indian paint market (about Rs 644.2 crore) serves the industrial sector while the remaining nearly 70 per cent (Rs 1,503.3 crore) is aimed at the decorative sector.¹

Paints are also categorised based on their basic composition. In this method, the primary separation is into latex-based and solvent-based paints. The primary differences between latex- and solvent-based paints are given in Table 1.²

Composition of paints

Paints present a toxic concoction of various metals and compounds to be used as vehicles, pigments or additives. These include organic solvents, cadmium, chromium, mercury and lead. Organic solvents are known to emit volatile organic compounds (VOCs) into their immediate environs. Mercury in the form of phenyl mercuric acetate has been used as a biocide³ in both exterior and interior latex

Table 1. Water-borne vs solvent-borne*

Latex or water-based paints	Solvent-based paints
▲ Identified by words on labels such as <i>latex, vinyl, acrylic, or water based</i>	▲ Identified by words on labels such as <i>alkyd, oil-based, urethane, epoxy, varnish</i>
▲ The liquid is water	▲ The liquid solvent is mineral spirit
▲ Dries much faster	▲ Dries slower than latex, takes 24 hours
▲ Clean up requires soap and water	▲ Clean up requires turpentine or paint thinner
▲ Better exterior durability	▲ Less exterior durability
▲ Better colour retention and resistance to cracking	▲ Not very good colour retention or resistance to cracking

AT A GLANCE

- ❖ Paints can be either water-borne or solvent-borne.
- ❖ The use of solvent-borne paints can lead to emissions of hazardous pollutants.
- ❖ The biggest danger to health and the environment is from lead-based paints.
- ❖ Though long gone in developed countries, lead-based paints continue to be part of the market in India.
- ❖ India has little by way of legislation or regulation of lead or other contaminants in paints.



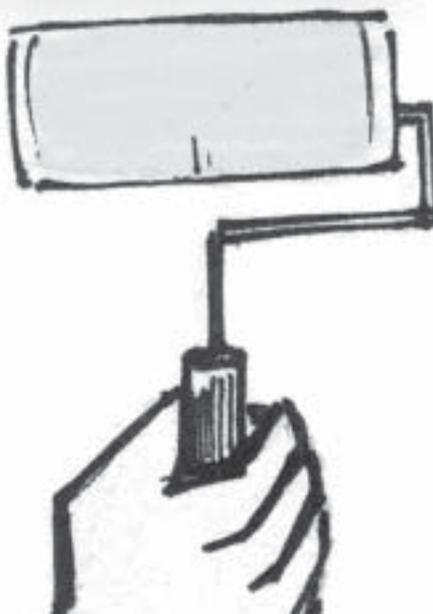
paints. One of the primary pigments used in paints is lead white (basic lead carbonate – $2\text{PbCO}_3 \cdot \text{Pb(OH)}_2$, though this was replaced by its less toxic substitute, titanium white⁴, during the

middle of the 20th century by some countries. A top quality paint will contain 35 to 45 percent volume of solids, while an ordinary paint will contain about 25 to 30 percent.

Table 2. Raw material used to manufacture paints

Component	Ingredient	Purpose	Type
Vehicle – the liquid portion of paint (constitutes 70-75 percent of paint)	Volatile Organic Compounds (VOCs)	Controls paint fluidity; dissolves suspend or changes physical properties of materials; helps in drying of paint; brings down viscosity of paints	Water-based – ethylene glycol; alcohol/oil-based – turpentine, mineral spirits
Pigment – the solid portion of paint	Finely ground solids or insoluble powders of different shades	Imparts colour, durability and consistency to paints; acts as a hiding agent ⁵ ; protects the substrate from harmful effects of UV radiation	Titanium dioxide (TiO ₂); Lead compounds are preferred hiding agents; Inorganic coloured pigments such as red and yellow iron oxides, aluminium flakes and mica flakes. Zinc as anti corrosion primers; Synthetic organic pigments to produce very bright clean colours such as blues, greens, reds, oranges and violets.
Additives	Variety of compounds present in small proportions	Function as corrosion inhibitors, fungicides, preservatives, wetting agents, and help accelerate drying; they affect colour, water resistance, slip control, foam control and gloss	Mildewcides; mercury as an anti-microbial pesticide to prevent mould growth. Water-based paints use VOC-based styrene-acrylic; vinyl acrylic (or "PVA" for polyvinyl acetate); oil paints use a binder based on drying oil linseed; soya
Binders	Generally oils, resins and plasticisers	Tend to hold pigment together; give paints its protective property; enable coatings to last longer	Alkyds, polyesters, emulsion polymers, epoxy resins, polyurethanes, polyesters, melamines; paraffin polyethylene (PE) blends

Paints with high levels of heavy metals can be identified by checking the container labels. In the absence of component information, however, the only way to accurately determine the amount of these toxins present in paint is to have the paint analysed.



Paints affect environment and health

Indoor air pollution

According to the California Air Resources Board, paints and varnishes are among the major contributors to indoor air pollution, mainly through VOCs.⁶ The effects of these VOCs may be felt from two months after application to periods of up to five years. VOCs are emitted as gases from a variety of chemicals used in paints, some of which may have short- and long-term adverse health effects. Furthermore VOCs can react to sunlight, changing to ozone and other pollutants that produce photochemical smog in the lower atmosphere. Various studies conducted on indoor air pollution establish that levels of many VOCs are 10 times higher indoors than outdoors.. The variety of airborne chemicals already present in the interior atmosphere tend to produce a synergistic effect to pollute indoor air. Though most of the paint companies argue that in 'well-ventilated areas' airborne concentrations are harmless, these ideal conditions are never achieved in real life.

The heavy metals in paint, such as cadmium, mercury, lead or chromium, tend to disperse their residues in the indoor environment and these remain persistent over a long period of time. Exposure to these heavy metals, either through respiration or direct contact, can result in long-term health effects (see box on page 4).

Lead in paints is a greater source of indoor air pollution through lead dust. Frequently handled components such as windows and doors are the primary culprits in this regard.

Health effects

VOCs – VOCs are used in paints as paint additives. Exposed to VOCs over a long period of time leads to damage to the nervous system, blood and kidneys. Some of the key symptoms associated with exposure to VOCs include conjunctival irritation, nose and throat discomfort, headache, allergic skin reaction, declines in serum cholinesterase levels, nausea, fatigue and dizziness. A World Health Organization (WHO) report⁷ released in 1989 reveals that professional painters had a 40 percent higher chance than normal of contracting lung cancer, a higher risk of nervous system disorders, and that female painters were likely to suffer frequent miscarriages. It was also found that painters were more prone to producing children with birth defects, had a higher than average chance of developing brain tumours, cancers of the stomach, lymph gland, larynx, kidney, prostate or liver. According to *Paint and Pregnancy* newsletter published by Illinois Teratogen Information Service, a study conducted on pregnant women who sniffed paint showed intra-uterine growth retardation in the infants. Several US states have devised regional laws to limit VOC

content in paints and coatings.⁸

Lead – Lead is readily inhaled or ingested in the body and can be found in blood, soft tissues and bones where it can remain for long periods. Lead disturbs calcium metabolism, and hinders the development of chemical communication between neurons in the brain and cellular activity.⁹ It tends to affect all systems within the body. At high levels (above 80 µg/dl of blood), it tends to cause convulsions, reproductive health problems (in men and women), digestive and high blood pressure problems, nerve disorders, coma and even death. Lower levels of lead can have adverse effect on the central nervous system, kidney and blood cells. According to the US Environmental Protection Agency (EPA)'s Integrated Risk Information System Profile on lead and lead compounds, blood lead levels as low as 10 µg/dl can impair mental and physical development.

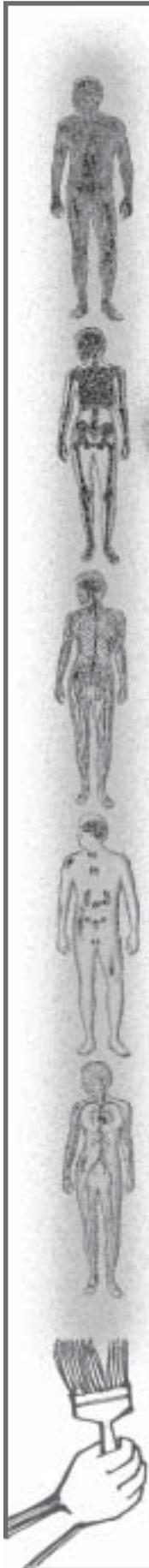
In 1999, the George Foundation, a Bangalore-based NGO, under the aegis of its Project Lead-free, conducted blood lead tests on over 22,000 children and adults in seven major cities (Mumbai, Delhi, Calcutta, Chennai, Bangalore, Hyderabad and Vellore) to assess the level of lead poisoning in the general population. The tests revealed that more than 51 percent of children below the age of 12 living in major urban areas of India had unacceptably elevated levels of blood lead of 10 µg/dl, the level currently considered 'elevated' by the US Centre for Disease Control (CDC). The study also unearthed the fact that in five of 10 homes of the elevated blood lead children, three or more locations in or around the home were found to have lead paint levels of 1.0 mg/cm³ or higher.¹⁰

The current blood lead level which defines lead poisoning is 10 µg/dl of blood. However, the hard fact is that no level of lead in blood is safe or normal. Exposure to extremely small amounts of lead can also have long-term effects, while causing no distinctive symptoms at the same time.

Unlike in developed countries like the US, UK and Germany which have taken aggressive steps to combat lead poisoning, developing countries have been slow to establish any substantive measures to tackle the problem. An important reason is a lack of awareness, and a lack of data relating health problems to the immediate surroundings.

Table 3 (following page) details the possible health effects of the compounds and metals used in paints.

Tests have revealed that over 51 percent of children below the age of 12 living in major urban areas of India have elevated levels of blood lead

	<p>Type of metals and compounds used in paints</p>	<p>Possible health effects</p>
	<p>Water-based – ethylene glycol (glycol ether)</p>	<p>Ethylene glycol, a known teratogen can cause birth defects, skeletal malformation in rats, albuminuria, tremors, cyanosis, anuria and the presence of oxalic acid in the urine. Acrylic paints may release methyl methacrylate to cause eye and mucous membrane irritation and drowsiness; linked with anorexia, they are suspected of causing carcinogenesis and mutagenesis</p>
	<p>Alcohol/oil-based – turpentine, mineral spirits</p>	<p>Turpentine and mineral spirits are moderately toxic by all routes of entry; they're irritants and narcotics</p>
	<p>Organic and inorganic pigments like cadmium, lead, chromium and nickel of which lead compounds are preferred hiding agents; Titanium dioxide (TiO₂)</p>	<p>Exposure to chromium compounds can lead to increased risk of lung cancer. Inhalation of chrome dust or spray may lead to irritation of the bronchial tubes, ulceration of the mucous membranes of the nose and cornea, allergic contact dermatitis and irritation of eyes.¹¹ Cadmium remains stored in the kidneys, resulting in reduced kidney function. Lead affects the nervous system, inhalation of lead dust may result in lead poisoning followed by memory failure, muscular weakness, etc.</p>
	<p>Mildewcides; organic mercury-based preservatives, water-based paints use styrene-acrylic; vinyl acrylic (or 'PVA' – polyvinyl acetate); oil paints use a binder based on drying oil linseed; soya, formadehyde</p>	<p>Mercury is a neurotoxin. Exposure to organic mercury may lead to birth defects Formaldehyde can cause a high level of irritation of the mucous membrane and may cause inflammation of the respiratory system and skin ailments. It is also a known carcinogen.</p>
	<p>Alkyds, polyesters, emulsion polymers, epoxy resins, polyurethanes, polyesters, melamines; paraffin/ polyethylene (PE) blends</p>	<p>Polyurethanes, made from isocyanates,¹² are sensitising chemicals which can cause lung irritation or lung damage. Released as monomers from both water- and organic solvent-based polyurethane varnishes, they are know to emit VOCs. Pregnant women are at greatest risk from inhaling their fumes. Epoxy resins are organic solvent-based and contain aromatic hydrocarbon solvents such as xylene or toluene, which can lead to headache, convulsions, central nervous system damage, respiratory irritation, dizziness, kidney and liver damage, fatigue, hallucinations, dermatitis, carcinogenesis, teratogenesis and mutagenesis.</p>

The core of the problem – lead

One of the biggest health and environmental hazards from paints is the presence of lead. Lead is a poison, a potent neurotoxin whose deadly health effects have been known for nearly 3,000 years.

Preference for lead-based paints

A number of properties of lead make it commercially attractive for use in paints. It is easy to work with and durable, has colour vibrance, a low melting point, and the ability to form carbon metal compounds, holds pigments well, is very easily recycled, stands up well to outside weather elements, has a high degree of corrosion resistance, reduces paint drying time, and is inexpensive. In the form of lead carbonate and lead oxides, it has excellent adhesion, drying, and covering abilities.

History of lead in paints¹³

Lead compounds have historically formed an important component of many paints. White lead, linseed oil and inorganic pigments were the basic components of paints in the 18th, 19th and early 20th centuries. Lead-based paint was used extensively on wooden exteriors and interior trimwork, window sash, window frames, baseboards, wainscoting, doors, frames and high-gloss wall surfaces such as those found in kitchens and bathrooms. Almost all painted metals were primed with red lead or painted with lead-based paints. Even milk (casein) and water-based paints (distemper and calcimines) could contain some lead, usually in the form of hiding agents or pigments. Varnishes sometimes contained lead. Lead compounds were also used as driers in paint.

According to Dr T. Venkatesh, Director, National Referral Centre for Lead Poisoning in India (NRCLPI), US medical authorities diagnosed childhood lead poisoning caused by lead paints as long ago as 1887. After this was further linked to scientific evidence in 1904, France, Belgium and Austria banned the use of white lead in interior paints in 1909. The US National Lead Company admitted to lead being a poison in 1921. A study in 1943 concluded that eating lead paint chips causes physical and neurological disorders, learning and intelligence problems in children. Finally, the US Government passed the Lead-based Paint Poisoning Prevention Act in 1971.

In India, however, as Dr Venkatesh states, “we have not recognised the lessons from history, and continue to manufacture, supply and use lead paints”.

Exposure routes to lead in paints

Lead-based paints are one of just six major sources of lead exposure¹⁴. With paints, this exposure can happen at various stages, from the manufacturing of pigments used in paints to the point of use, and beyond to when the lead-based paint has dried. Paint industry workers and their family members are obviously at a high risk of exposure to lead, as are painters who take up contract jobs and their families. Even the end-consumer is not spared the exposure harm caused by lead-based paints. Climatic changes and humidity lead to the peeling off of paints in homes, generating fine lead dust, which is inhaled or consumed by residents. Children are the most vulnerable to these toxic effects, due to their developing stage and high hand-to-mouth activity.

There is an increased formation of lead dust during repainting or renovation of houses, when prior to applying a fresh coat of paint on pre-painted walls, the existing paint is scraped or sanded using abrasive paper. This generates a lot of paint dust that settles on floors, walls and furniture. Under these conditions, the fine dust can be dispersed into the air through cleaning, such as sweeping or vacuuming, or by the movement of people through the house, and thus be inhaled.

Lead exposure in children

Young children and unborn foetuses are at a higher risk of exposure to lead since it is more easily absorbed into the growing bodies and tissues of small children. According to the Illinois Teratogen Information Service, increased maternal blood lead levels are associated with foetal toxicity and a variety of minor anomalies, while children can ingest lead dust from hand-to-mouth contact or from food. Children are more susceptible to lead poisoning through consuming lead dust because lead has a sweet flavour, which makes children eat paint chips or chew on lead-painted toys. A single chip of paint of the size of a thumbnail contains 1 gm of lead and a few such chips can raise the intake of lead to over 1,000 times the acceptable limit.¹⁵ Children’s digestive systems absorb up to 50 percent of the lead ingested by them.¹⁶ Nutritional deficiencies also play a vital role, as the body tends to absorb more lead when deficiencies in calcium, magnesium and iron exist.

According to Dr Venkatesh, a number of cases of lead poisoning in children have been reported at St John’s Medical College, Bangalore. The main cause is the consumption of leaded paint chips. Due to economic constraints, Dr Venkatesh adds, many people are not in a condition to get their blood lead levels tested in order to establish the incidence and intensity of lead poisoning, resulting in children with impaired IQ.

Lead exposure in children can cause a delay in physical and mental development, accompanied by

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lower IQ levels, shortened attention spans and increased behavioural problems. Exposure to even low levels of lead in children can permanently affect children, causing

- ▼ Nervous system and kidney damage.
- ▼ Learning disabilities, attention deficit disorder, and decreased intelligence.
- ▼ Speech, language and behaviour problems.
- ▼ Poor muscle coordination.
- ▼ Decreased muscle and bone growth.
- ▼ Hearing damage.

Regulations specific for use of toxic compounds in paints

As with so many other aspects of consumer products, stringent rules and regulations exist internationally on the use of lead in paints; in India, however, there are few specific rules, and even those that do exist are loose in their interpretation and implementation. While the global trend has long been towards banning the use of lead in paints (*see box below*), India only laid down its first set of standards describing use of toxic compounds including lead in paints in 1995, and even these require only voluntary implementation.

According to the Ecolabelling Notification No VIII, issued by the Ministry of Environment and Forests, the Bureau of Indian Standards (BIS) has laid down volunteer standards for architectural paints and powder coatings to meet the Ecomark criteria, stating that²⁰:

- ▼ The product must display a list of critical ingredients in descending order of quantity present. The list of such ingredients shall be identified by the Bureau of Indian Standards.
- ▼ The product packaging may display in brief the criteria based on which the product has been labelled as environment-friendly.

For water-based coatings

- ▼ The product shall not contain more than 5 per cent VOCs.
- ▼ The product shall not be formulated with mercury and mercury compounds or be tinted with pigments of lead, cadmium, chromium VI or their oxides.

For powder coatings

- ▼ The product shall be free from any VOCs.
- ▼ The product shall not be formulated with mercury and mercury compounds or be tinted with pigments of lead, cadmium, chromium VI or their oxides

For solvent paints high solid coatings

- ▼ The product shall not contain VOCs in excess of 380 gm/l. (This limit is equal to one prescribed by EPA's Environmentally Preferable Purchasing Program.²¹)
- ▼ The product shall not be formulated with mercury and mercury compounds or be tinted with pigments of lead, cadmium, chromium VI or their oxides.

Global status of lead used in paints

The International Labour Organization (ILO) laid down a White Lead (Painting) Convention, 1921, which came into force in 1923. According to this Convention, "each member of the ILO ratifying the Convention undertakes to prohibit the use of white lead along with the products containing these pigments, in the internal painting of buildings except where their use is considered necessary for railway stations or industrial establishments after consultation with the employers' and workers' organisations concerned".¹⁷ India, despite being one of the member organisations of ILO, **has still not ratified the Convention**, to escape enforcement of the regulations that it lays down.

The sixth chapter of the Johannesburg Plan of Implementation laid down by the UN Division of Sustainable Development also discusses phasing out of lead in lead-based paints to prevent exposure among humans, and in particular, children. It lays emphasis on monitoring and surveillance efforts, along with the treatment of lead poisoning¹⁸.

France, which started banning lead in paint in the 1870s, was the pioneer in this matter.¹⁹ Germany, Australia, Japan and many other countries banned the use of lead in residential paints in the early 1920s. The United States and England were among the last industrialised nations to address the issue.

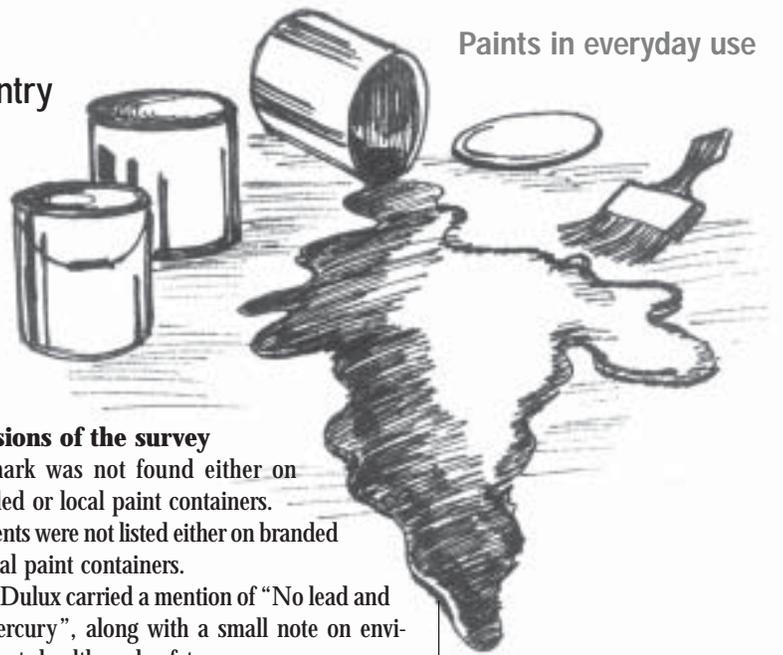
Current status of paints available in the country

The George Foundation, a Bangalore-based NGO, conducted a small survey of commercially available paints in 1999, under which 24 paint samples selected from six paint companies were purchased in stores in Bangalore and Chennai. These samples were sent to Australia for analysis²². The following observations were noted:

- 1 Paint cans did not have any warning labels regarding lead content nor was any guidance issued on hazardous usage of paints. This implies that there is no regulation in India regarding labelling on paint cans containing lead. Consumers are totally unaware of the lead content in paints, and of the unsuitability of such paints for many purposes.
- 2 Of the 24 samples analysed, 17 had lead concentrations exceeding 0.5% by weight; 13 had lead concentrations exceeding 1%; and five exceeded 10%.
- 3 The lead in paints collected were dominated by a group of pigments best described generically as lead chromates.
- 4 Most of the colours of these paints were characteristic of mineral compounds that make up the lead-chromate group.
- 5 Another selection of five white paints and timber primers were purchased to discover white lead. Apart from a metal primer, the remaining paints were bright, colourful enamels for timber surfaces in blue, green, red, orange and yellow that might readily be used on children's toys. These type of paints are also commonly seen in use on temples and shrines in Bangalore and Chennai.

The study also revealed that lead-based paints are readily available for purchase for household use in India. Eleven of 29 currently available paints from five manufacturers would equal or exceed 1.0 mg/cm² after the application of one to three coats, with yellow and yellow derivative paint colours having the highest lead content. More than 10 percent of the surfaces in existing houses in Managalore were tested to contain lead-based paint. The study concluded that lead paint is a significant potential source of lead poisoning in India.

Toxics Link also conducted a small survey in March 2005, to review the information provided on paint cans regarding content percentages and usage of the Ecomark label. Ten shops were surveyed in the markets of Kotla Mubarakpur and Bhogal in New Delhi with a focus on branded and local paints, respectively. The branded paints studied were Nerolac, Asian Paints, Dulux, Duco, Shalimar and Berger, while the local paints were Rangolite, Honda, Dyeton, Everlac and Crown.



Paints in everyday use

Conclusions of the survey

- ▼ Ecomark was not found either on branded or local paint containers.
- ▼ Contents were not listed either on branded or local paint containers.
- ▼ Only Dulux carried a mention of "No lead and no mercury", along with a small note on environment, health and safety.
- ▼ Every paint can carried mention of handling and disposal methods.

Regulations don't regulate enough

Leaded paints rule 91 percent of the Indian market share; less than 8 percent of our paints are manufactured unleaded or lead-free. There is no specific demand for unleaded paint products, so such products tend to be more expensive and not in frequent use.

According to Dr T. Venkatesh, the lack of awareness at the consumer level regarding the toxic effect of lead results in people continuing to buy lead-containing paints. Display labels on paint containers do not carry information about their contents and the possible environmental and health effects of those components.

Alternatives to lead pigments in paints

On realising the toxic effects of lead use in paints, a number of developed countries switched to pigments such as titanium dioxide and zinc oxide during the 1960s and '70s. The superior early drying property of lead, however, makes it a more attractive option to uninformed consumers. Also the use of lead as a pigment in paints is much more economic than these alternatives, says Dr Venkatesh. Titanium dioxide, for example, is imported to India for use in paint manufacturing. The imports are in excess of Rs 1 billion²³. If the demand of the material grows – which it would if the paint industry among other sectors were to insist on its usage – its domestic production would get enhanced. As the capacity for expansion exists in the industry, this scenario could see India ending up as a net exporter of TiO₂ within the next five years.

There is little awareness at the consumer level regarding the toxic effect of lead used in paints, as a result of which people continue to buy the leaded paints which rule 91% of our market share

Concerns and recommendations

One fact made evident by this review of the paints scenario is that, in order to effectively address our environmental health status, we need to engage on issues at a consumer level. Consumers must make it a point to seek all possible information of the constituents of products. An aware community will be a driver in maintaining the standards and laws laid down in the country.

There are a number of important concerns regarding the use of lead in paints, some of which are listed below.

- ▲ Stringent legislations should be passed banning the use of lead and harmful compounds in paints.
- ▲ A mandatory standard required for paint manufacturers to conform to Ecomark labelling must be established.
- ▲ It must be made mandatory to display the listing of constituents of paints with percentages thereof, on every container.
- ▲ There is an immediate high-priority need to ensure that colourful lead-pigmented paints are not applied to children's toys.
- ▲ Research should be conducted to assess the likely presence of lead-painted objects in residential settings in India that are accessible to children and pose an exposure risk.
- ▲ There is an urgent need for a comprehensive survey of the paint manufacturing industry in India, to establish the patterns of manufacture of lead paints and determine whether there are opportunities for diversification into alternative manufacturing processes and materials.
- ▲ Incentives should be provided for the development of environment- and health-friendly paints, devoid of toxic compounds.

References

- ¹ *Paint Wars, a presentation by Asian Paints, 2000*
- ² www.paintquality.com.au
- ³ *A biocide generally means any substance that kills or inhibits the growth of microorganisms such as bacteria, molds, fungi, etc*
- ⁴ *The titanium white used in most paints is a mixture of titanium dioxide (pure titanium white) and zinc oxide (zinc white).*
- ⁵ *Hiding power is the ability of the paint to sufficiently cover or conceal the surface on which it is applied. Hiding power comes from the paint's pigment and is affected by the manner and thickness of the application*
- ⁶ www.arb.ca.gov
- ⁷ www.rainforestinfo.org.au/good_wood
- ⁸ www.parish-supply.com/volatile_organic_compounds.htm
- ⁹ *Gavaghan, Helen: Lead, unsafe at any level. Bull World Health Organ. [online], p 82, vol 80, no 1, 2002 [cited May 18, 2005]*
- ¹⁰ *Clark, C. S. et al: Lead in paint and soil in Karnataka and Gujarat, India. Journal of Occupational and Environmental Hygiene, 2005*
- ¹¹ www.hse.gov.uk/pubns/eis32.pdf
- ¹² *Isocyanates are the group of chemicals associated with the world's worst chemical accident, the Bhopal Gas disaster, which took place in Bhopal, India, in 1984*
- ¹³ architecture.about.com/library/bl-preservationbrief-leadpaint.htm
- ¹⁴ www.tgfworld.org/lead.html
- ¹⁵ www.tgfworld.org/lead.html
- ¹⁶ *ibid 10*
- ¹⁷ www.ilo.org
- ¹⁸ www.un.org/esa/sustdev/
- ¹⁹ www.leadpro.com/faq.html
- ²⁰ *Ecomark Criteria for Architectural Paints and Powder Coatings (The Gazette of India, Extraordinary, Part II-Section 3(i), No 364, Sept 7, 1995)*
- ²¹ *NAHB Green Home Building Guidelines, 2004*
- ²² *van Alphen, Mike: Lead in paints and water in India*
- ²³ www.equitymaster.com/research-it/sector-info/paint/paint-inputs.html

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