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Metals in Printing Inks©

There is currently a renewed interest in the environmental impact and safety of a whole range of manufactured materials including printing inks. The recent media attention concerning the detection of toxic metals in pigmented coatings (paints and inks) applied to imported products has led to a plethora of published information as well as posted information on a variety of internet sites. In many instances this information is incorrect, inaccurate or misleading as there is a tendency to make generalizations about metals of all types. The objective of this report is to provide current and accurate information regarding the origins, presence and usage of metals in printing inks currently manufactured in the United States.

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Metals in Printing Inks©

Overview

Metals can be present in printing inks in the form of metal-based pigments, driers or through impurities and contaminants in the raw materials used in the formulation process.

Federal health and environmental regulations enacted in the United States beginning 1970's made the usage of the known highly toxic metals (i.e. lead, arsenic, selenium, mercury, cadmium and hexavalent chromium or compounds based on these metals) as printing ink formulation components an unattractive option and ultimately resulted in the large-scale removal of these metals from commercial usage in printing inks. It is important to note that the term "heavy metal" has no specific definition within the U.S. health, safety and environmental regulations or within the scientific/technical community.

Metallic Inks

Metallic printing inks are generally based upon systems containing copper, brass (alloy of copper and zinc) and aluminum-based pigments. These materials do not lead to soluble metal salts under ambient environmental and physiological conditions and therefore are not considered an environmental risk.

Fluorescent Inks

Fluorescent inks generally do not use metal-based pigment systems.

Inks using Metal-based pigments

Some pigments used in printing inks contain metals such as copper and barium-based pigments. Copper phthalocyanine (commonly called phthalo blue) contains covalently bound copper. The copper in phthalo blue is not available under ambient environmental and physiological conditions. Barium-based pigments are used in some types of "warm red" inks. This barium is used to precipitate the soluble chromophore (part of the pigment molecule responsible for its color) and is not readily made available as a soluble salt under ambient environmental and physiological conditions. It is important to note that these pigments are not considered hazardous under the OSHA Hazard Communication Standards (29 CFR 1910.1200)

Inks Using Metal-Based Driers

Printing inks that dry by oxidation usually contain driers. Driers act as catalysts to accelerate the oxidation or polymerization of the oils used in the printing ink. Driers can be inorganic salts, metallic soaps and organic derivatives of various metals. Cobalt and manganese carboxylate compounds either singly or more often in combination are the most widely used driers in printing inks. Driers based on zinc, calcium, zirconium and other metal compounds are also used for this purpose. The driers themselves may typically contain 5-10% metal, and are typically added to the ink at levels of 0.5% - 2.0% so the metal content of the final ink may be in the range of 0.025% - 0.2%. Printing ink

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driers do not use the known highly toxic metals (i.e. lead, arsenic, selenium, mercury, cadmium and hexavalent chromium).

Impurities and Contaminants

Toxic heavy metals occur naturally in the earth's crust in varying concentrations. There are natural background/baseline concentrations in soils, sediments, waters and organisms. The New York State Department of the Environmental Conservation lists the following background concentrations of heavy metals in the eastern United States:

Metal	PPM
Arsenic	3 - 12
Lead	4 - 61
Cadmium	0.1 - 1
Chromium	1.5 - 40
Selenium	0.1-3.9

Petroleum-based raw materials used in printing inks can also contain background concentrations of toxic heavy metals at similar or greater than natural background concentrations depending on the source of the raw materials, processing operations and other variables.

U.S. Regulations and Guidelines

Consumer Product Safety – Paint and Painted Toys - The Consumer Product Safety Commission has under 16 CFR 1303 declared "...that paint and similar surface-coating materials for consumer use that contain lead or lead compounds and in which the lead content (calculated as lead metal) 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. ...". It is important to note that 16 CFR 1303.2(b)(1) excludes printing ink from the definition of paint and other similar surface-coating materials.

Consumer Product Safety Improvement Act of 2008 (CPSIA) – The General Lead Ban of the CPSIA restricts lead concentrations in children's products according to the table below:

Lead Concentration (PPM)	Applies to	Effective Date
600	Children's Products	Feb. 10, 2009
300		Aug. 14, 2009
100*		Aug. 14, 2011

*if technologically feasible

Additional information related to CPSIA metals concentrations restrictions in children's toys and childcare articles is available on the NAPIM website.

OSHA – OSHA regulates occupational exposure to aluminum, arsenic, cadmium, copper, hexavalent chrome and mercury under both the Hazard Communication Standard and the Toxic and Hazardous Substances regulations.

RCRA – The Resource Conservation and Recovery Act regulates disposal of the following metals or materials containing the following metals in specific concentrations: arsenic, barium, cadmium, chromium, lead, mercury, selenium and silver. RCRA regulations specify EPA Test Method 1311 – Toxicity Characteristic Leachate Procedure for determination of metals concentrations in solid wastes.

Emergency Planning and Community Right to Know Act (EPCRA) – Barium compounds (except barium sulfate), copper compounds (except certain copper phthalocyanine pigments), zinc compounds and cobalt compounds are reportable under Section 313 of EPCRA

Coalition of Northeastern Governors (CONEG) - Nineteen states (California, New Hampshire, Connecticut, New Jersey, Florida, New York, Georgia, Pennsylvania, Illinois, Rhode Island, Iowa, Vermont, Maine, Virginia, Maryland, Washington, Minnesota, Wisconsin and Missouri) have toxics in packaging laws based on the "CONEG" Model Legislation. State toxics in packaging laws prohibit the intentional use of lead, cadmium, mercury, and hexavalent chromium in packaging or individual packaging components, such as inks, adhesives, or labels. These regulated metals are limited under state law when present as incidental impurities at 100 ppm in any package or individual packaging component. In some case other federal and state laws provide exemptions for recycled-content, reusable containers, and recycled packages.

Testing for Metals

Analysis of EPA priority pollutant metals is conducted by inductively coupled plasma (ICP) atomic emission spectroscopy according to EPA methods 6010 or 6020. Samples are prepared by digestion with nitric acid using EPA Method 3050 (for hazardous waste determinations) EPA Method 3052 (total metals) and analyzed for the requested elements, with the exception of mercury, which uses EPA Method 7471A. Analytical values less than the method detection limit (MDL) are reported as not detected. The American Society for Testing and Materials standard – F963-07e1 is the specified test method for compliance with the Consumer Product Safety Act "Toy Standard".

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