Health and Safety in the Ink Industry

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Abstract:

This presentation will address the fastest growing areas of printer's concerns:

A. Health and Safety Concerns of Ink Handling,
B. Ink Hazardous Waste Characteristics, and
C. Ink Heavy Metal Content.

A brief overview of each topic will be given from Flint Ink's perspective, with testing results to demonstrate empirically the relative hazards associated with ink handling and the sources of heavy metal contamination in inks.

With the demise in the 70's, 80's and 90's of lead, chromium and cadmium-based pigments as standard ink colorants, the perception of ink handling hazards has changed somewhat. Even though many laboratory animal studies demonstrated that heavy metal pigments posed little or no human health threat, these pigments have been phased out of use for inks. The reasons are many and include: continued regulation by OSHA of the heavy metal operations (i.e. lead); Regulation of heavy metal pigments under SARA, CERCLA, RCRA, and CONEG.

In many cases, particularly in gravure and solvent flexographic inks, the degree of hazard of the finished ink depends largely upon the solvents which have been used in the mixture. Characteristics such as flash point and solvent toxicity, will be only slightly changed with the addition of the ink vehicle and colorants. The toluene in a rotogravure ink, for example, will still be the primary health hazard for that ink.

Ink handling safety is a function of many factors:

A. Inherent toxicity of the solvents involved
B. Degree of human exposure (i.e. duration and quantities)
C. Means of exposure to individuals (i.e. air, skin contact, etc.)
D. Susceptibility of the exposed individual

Environmental issues including hazardous wastes, solid waste and empty container management are high priority topics at all levels of a printing operation. Speculation has recently been raised regarding the suitability of some disposal techniques for printed material (i.e. newspapers and packaging).

Proper identification and segregation of waste types can assist in managing costs as well as long-term exposure.

Suitable recycling and treatment options for a printer's wastes are slow in coming. Wash-up solvents are easily reclaimed and fuel blended. However, waterbased wastes and solids are much more expensive to manage.

Ink industry safety and health issues revolve around the toxicity of the inks. The toxicity is measured by exposing the inks to test criteria. The tests may be actual animal exposures or chemical tests and modeling which approximate potential exposures.

The toxicity of a substance is the relationship between the dosage or amount of the substance and the response it elicits in the test subject. For a substance to elicit a toxic response two requirements must be met: 1. The substance must be available metabolically to the subject; and 2. The dosage must be sufficient to elicit a response (Casarett and Doull, 1975).

Flint Ink Corporation inks were tested by two completely different methods. The test data in Tables 1 and 1.1 is laboratory animal data which was derived from Federal Hazardous Substance Labeling Act (FSHLA) testing guidelines. Table 2 contains the Toxicity Characteristic Leachate Procedure (TCLP) test results. Another method of assessing toxicity is to look backward at the population of ink industry workers which have been exposed over the years to all manner of inks and ingredients. The human exposure evaluations have not generated to date any literature which links ink manufacturing to increases in morbidity (disease) or mortality among those affected workers. Flint Ink's analysis of employee physical examinations and workers compensation forms supports this contention.

The Table 1 and Table 2 information resulted from testing the finished inks as they are sold to our customers. The animal (FHSLA) results demonstrate that none of the inks tested were toxic by ingestion. The most significant results are the eye (occular) irritation scores.

The eye irritation results can be directly correlated to the solvents used in the ink. For example, gravure inks which are made with strong solvents (high kauri butanol values) elicit a severe irritation of the tissues of the eye. Oil-based inks on the other hand are practically non-irritating.

The pigments, resins and other ink components have a relatively small impact on the overall toxicity of the inks. An examination of the supplier's material safety data sheets substantiates this observation. Supplier products are continually evaluated to reduce and eliminate any potential health hazards.

An ink may be classified as a hazardous waste by any one of six criteria:

1. Toxicity Characteristic Leachate Procedure
2. Ignitability
3. Corrosivity
4. Reactivity
5. Content of listed (F, P, K, U) wastes
6. Administrative Declaration

(40 CFR 261.11, Subpart C and Subpart D)

The Toxicity Characteristic Leachate Procedure (TCLP) is the USEPA's analytical tool for making hazardous waste determinations. If one or more of the listed elements or compounds is detected at or above its listed limit, the USEPA considers the waste to be toxic and therefore a hazardous waste. Analytical procedures and the matrix interference, the chemical properties of ink which prevent the ink from breaking down, can lead to difficulties for the chemists performing TCLP on ink. The procedure stipulates that a weak acid solution be used to digest the test material. An inexperienced laboratory will have difficulty dealing with the procedure and may report limits of detectability and results as "less than" an amount which may be higher than the waste concentration limit. False positives may also be reported (i.e. mercury in water ink and selenium in aluminum metallic inks). To prevent these situations, put your analytical laboratory in touch with your ink supplier ahead of time. The professional ink chemists can provide useful insights into ink properties for your testing laboratory. If your testing laboratory won't listen, change testing laboratories.

The TCLP testing which has been performed on the Flint Ink products listed on Table 2 show that these inks are not TCLP toxic as they are supplied to customers. Ink wastes can become TCLP toxic if metal-containing prepress chemicals, or solvents which contain TCLP organics such as benzene, are mixed with the ink. Solvent-based inks such as packaging rotogravure or flexographic inks have flash points which are below 141°F. These inks would be hazardous wastes due to ignitability (flash point less than 141°F).

For many years the various agencies assumed that inks were hazardous waste because of lead and chromium content. This just isn't so. Each waste must be evaluated either by process knowledge or testing to make such a determination.

The tests for corrosivity and reactivity are relatively straight forward and have been dealt with at length in other articles.

The content in waste ink of listed solvents such as "F" wash-up solvents may be controlled by elimination of those materials from the solvents used in the press room. Lists of these solvents, as well as the "P, K and U" wastes, are available from a number of sources including the USEPA RCRA/superfund Hotline (800)424-9346.

The Administrative Declaration that waste is hazardous generally occurs because a generator has insufficient information regarding the five criteria previously discussed. The agency inspector usually demands that a waste be handled as hazardous or that documentation be provided within 15 to 30 days which supports a nonhazardous waste determination.

Summary:

The information provided in Tables 1, 1.1 and 2 is not intended to be all inclusive or applicable for products from other ink suppliers. This data is however supported by many tests of Flint Ink products. Similar data from a printer's supplier should be kept on file by

the printer for review by the regulatory agencies.

This data will help to alleviate some regulatory issues, as well as provide assistance when monitoring worker exposures. The lack of adverse human health data, when combined with the animal toxicity data, supports the contention that the heatset, sheetfed and other oil-based inks are of relatively little health concern under conditions of normal use. The solvent inks must be used in well ventilated areas for fire code reasons as well as for concerns of human exposure to solvents. Protective equipment should be worn which protects the eyes and skin from all solvents and cleaners.

Each printer must evaluate his workplace under the requirements of the Hazard Communication Standard (29 CFR 1910.1200). This evaluation involves use of data as presented in this paper and other data to define safe operating conditions in the press room. To protect his workers, the printer must enforce the safe operating conditions.

Bibliography

1. Casarett, L. J. PhD, and Doull, J. MD. PhD., editors, Toxicology, The Basic Science of Poisons, Macmiltan Press, 1975.

2. U.S. EPA Regulations for Identifying Hazardous Wastes, Title 40 Code of Federal Regulations, Chapter 1, Part 261.11, Subpart C and Subpart D, as amended May 3, 1993.

3. Occupational Safety and Health Administration, U.S. Department of Labor, Title 29, Code of Federal Regulations, Chapter 1910.1200.

Table 1

General Ink Category	Primary Eye Irritation	Primary Skin Irritation	Acute Dermal Toxicity	Acute Oral Toxicity	Acute Inhalation Study
Packaging Rotogravure Chicago	Severely Irritating	Non-Primary Irritant	>2.0 m/kg	>5.0 ml/kg	
Waterbased Packaging Flexo.	Moderately Irritating	Mild Primary Irritant	>2.0 ml/kg	>5.0 ml/kg	LC 50 >36.1 mg/4hr. nominal
Solvent Flexo	Severely Irritating	Moderate Primary Irritant	>2.0 ml/kg	>5.0 ml/kg	
Heatset Web	Practically Non-Irritating	Moderate Primary Irritant	>2.0 g/kg	>5.0 g/kg	
Sheetfed Offset	Practically Non-Irritating	Moderate Primary Irritant	>2.0 g/kg	>5.0 g/kg	
Glycol Moisture Set	Severely Irritating	Non-Primary Irritant	LD 50 >2.0 g/kg	>5.0 g/kg	
Silk Screen Glycol Ethers	Mildly Irritating	Mild Primary Irritant	LD 50 >2.0 g/kg		
O/S UV Black	Severely Irritating	Mild Primary Irritant	LD 50 >2.0 g/kg	>5.0 g/kg	
Metal Deco	Moderately Irritating	Mild Primary Irritant	>2.0 g/kg	>5.0 g/kg	

Table 1.1

TOXICITY TESTING RESULTS

Ink Type	Oral Toxicity	Eye Irritation	Skin Irritation	Inhalation Toxicity
Letterpress Black News	non-toxic	practically non-irritating	non-primary irritant	non-toxic
Offset Black News	no data	mild irritant	non-primary irritant	non-toxic
Water Flexo-graphic News	no data	moderate irritant	non-primary irritant	no data
Web Heatset Black	non-toxic	mild irritant	non-primary irritant	non-toxic

Table 2

Hazardous Waste Characteristic of Printing Inks as Supplied

	Flash Point	Corrosive	Reactive	Toxic By TCLP
Solvent Flexo, Gravure and Screen Inks	<100° F	No	No	No
Water Flexo Gravure and Screen Inks	>105° F (Some may be <141°F)	No	No	No
Sheetfed Offset	>185° F	No	No	No
Heatset Offset	>185° F (Most >200° F)	No	No	No
Noheat Web News Ink	>200° F	No	No	No
Letterpress News Ink	>200° F	No	No	No
Offset News Ink	>200° F	No	No	No
Water Based	>200° F	No	No	No
Glycol Based	>185° F	No	No	No