

DATA SHEET:
USING ARTISTS' PAINTS

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The diseases caused by painting and pigment grinding have been observed since Ramazini wrote about them in 1713. Back then, painters did not know about the chemical hazards in their paints as we do now.

WHAT ARE PAINTS?

Today artists use a vast array of different paints; however, these products have many properties in common because almost all of them contain pigments suspended in vehicles or bases. Vehicles usually contain a liquid such as an oil, a solvent, or water. Cleaners and thinners for most paints are these same liquids or liquids which are compatible with them. For example, turpentine will thin and clean up oil paints.

WHAT ARE DRAWING MATERIALS?

Drawing materials also are pigments suspended in vehicles. Some drawing material vehicles include wax (crayons), inert minerals (pastels, conte crayons, chalks), and liquids (solvent and water-based inks and marking pens). Pencils contain "leads" made of graphite and clay ("lead" pencils) or pigmented clay/binder mixtures (colored pencils).

The hazards of painting and drawing materials arise from exposure to their pigments, vehicles, and solvents.

WHAT ARE PIGMENTS?

The origins of pigments and dyes are lost in antiquity, although we know that they sprang from common natural products such as minerals, berries,

roots, and insects. When mauve, the first synthetic dye, was discovered in 1856, it catalyzed the development of the whole organic chemical industry. Since then a host of synthetic chemical dyes and pigments have been created.

It is necessary to consider pigments and dyes together since the distinction between pigments and dyes often is based on usage and physical properties rather than on chemical constitution. The principle characteristic of a pigment which distinguishes it from a dye is that it is substantially insoluble in the medium in which it is used. In fact, there are numerous instances in which the same chemical product serves as either a dye or a pigment. Thus it is often difficult to understand how various types of colorants are classified.

PIGMENT AND DYE CLASSIFICATION

Companies selling paints, inks, pigments and dyes list colors in many ways, sometimes using traditional names (Prussian blue, Mars brown etc.), simple colors (white, red, etc.), and sometimes fanciful names designed to attract customers (peacock blue). As a result, it is almost impossible to know the actual color chemicals to which these names refer.

One answer to this identification problem is to prevail upon dye and paint manufacturers and distributors to reveal their products' internationally accepted Color Index (C. I.) names and/or numbers. All but a handful of commercial pigments and dyes are assigned these identifying names and/or numbers. Many responsible manufacturers of fine arts products already provide this service for customers.

Another way to identify some dyes and pigments is by their Chemical Abstracts Service numbers.¹ However, not all pigments and dye have Chemical Abstracts Service numbers. At the very least, artists need to know if the pigments they use are classified either as inorganic or organic chemicals.

INORGANIC PIGMENTS come from the earth (ochres, for example), or they are manufactured from metals or minerals (like lead white or cerulean blue). These pigments have been used for many years and their toxic effects are fairly well known. The lead-containing colors are especially toxic and have a long history of causing poisoning. For this reason they are banned in consumer wall paints. But artists' paints and inks, boat paints, automobile paints, and metal priming paints may still employ them.

ORGANIC PIGMENTS are either from natural sources such as Alizarin crimson from madder root, or they are synthesized from organic chemicals. Examples of synthetic pigments include phthalo blue and the fluorescent colors.

There are hundreds of organic pigments used in art materials. Most of the natural organic pigments and only a handful of the synthetic organic pigments have been studied for long-term hazards. Of those which have been studied, some have been shown to be toxic, some are not toxic, and some cause cancer in animals. Some synthetic pigments also are hazardous because they contain highly toxic impurities such as cancer-causing PCBs. (These impurities, poly-chlorinated biphenyls, are unwanted by-products created during manufacture.)

Some pigments are related to the chemical "benzidine" which is known to cause bladder cancer. Benzidine pigments and dyes may also cause this disease. Recent epidemiological studies of artist painters and industrial painters found elevated incidence of diseases, especially bladder cancer.²

PIGMENT HAZARDS

There are only a few hundred pigments which

are light-fast enough to be used in art. These pigments are used in oils, acrylics, alkyds, pastels, colored pencils, and all colored materials used in high-quality fine arts products. The hazards of these pigments are listed in a chart in *The Artist's Complete Health and Safety Guide*, pages 114-134.³

Paints with fugitive pigments (those which fade with time or exposure to light) can be used for work which is not expected to endure many years, such as theatrical scenery or props, commercial art, or children's art work. Artists who use untraditional paints such as consumer wall paints will also find that the pigments in these paints fade. Fugitive pigments are often complex organic chemicals whose long-term hazards are not well-studied.

1. Inhalation is the route by which pigments are most hazardous. Processes during which pigments could be inhaled include: working with raw powdered pigments; using dusty chalks or pastels; sanding or chipping paints; airbrushing or spraying paints; and heating or torching paints until pigments fume. One common source of pigment dust is walking on paint splattered floors which, over time, grinds the paint to a fine dust which is tracked all over the home or school.
2. Skin contact with pigments is less hazardous. It is assumed that pigments usually are not absorbed in significant amounts by skin contact. However, there has almost no testing of this premise. It is now known that lead and some of its compounds absorb through the skin, but tests on the lead pigments except for lead oxide (which skin-absorbs) have never been done. Neither has testing been done on cadmium and other toxic metal pigments. No testing of skin absorption of the organic pigments has been done either. Some contaminants in the organic pigments such as PCB's and dioxin could be skin absorbed in very small amounts. And some pigments can cause dermatitis or skin irritation. Preventing skin contact through good hygiene can prevent all these problems.
3. Ingestion of pigments occurs from hand to mouth contact, from contaminating food and drink in the studio, and from ingestion of

inhaled pigments by lung clearing mechanisms. Good hygiene can reduce ingestion of paint pigments.

VEHICLE HAZARDS

Common vehicles include oils, wax, water, egg yolk, casein, resins, and polymer emulsions and solvent solutions. Vehicles usually also contain additives such as stabilizers (to keep ingredients in suspension), preservatives, plasticizers, antioxidants, fillers, wetting agents, retarders, and more. These additives affect paint characteristics such as drying time and workability. The hazards of many of these additives have not been well researched. And manufacturers often are reluctant to divulge the identity of these additives.

Vehicle preservatives can be especially hazardous since their purpose is to kill microorganisms. Common paint preservatives include formaldehyde (sometimes in the form of paraformaldehyde or formalin), phenol, mercury compounds, bleach, and a host of commercial fungicides and pesticides.

Even though these additives are present in small amounts, they have caused illness in artists. For example, a mural artist developed mercury poisoning some years ago from soluble mercury preservatives used in her paints.

Vehicle ingredients can be divided into volatile (will evaporate into the air) and nonvolatile components. Since nonvolatile ingredients do not become airborne, they usually present no significant hazard to artists unless they are used in techniques that make them available to be inhaled, such as spray painting. Some resins and vehicle solids are associated with allergies.

Volatile vehicle ingredients, on the other hand, can be inhaled by artists while they work or while paints or inks are drying. Acrylic paints, for example, usually contain ingredients which release ammonia and formaldehyde gases while they dry. Permanent markers contain solvents which evaporate and can be inhaled.

SOLVENT HAZARDS

Solvents may be found in paints and inks or may be used to thin and clean up materials. Solvents are also found in products used with painting and drawing such as varnishes, shellacs, lacquers, and fixatives. These products include resins such as damar, mastic, copal, lac, shellac, acrylic, and other plastic resins dissolved in solvents. (Some of these resins have been known to cause allergies.)

Solvents commonly used in paints, thinners, varnishes, etc., include turpentine, paint thinner, mineral spirits, methyl alcohol, ethyl alcohol, acetone, toluene, xylene, ethyl and other acetates, and petroleum distillates. Solvents are some of the most dangerous chemicals used in painting. Details of their hazards are discussed in Chapter 9 of *The Artist's Complete Health and Safety Guide*.³ This data sheet helps artists interpret TLVs and how to use them to select safer solvents.

In general, if solvents have similar evaporation rates, higher TLVs mean that greater amounts can be tolerated by most healthy adults in the workplace. (TLVs should not be used to predict safety for children or pregnant women.) Comparing the TLVs of some solvents used specifically for oil painting in order of increasing toxicity show that Gamsol and Isopar L are safer to use:

<u>SUBSTANCE</u>	<u>TLV-TWA</u> ⁴
Gamsol or Isopar L	300 parts per million
mineral spirits, paint thinner	100 ppm
turpentine or citrus oil ⁵	20 ppm ⁵

GENERAL PRECAUTIONS FOR VARIOUS MEDIA

The hazards of each type of painting or drawing will depend on the toxicity of the ingredients of the materials and how much exposure occurs during use. The most hazardous exposure to paints will occur if they are air-brushed, sprayed, or otherwise made airborne. These processes always require local exhaust ventilation.

When paint and ink are applied by brushing, rolling, dipping and other methods which do not cause pigments and vehicles to become airborne, precautions will vary depending on the hazards of each paint or ink.

VENTILATION AND PRECAUTIONS FOR PAINTING AND DRAWING MEDIA IN STUDIOS (not at home)

The following hazards and precautions apply only to paint and ink techniques such as brushing, rolling, and dipping which do not cause paints to become airborne:

ACRYLIC PAINTS (WATER-BASED EMULSIONS) are composed of synthetic acrylic resins and pigments with many additives usually including an ammonia-containing stabilizer and often formaldehyde or some other preservative. Formaldehyde has caused cancer in animals. But without a preservative, the paint will support bacterial and mold growth. Diluting the paint and leaving it stand out will demonstrate this fact. The small amounts of ammonia and preservative released during drying can cause respiratory irritation and allergies, but so will emanations from mold and bacteria. A little ventilation such as that provided by a window exhaust fan should be sufficient even for large canvases.

ACRYLIC PAINTS (SOLVENT-BASED) are synthetic acrylic resins and pigments dissolved in solvents. The solvents should be identified and the ventilation should be sufficient to keep the solvent's concentration at a safe level.

ALKYD PAINTS are alkyd resins and pigments dissolved in solvents. Provide dilution ventilation at a rate sufficient to keep solvent's concentrations at safe levels.

ARTIST'S OILS are pigments milled into oils such as pre-polymerized linseed oil. There usually are no volatile ingredients, but oil paints are commonly thinned and cleaned up with solvents such as paint thinner. Dilution ventilation sufficient to keep solvent exposure low should be provided. Some people use oil paints without solvents and clean brushes and skin with baby oil followed by soap and water. This is a very safe way to work and

requires no special ventilation.

CASEINS are made from dried milk, pigments, and preservatives. Some contain ammonium hydroxide which can be irritating to the skin and eyes and dust from the powdered paint should not be inhaled. There are usually very strong preservatives added because the casein is a good source of food for microorganisms. When painting with brushes or rollers, ordinary comfort ventilation should be sufficient.

CHARCOAL has no known significant hazards except that dust of any type can cause symptoms in some people with severe respiratory problems such as asthma.

CONSUMER OIL PAINTS AND ENAMELS contain pigments, fillers, and a variety of solvents. A common solvent for these paints is paint thinner. Sufficient dilution ventilation should be provided.

CONSUMER LATEX PAINTS are primarily pigments and water emulsions of various plastic resins. Most also contain between 5 and 15 percent solvents. On occasion, these solvents are the highly toxic glycol ethers (see *The Artist's Complete Health and Safety Guide* for a list of Common Solvents and Their Hazards, pages 114-134)³ which can be skin-absorbed and inhaled. Dilution ventilation and proper gloves should be provided. Men and women planning families and pregnant women should avoid exposure to paints containing the glycol ethers.

CRAYONS are pigments in wax. Most have no significant hazards because the pigments are contained. Techniques which involve melting crayons may produce toxic emissions from wax and pigment decomposition which would require exhaust ventilation.

DRAWING INKS may contain hazardous dyes and solvents. Skin contact should be avoided. Ventilation is needed only if extraordinary amounts are used or if the solvents are especially toxic.

FRESCO consists of pigments ground in lime water (calcium hydroxide). It is corrosive to eyes, skin, and respiratory tract. Gloves and goggles should be worn.

ENCAUSTICS are pigments suspended in

molten white refined wax such as beeswax along with drying oils, Venice turpentine, and natural resins. Working with powdered pigments is very hazardous (see above). Heating waxes can release highly irritating wax decomposition products such as acrolein and formaldehyde. Torching the wax surface can cause both wax and pigments to fume. The solvents and wax and pigment fumes require local exhaust ventilation.

EPOXY PAINTS are two part epoxy resin systems and containing highly toxic and sensitizing organic chemicals and diluents (solvents). Some contain highly toxic glycidyl ether solvents. Wear gloves, goggles, and avoid inhalation with local exhaust ventilation or respiratory protection.

GOUACHE is an opaque water color which contains pigments, gums, water, preservatives, glycerin, opacifiers, and other ingredients. The opacifiers may be chalk, talc, and other substances. Formaldehyde may be used as a preservative. Ordinary comfort ventilation should be sufficient ventilation unless very large amounts are used.

MARKING PENS contain pigments or dyes in a liquid. The liquid may be water or a solvent. Water-based markers are usually safer. Of the solvent-based markers, those containing ethyl alcohol are the safest. Others may contain very toxic solvents. Solvent-based markers require some ventilation.

OILS used in oil painting usually are not hazardous in themselves. The oils contain chemical driers based on toxic metals such as lead, cobalt, or manganese. Linseed oil is the most common oil, but poppy seed, walnut, sunflower, and some synthetic oils also have found use in oil painting. Since most come from plants and trees, allergies to the oils are not uncommon. Rags and paper towels damp with these oils can spontaneously ignite.

The new water washable oil paints eliminate solvent exposure. These are worth the effort of learning to use them.

PASTELS, CHALKS AND CONTE CRAYONS are pigments in binders and chalk (calcium carbonate), talc, barytes (barium sulfate mineral), or other powdered inert minerals. Oil

pastels are much safer because they contain small amounts of oils and waxes which keep dust from getting airborne.

"Dustless" chalks and conte crayons also are easy to use safely because they contain binders which prevent creation of respirable-sized dust particles. Unfortunately, it is almost impossible to use dusty pastels and chalks without being exposed to pigment and vehicle dust. A dust mask and ventilation (such as working very near a window exhaust fan or in a local ventilation hood) may reduce exposure.

PENCIL AND GRAPHITE drawing usually exposes artists to such small amounts of dust that they are not hazardous. Very large amounts of graphite can cause black lung disease similar to that which afflicts coal miners.

TEMPERA PAINTS are pigments suspended in emulsions of substances like oils, egg, gum casein, and wax. Preservatives are added to kill microorganisms. If no solvents are used in these paints, ordinary comfort ventilation should be sufficient for working with premixed paints.

VARNISHES are natural or synthetic resins or waxes which are usually dissolved in organic chemical solvents. Those dissolved in alcohols are less toxic than those containing turpentine or aromatic hydrocarbons. Varnishes should be used following all precautions for solvent use.³

WATERCOLORS (dry cakes) are composed of pigments, preservatives (often paraformaldehyde) and binders such as gum Arabic or gum tragacanth. Liquid watercolors may also contain water, glycerine, glucose, and other materials. Both liquid and dry watercolors may give off small amounts of formaldehyde, but these materials generally do not need exhaust ventilation.

WATER-WASHABLE OIL PAINT. These relatively new materials are now manufactured by most of the major art materials companies. The oil in the paints has been modified with hydrophilic chemical groups so that they can be thinned and cleaned up with water. The same pigments are used in these paints, but they need no special ventilation to use safely.

RULES FOR PAINTING AND DRAWING

1. Choose studio locations with safety in mind. Floors, tables, and shelving should be made of materials which can be easily cleaned. A sink should be at hand. Isolate the studio totally from living spaces unless you use materials with no significant hazards such as children's art materials. Never use or clean up paint or drawing materials in kitchen areas.

2. Only buy materials that state "Conforms to ASTM D-4236" on the label. While this does not guarantee a safe product, it should mean that the manufacturer is following the U.S. labeling laws.

3. Obtain Material Safety Data Sheets (MSDSs) on all paints, inks, thinners, varnishes, etc. If paint pigments are not identified on the label by Color Index (C.I.) names or numbers, ask your supplier for this information. Only use paints for which C.I. data is available.

4. Use water-based products over solvent-containing ones whenever possible. Do not assume that water-based products contain no solvents. Check the MSDS.

5. If solvents must be used, use TLVs and other toxicity data to choose the safest ones and provide gloves, eye protection (when pouring solvents), and ventilation.

6. Do not clean oil painting brushes with solvents or leave brushes standing in solvents overnight. There are many safer cleaning methods including using baby oil followed by soap and water, or using some of the brush cleaning soaps developed by oil paint manufacturers specifically for brush cleaning. These methods will also be better for brushes that letting them stand on their bristles in solvent.

7. Buy premixed paints and avoid working with powdered pigments if possible. Pigments and paints are most hazardous when they are inhaled in a dry powdered state.

8. Choose brushing and dipping techniques over spray or air-brush methods whenever possible.

9. Use Material Safety Data Sheets and product labels to identify the hazards of all of the ingredients in your materials: solvents, pigments, preservatives, etc. Look up the hazards of the pigments in Table 10 of *The Artist's Complete Health and Safety Guide*.

10. Plan studio ventilation appropriate for your materials. For example, if solvents are used, provide sufficient dilution ventilation to remove vapors from the studio. If powdered paints or pigments are used, plan local exhaust ventilation such as a chemical fume hood or spray booth.

11. Avoid dusty procedures. Sanding dry paints, sprinkling dry pigments or dyes on wet paint or glue, and other techniques which raise dust should be discontinued or performed in a local exhaust environment or outdoors. One source of dust often overlooked is when paint splashes dry on the floor and people walk on the paint. This grinds the paints into a dust which is distributed where ever people walk. (See also #17.)

12. Spray or airbrush only in local exhaust conditions such as in a spray booth. A proper respirator may provide additional protection. Use a dust/mist respirator for water-based paints. Use a paint, lacquer, and enamel mist (PLE) respirator for solvent-containing products.

13. Follow all solvent safety rules if you use solvent-containing products, and give extra attention to fire safety. Rags damp with setting oils like linseed and poppy oil will spontaneously ignite. Place them in an air tight metal container or in water.

14. Avoid skin contact with paints and pigments by using techniques that keep the paint from getting on your skin, or by wearing gloves. If you use solvents, obtain the glove manufacturer's permeation data in order to choose the right gloves. Always use gloves with dyes. Wash off paint splashes on the skin with safe cleaners like a) baby oil followed by soap and water, b) nonirritating waterless hand cleaners, or c) plain soap and water. Never use solvents or bleaches to remove splashes from your skin.

15. Wear protective clothing, including a full-length smock or coveralls. Leave these garments in your studio to avoid bringing dusts home. Wash clothing frequently and separately from other clothing. Wear goggles if you use caustic paints or corrosive chemicals.

16. If respirators must be used, follow all rules regarding their use (see *The Artist's Complete Health and Safety Guide*, Chapter 8).³

17. Avoid ingestion of materials; eat, smoke, or drink outside your studio. Never point brushes with your lips or hold brush handles in your teeth. Wash your hands before eating, smoking, applying make-up and other personal hygiene procedures.

18. Keep containers of paint, powdered pigments, solvents, etc., closed except when you are using them.

19. Work on easy-to-clean surfaces. Wipe up spills promptly. Wet mop and sponge floors and surfaces. Do not sweep. Never use flammable liquids in studios with wooden floors or floors with cracks and openings between the flooring elements.

20. Follow Material Safety Data Sheet advice and purchase a supply of materials to control spills and for chemical disposal (e.g., kitty litter, solvent spill kits).

21. Dispose of waste solvents, paints, and other materials in accordance with health, safety, and environmental protection regulations. Hazardous waste companies must be consulted by places of employment such as schools and commercial art studios. Private citizens and hobbyists can dispose of most consumer art paints and chinks as ordinary waste and can take solvents and solvent-contain products to household hazardous waste programs.

22. Always be prepared to provide your doctor with precise information about the chemicals you use and your work practices. Arrange for regular blood tests for lead if you use lead-containing paints or pigments.

FOOTNOTES

1. A CAS number is one assigned by the Chemical Abstracts Service, an organization that indexes information published in Chemical Abstracts by the American Chemical Society. The CAS number is a concise means of identification. (Chemical Abstracts Service, Division of American Chemical Society, Box 3012, Columbus, OH 43210; 614/447-3600.)

2. Miller, Barry A., Silverman, D.T., Hoover, R.N., Blair, A. "Cancer Risk among Artistic Painters." *American Journal of Industrial Medicine*, 1986; 9:281-287. See also Miller, Barry A., and Blair, Aaron. "Cancer Risks Among Artists." Submitted for publication to *Leonardo* (Journal of the International Society for the Arts, Sciences and Technology), New York, 1989; and "Occupational Risks of Bladder Cancer in the United States: I. White Men," *Journal of the National Cancer Institute*, Vol. 81, No. 19, Oct. 4, 1989.

3. *The Artist's Complete Health and Safety Guide*, 3rd edition, M. Rossol, Allworth Press, New York, 2001. Available from ALLWORTH PRESS, 10 East 23 Street, New York, NY 10010. 800/491-2808 credit card.

4. From the American Conference of Governmental Industrial Hygienist's *2008 Guide to Occupational Exposure Values*. The TLV-TWAs are eight-hour time weighted averages used here only for comparison.

5. Citrus oil's primary ingredient, d-limonene, does not have a TLV. But the German Federal Republic has set a limit of 20 ppm for it. This limit is used by most of the European countries.