Art Safety Manual

The visual arts can pose significant risks to the health and safety of artists. This guide provides an overview of some of the most common risks associated with painting, drawing, photography, ceramics, lithography, and sculpture. All effort has been made to keep this document up to date with new non-toxic products and innovations as well as rediscovered traditional practices.

Chemicals, compressed gases, machines and electrical hazards are the most common health and safety risks associated with the visual arts.

It is in the artists’ best interest to be informed of the toxic hazards of their medium and how to use their materials safely.
TOXIC EFFECTS

The health hazards associated with painting and drawing have been known since Ramazzini described them in his book, *De Morbis Artificum Diatriba*, in 1713. Working safely can involve changes in how you select your art materials, how you handle and dispose of them.

Jay DeFeo, died at the age of sixty due, in large part, to her exposure to lead paints. Many artists of her day did not know what was in the materials they were using. In fact, manufacturers were not required to disclose that information until, for the first time in 1984, California legislation was introduced forcing manufactures to reveal the health hazards within their products.

Though there is a better consciousness of one’s materials today there still persists a disregard of the dangerous effects of some materials. Painting materials have been highly regulated in recent years but there are still hazards to be aware of and try to avoid or minimize.

MATERIAL LABELING \ KNOWING WHAT TO LOOK FOR

On November 18, 1988, the Labeling of Hazardous Art Materials Act (Public Law 100-695) was signed into law. This law requires that all art materials be reviewed to determine the potential for causing a chronic hazard and that appropriate warning labels be put on those art materials found to pose a chronic hazard. The term “art material” includes “any substance marketed or represented by the producer or re-packager as suitable for use in any phase of the creation of any work of visual or graphic art of any medium.” The “Labeling of Hazardous Art Materials Act” (LHAMA) amended the Federal Hazardous Substances Act (FHSA) by adding Section 23 and designating the ASTM Standard Practice for Labeling Art Materials for Chronic Health Hazards (ASTM D-4236-88) as a regulation under Section 3(b) of the FHSA.
Most manufacturers use the guidelines of ASTM D 4236, Standard Practice for Labeling Art Materials for Chronic Health Hazard. Below are the labels printed on most manufacturers' packaging. Note that some companies, such as Golden Acrylics, have designed their own labels. If you are uncertain about a product's toxicity or cannot find a label the store you are buying it from should have the Material Safety Data Sheet (MSDS) on file.

**AP Seal:** The new AP (Approved Product) Seal, with or without Performance Certification, identifies art materials that are safe and that are certified in a toxicological evaluation by a medical expert to contain no materials in sufficient quantities to be toxic or injurious to humans, including children, or to cause acute or chronic health problems.

--Art & Creative Materials Institute (ACMI)

**CL Seal:** “The CL Seal identifies products that are certified to be properly labeled in a program of toxicological evaluation by a medical expert for any known health risks and with information on the safe and proper use of these materials. This seal is currently replacing the HL Health Label (Cautions Required) Seal over a 5-year phase-in period. These two Seals appear on only 15% of the adult art materials in ACMI’s certification program and on none of the children's materials. These products are also certified by ACMI to be labeled in accordance with the chronic hazard labeling standard…”

-- Art & Creative Materials Institute (ACMI)

Some manufactures take a decidedly more cautious stance on their product labeling:

<table>
<thead>
<tr>
<th>NON-TOXIC</th>
<th>WARNING</th>
<th>X MEANS HARMFUL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Based upon toxicological review, there are no acute or known chronic health hazards with anticipated use of this product (most chemicals are not fully tested for chronic toxicity).</td>
<td>WARNING: This product contains a chemical known to the State of California to cause cancer”.</td>
<td>WARNING: DO NOT SPRAY APPLY– This product contains cadmium, a chemical known to the State of California to cause cancer”.</td>
</tr>
</tbody>
</table>

**Additional Health Labeling: California Proposition 65**

The State of California requires clear and reasonable warnings on products and/or storage containers containing chemicals that have been shown to cause cancer, birth defects, or other reproductive harm. Even if these products contain only trace levels of harmful chemicals, a warning is required by the State of California. Manufacturers of certain products have included warnings pursuant to California Proposition 65, and caution is recommended when using products marked with the Prop 65 icon.
As of June 1, 2015, the OSHA Hazard Communication Standard (HCS) required pictograms on labels to alert users of the chemical hazards to which they may be exposed to in the workplace. Each pictogram consists of a symbol on a white background framed within a red border and represents a distinct hazard(s). The pictogram on the label is determined by the chemical hazard classification. If the visual art supply is not intended for home use it should have the new OSHA label.

**HCS Pictograms and Hazards**

<table>
<thead>
<tr>
<th>Health Hazard</th>
<th>Flame</th>
<th>Exclamation Mark</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Carcinogen</td>
<td>- Flammable</td>
<td>• Irritant (skin and eye)</td>
</tr>
<tr>
<td>- Mutagenicity</td>
<td>- Pyrophoric</td>
<td>• Skin Sensitizer</td>
</tr>
<tr>
<td>- Reproductive Toxicity</td>
<td>- Self-Heating</td>
<td>• Acute Toxicity (harmful)</td>
</tr>
<tr>
<td>- Respiratory Sensitizer</td>
<td>- Emits Flammable Gas</td>
<td>• Narcotic Effects</td>
</tr>
<tr>
<td>- Target Organ Toxicity</td>
<td>- Self-Reactives</td>
<td>• Respiratory Tract Irritant</td>
</tr>
<tr>
<td>- Aspiration Toxicity</td>
<td>- Organic Peroxides</td>
<td>• Hazardous to Ozone Layer (Non-Mandatory)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Gas Cylinder</th>
<th>Corrosion</th>
<th>Exploding Bomb</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Gases Under Pressure</td>
<td>- Skin Corrosion/ Burns</td>
<td>• Explosives</td>
</tr>
<tr>
<td></td>
<td>- Eye Damage</td>
<td>• Self-Reactives</td>
</tr>
<tr>
<td></td>
<td>- Corrosive to Metals</td>
<td>• Organic Peroxides</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Flame Over Circle</th>
<th>Environment (Non-Mandatory)</th>
<th>Skull and Crossbones</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Oxidizers</td>
<td>- Aquatic Toxicity</td>
<td>• Acute Toxicity (fatal or toxic)</td>
</tr>
</tbody>
</table>

In addition to the new pictograms the label will have the wording “Warning” or “Danger”. The label will have 4 elements that cover:

- The hazardous of the material
- Handling instructions including personal protection equipment
- Spill clean-up/disposal instructions
- First aid instruction
PIGMENTS / Degrees of Toxicity

Painters use pigments in oil paints, acrylics, watercolor paints, gouache, encaustic, poster paints, casein paints and tempera. Sometimes commercial paints such as oil, enamel, epoxy paints and automobile paints are used.

Paints are pigments mixed with a vehicle or binder. Both inorganic and organic pigments are used as colorants. Dry pigments are especially hazardous because they are easily inhaled and ingested. They are used in encaustic, paper-marbleizing and in the fabrication of paint products, and will be discussed more thoroughly in the section below on pastels.

Pigments vs. Hues

Some paints do not contain metal pigments and are considered non-toxic. These are most easily identified by the product name. If the paint is described as hue, such as "chromium yellow hue", there is no (or too little to be concerned about) toxic metal contained in the product.

Hazards

1. Poisoning can occur if toxic pigments are inhaled or ingested. The main hazard in standard painting techniques is accidental ingestion of pigments due to eating, drinking or smoking while working, inadvertent hand to mouth contact, or pointing the paint brush with the lips. If methods such as spraying, heating, or sanding are employed then there is an opportunity for inhalation of toxic pigments.

2. The classic example of a toxic inorganic pigment in painting is white lead, or flake white (basic lead carbonate). Lead pigments can cause anemia, gastrointestinal problems, peripheral nerve damage (and brain damage in children), kidney damage and reproductive system damage. Other inorganic pigments may be hazardous, including pigments based on cobalt, cadmium, and manganese. (See Table 1)

3. Some of the inorganic pigments, in particular cadmium pigments, chrome yellow and zinc yellow may cause lung cancer. In addition lamp black and carbon black may contain impurities that can cause skin cancer.

4. Chromate pigments (chrome yellow and zinc yellow) may cause skin ulceration and allergic skin reactions (such as rashes).

5. The long-term hazards of the modern synthetic organic pigments have not been well studied. Listed below are the common name of the pigment and the reason they are so toxic.

NOTE: Paints with the word "hue" at the end of their name are actually substitutes for the original, and are usually non-toxic. For instance, Cadmium Yellow Hue contains no actual Cadmium Yellow, but is usually a blend of the non-toxic Arylide Yellow G and Arylide Yellow 10G.
<table>
<thead>
<tr>
<th>Pigment</th>
<th>Components</th>
</tr>
</thead>
<tbody>
<tr>
<td>Antimony White</td>
<td>Contains antimony</td>
</tr>
<tr>
<td>Barium Yellow</td>
<td>Contains barium and chromates</td>
</tr>
<tr>
<td>Burnt or Raw Umber</td>
<td>Contains iron oxides, manganese silicates or dioxide</td>
</tr>
<tr>
<td>Cadmium Red, orange or yellow</td>
<td>Contains cadmium sulfide, cadmium selenide</td>
</tr>
<tr>
<td>Chrome Green, Orange or Yellow</td>
<td>Contains lead and chromates</td>
</tr>
<tr>
<td>Cadmium Red, orange or yellow</td>
<td>Contains cadmium sulfide, cadmium selenide</td>
</tr>
<tr>
<td>Cobalt Violet or Yellow</td>
<td>Contains cobalt, cobalt phosphate and arsenite</td>
</tr>
<tr>
<td>Lead or Flake white</td>
<td>Contains lead carbonate</td>
</tr>
<tr>
<td>Lithol Red</td>
<td>Contains sodium, barium and</td>
</tr>
<tr>
<td>Manganese Violet</td>
<td>Contains manganese and barium</td>
</tr>
<tr>
<td>Molybdate Orange</td>
<td>Contains lead chromate</td>
</tr>
<tr>
<td>Naples Yellow</td>
<td>Contains lead and antimony</td>
</tr>
<tr>
<td>Strontium Yellow</td>
<td>Contains chromates</td>
</tr>
<tr>
<td>Vermilion</td>
<td>Contains mercury compounds</td>
</tr>
<tr>
<td>Zinc White</td>
<td>Contains chromates</td>
</tr>
<tr>
<td>Zinc Yellow</td>
<td>Contains chromates</td>
</tr>
<tr>
<td>MODERATELY TOXIC PIGMENTS</td>
<td></td>
</tr>
<tr>
<td>Alizarin Crimson</td>
<td></td>
</tr>
<tr>
<td>Carbon Black</td>
<td></td>
</tr>
<tr>
<td>Cerulean Blue</td>
<td>Contains cobalt stannate</td>
</tr>
<tr>
<td>Cobalt Blue</td>
<td>Contains cobalt stannate</td>
</tr>
<tr>
<td>Cobalt Green</td>
<td>Contains calcined cobalt, zinc</td>
</tr>
<tr>
<td>Chromium Oxide Green</td>
<td>(Olive Green,</td>
</tr>
<tr>
<td>Phthalo Blue and Greens</td>
<td>Contains copper</td>
</tr>
<tr>
<td>Manganese Blue</td>
<td>(Blue 33) Contains manganese</td>
</tr>
<tr>
<td>Prussian Blue</td>
<td>(Iron Blue, Milori Blue, Bronze Blue,</td>
</tr>
<tr>
<td>Toluidine Red and Yellow</td>
<td>Contains insoluble azo</td>
</tr>
<tr>
<td>Viridian</td>
<td>(Emeraude Green, Green 18) Contains chromic oxide</td>
</tr>
<tr>
<td>Zinc White</td>
<td>Contains zinc oxide</td>
</tr>
</tbody>
</table>
Non Water-Based Paints

Oil paints, encaustic and egg tempera use linseed oil, wax and egg respectively as vehicles, although traditionally solvents are often used as a thinner and for cleanup. Alkyd paints use solvents as their vehicle. In addition many commercial paints used by artists also contain solvents.

Hazards

1. See section above for pigment hazards.
2. All solvents can cause defatting of the skin and dermatitis from prolonged or repeated exposure. Turpentine can also cause skin allergies and is absorbed through the skin.
3. Acute inhalation of high concentrations of mineral spirits, turpentine vapors, and other solvents can cause narcosis, which can include symptoms of dizziness, headaches, drowsiness, nausea, fatigue, loss of coordination, coma, as well as respiratory irritation.
4. Chronic inhalation of large amounts of solvents could result in decreased coordination, behavioral changes and brain damage. Chronic inhalation of turpentine can cause: kidney damage, respiratory irritation, and allergies. Odorless mineral spirits and turpenoid, in which the aromatic hydrocarbons have been removed, are less hazardous.
5. Ingestion of either turpentine or mineral spirits can be fatal. In the case of mineral spirits, this is usually due to chemical pneumonia caused by aspiration (breathing in) of the mineral spirits into the lungs after vomiting.
6. Natural resins (copal, damar, rosin, Japanese Lacquer) may cause skin irritation or allergies. Rosin dust can cause asthma.
7. Encaustic involves suspending pigments in molten wax. If the wax is overheated, flammable wax vapors and wax decomposition fumes are produced, which are strong respiratory irritants.
8. Epoxy paints consist of an epoxy resin component containing the pigment, and a hardener component. The epoxy resin may contain diglycidyl ethers which are irritants, may cause bone marrow damage, and are suspect carcinogens. Epoxy hardeners may cause skin and respiratory allergies and irritation.

Precautions

1. Whenever possible replace turpentine or ordinary mineral spirits with the less toxic odorless mineral spirits. Mineral spirits is also less flammable than turpentine, since its flashpoint is over 100 F (38 C), while turpentine has a flashpoint of 95 F (35 C).
2. Apply the same health and safety considerations for the use of "citrus" or "pine" solvents. These have been found to be quite irritating to the skin and eyes.
3. If possible, artists should set up their easel about 3 feet from a fan exhausting at work level and pulling the solvent vapors away from your face.
4. Techniques such as turpentine washes will require a lot of ventilation because they result in the evaporation of large amounts of solvents in a short period of time. Acrylic paint can be substituted for underpainting.
5. Ventilation only needs to be provided while the solvent is evaporating from the canvas, not during the time while the oil paint film is drying (oxidizing).
6. Wear neoprene gloves while cleaning brushes with mineral spirits or turpentine (Note Nitrile gloves will dissolve in the solvents).

7. Used solvent can be reclaimed by allowing the paint to settle and then pouring off the clear solvent.

8. Paint can be removed from your hands with baby oil, and then soap and water.

9. Wax should be only heated to the minimum temperature needed for proper flow of the paint. Do not heat with open flame or hot plate with exposed element. During pregnancy and nursing, switch to water-based paints to avoid exposure to solvents.

**Alternative Oil Painting mediums**

**Galkyd products. (Gamblin)**

Galkyd painting mediums speed the drying time of oil colors and increase their flexibility. Galkyds will not yellow over time and the painting mediums are formulated for different painting techniques. Most importantly using Galkyds means painters can remove turpentine entirely from their painting process.

*Galkyd* is like a medium made from stand oil so use Galkyd to level brush strokes.

*Galkyd Lite* is like a linseed oil based medium so use Galkyd Lite for direct painting and techniques where leaving brush marks is desired.

*Galkyd Slow Dry* gives painters time to work wet into wet.

*Galkyd Gel (G-Gel)* creates transparent impasto.

**Walnut Oil**

Walnut oil is a pale yellow-brown oil (when newly made it's a pale oil with a greenish tinge) that has a distinctive smell. As it's a thin oil, it's used to make oil paint more fluid. As it yellows less than linseed oil (but more than safflower oil) it's good for pale colors. Walnut oil dries in four or five days. It's an expensive oil and must be stored correctly otherwise it goes rancid (off). It generally needs to be kept in a cool dark space or refrigerated. If you have a reaction to linseed oil, walnut oil is a good alternative.

**Walnut Alkyd Medium**

Walnut/Alkyd Medium was developed to provide artist's with a non-toxic, environmentally responsible alternative to solvent based, rapid drying alkyd mediums. This is a medium that closely resembles the wonderful combinations of sun-thickened oil and natural resins used so effectively throughout the history of art but with the singular advantage of being free from solvents. This medium, unlike straight walnut oil, does not easily go rancid.
Water-Based Paints

Water-based paints include water color, acrylic, gouache, tempera and casein. Water is used for thinning and cleanup.

Hazards
1. See section above for pigment hazards.
2. Acrylic paints contain a small amount of ammonia. Some sensitive people may experience eye, nose and throat irritation from the ammonia. Acrylics and some gouaches contain a very small amount of formaldehyde as a preservative. Only people already sensitized to formaldehyde would experience allergic reactions from the trace amount of formaldehyde found in acrylics. The amounts can vary from manufacturer to manufacturer.
3. Casein paints use the protein casein as a binder. While soluble forms are available, casein can be dissolved in ammonium hydroxide which is moderately irritating by skin contact and highly irritating by eye contact, ingestion, and inhalation.
4. All water-based paints contain a preservative to prevent mold or bacterial growth. Sometimes artists add preservatives when they make their own paints. Although present in small amounts, certain preservatives may cause allergic reactions in some people.

Precautions
1. See section above for precautions when mixing dry pigments.
2. If you add your own preservative, avoid using sodium fluoride, phenol or mercury compounds. For tempera, a small amount of pine oil works for short periods of time.
3. If you experience eye, nose or throat irritation while using acrylics, opening a window is usually sufficient; if not try a window exhaust fan.
4. If you mix casein paints using ammonium hydroxide, you will need a window exhaust fan to provide ventilation.
5. Wear gloves, goggles and protective apron when handling ammonia. An eyewash fountain should be available when handling ammonia.
Airbrush, Spray Cans, and Spray Guns

Artists use many products in spray form, including fixatives, retouching sprays, paint sprays, varnishes, and adhesive sprays. Airbrush, aerosol spray can and spray guns are used.

Hazards
1. Spray mists are particularly hazardous because they are easily inhaled. If the paint being sprayed contains solvents, then you can be inhaling liquid droplets of the solvents. In addition the pigments are also easily inhaled, creating a much more dangerous situation than applying paint by brush.
2. Aerosol spray paints have an additional hazard besides pigments and solvents. They contain propellants, usually isobutanes and propane, which are extremely flammable and have been the cause of many fires. Other aerosol spray products such as retouching sprays, spray varnishes, etc. also contain solvents, propellants and particulates being sprayed.
3. Airbrushing produces a fine mist which is a serious inhalation hazard because artists work so close to their art work. Airbrushing solvent-containing paints is especially dangerous.
4. Spray guns are less common in art painting but usually involve spraying much larger quantities of paint than either spray cans or airbrush. Spraying solvent-based paints is a serious fire hazard.

Precautions
1. See section above for precautions with pigments.
2. Try to brush items rather than spraying if possible.
3. Use water-based airbrushing paints and inks rather than solvent-based paints.
4. Use spray cans or an airbrush in a spray booth if possible.
5. If ventilation is not adequate, then respiratory protection is necessary while airbrushing or spraying. Contact EHS for selection and fit-testing.
6. Never try to spray paint by blowing air from your mouth through a tube. This can lead to accidental ingestion of the paint.

Dry Drawing Media

This includes dust-creating media such as charcoal and pastels which are often fixed with aerosol spray fixatives, and media such as crayons and oil pastels which do not create dust.

Hazards
1. Pencils are made with graphite, rather than lead and are not considered a hazard. Colored pencils have pigments added to the graphite, but the amounts are small so that there is no significant risk of exposure. Over 10 years ago, a significant hazard in pencils was from lead chromate paint on the exterior of yellow pencils. However this has since been eliminated as a risk.
2. Charcoal is usually made from willow or vine sticks, where wood cellulose has been heated without moisture to create the black color. Compressed charcoal sticks use
various resins in a binder to create the color. Although charcoal is just considered a nuisance dust, inhalation of large amounts of charcoal dust can create chronic lung problems through a mechanical irritation and clogging effect. A major source of charcoal inhalation is from the habit of blowing excess charcoal dust off the drawing.

3. Colored chalks are also considered nuisance dusts. Some chalks are dustier than others. Individuals who have asthma sometimes have problems with dusty chalks, but this is a nonspecific dust reaction, not a toxic reaction.

4. Pastel sticks and pencils consist of pigments bound into solid form by a resin. Inhalation of pastel dusts is the major hazard. Some pastels are dustier than others. Pastels can contain toxic pigments such as chrome yellow (lead chromate) which can cause lung cancer, and cadmium pigments (which can cause kidney and lung damage and are suspect human carcinogens). Blowing excess pastel dust off the drawing is one major source of inhalation of pastel pigments. Pastel artists have often complained of blowing their nose different colors for days after using pastels, a clear indication of inhalation.

5. Crayons and oil pastels do not present an inhalation hazard, and thus are much safer than pastels. Some oil pastels can contain toxic pigments, but this is only a hazard by accidental ingestion.

6. Both permanent and workable spray fixatives used to fix drawings contain toxic solvents. There is high exposure by inhalation to these solvents because the products are sprayed in the air, often right on a desk or easel. In addition you can be inhaling the plastic particulates that comprise the fixative itself.

7. Never try to spray fixative by blowing air from your mouth through a tube. This can lead to accidental ingestion of the fixative.

**Precautions**

1. Use the least dusty types of pastels, chalks, etc. Asthmatics in particular might want to switch to oil pastels or similar non-dusty media.

2. Spray fixatives should be used with a spray booth that exhausts to the outside. If use of spray fixatives is occasional, you can use them outdoors with a NIOSH-approved respirator equipped with organic vapor cartridges and dust and mists filter for protection against inhalation of solvent vapors and particulates. An exhaust fan is also needed to remove organic vapors and particulates.

3. Don’t blow off excess pastel or charcoal dust with your mouth. Instead tap off the built up dust so it falls to the floor (or paper on floor).

4. Wet-mop and wet-wipe all surfaces clean of dusts.

5. If inhalation of dusts is a problem, a respirator may be appropriate. Contact EHS for selection and fit-testing.
Liquid Drawing Media

This includes both water-based and solvent-based pen and ink and felt tip markers. Hazards of dry erase or white board markers can be considered here, although they are more used in teaching or commercial art.

Hazards
1. Drawing inks are usually water-based, but there are some solvent-based drawing inks. These usually contain toxic solvents like xylene.
2. Permanent felt tip markers used in design or graphic arts contain solvents. Xylene, which is a highly toxic aromatic hydrocarbon, is the most common ingredient; newer brands often contain the less toxic propyl alcohol (although it is an eye, nose and throat irritant). The major hazard from using permanent markers results from using a number of them at the same time at close range.

Precautions
1. Use water-based markers and drawing inks if possible.
2. Alcohol-based markers are less toxic than aromatic solvent-based markers.
3. Solvent-based drawing inks and permanent markers should be used with good dilution ventilation (e.g. window exhaust fan).
4. Never paint on the body with markers or drawing inks. Body painting should be done with cosmetic colors.
Ceramics

Ceramic art and pottery has a wide variety of hazards. The specific hazards and precautions can be divided into four areas:

1. working with clay
2. glazing and coloring
3. firing in a kiln

Clay

Clays are minerals composed of hydrated aluminum silicates, often containing large amounts of crystalline silica. Other impurities may include organic matter or sulfur compounds. Sometimes, grog (ground firebrick), sand, talc, vermiculite, perlite, and small amounts of minerals such as barium carbonate and metal oxides, are added to modify clay properties. Clays can be worked by hand or on the potter's wheel, or cast in a clay slurry into molds.

Clay is made by mixing dry clay with water in clay mixer. Clay slip is made by adding talcs which themselves can be contaminated with fibrous asbestos or asbestos-like materials. Geographical sources of talcs are relevant, for example, New York State talcs are notoriously asbestos-contaminated, while Vermont talcs are not. Pfizer has some fiber-free talcs.

Hazards

1. There have been known cases of silicosis, or "potter's rot, from chronic inhalation of large amounts of free silica during clay mixing. Symptoms of silicosis include: shortness of breath, dry cough, emphysema, and high susceptibility to lung infections such as tuberculosis. The disease may take years to develop. Silica dust exposure is not hazardous by skin contact or ingestion.
2. Chronic inhalation of kaolin is moderately hazardous, and can result in kaolinosis, a disease in which the lungs become mechanically clogged.
3. Asbestos is extremely toxic by inhalation and possibly by ingestion. Asbestos inhalation may cause asbestosis, lung cancer, mesothelioma, stomach cancer, and intestinal cancer.
4. Sand, perlite, grog, and vermiculite contain free silica and are, therefore, highly toxic by inhalation. Vermiculite is also frequently contaminated with asbestos.
5. There is a danger of accidents if clay or water can be added while the mixer is in operation.
6. Bags of clay and glaze materials can be very heavy, and lifting can cause back problems.
7. Hypersensitivity pneumonia, asthma, or other respiratory problems may occur with exposure to molds growing in wet clay that is being soured or aged in a damp place, in slips that stand for months, or with inhalation of dry aged clay. Molds can cause or exacerbate skin problems and change the workability of clay.
8. Throwing on a potter's wheel for long periods of time can result in carpel tunnel syndrome because of the awkward position of the wrists. Pain, numbness and/or pins
and needles in the thumb and first three fingers, are common symptoms. Back problems can occur from bending over the potter’s wheel for long periods of time.

9. Hand contact with wet clay can result in abrasion and dryness of fingertips and hands. Moving parts of kick wheels can cause cuts and abrasions.

10. Clay scraps on the floor, bench and other surfaces can dry and pulverize, producing an inhalation hazard due to the presence of free silica. Similarly, reconditioning clay by pulverization and sanding finished green ware, can create very high concentrations of hazardous silica dust.

11. Mechanized wheels and mixers need to be unplugged and locked or tagged out during cleaning or maintenance.

Precautions

1. Use premixed clay to avoid exposure to large quantities of clay dust.
2. Clay storage and mixing should take place in a separate room. Bags of clay (and other pottery materials) should be stacked on palettes or grids off the floor for easier clean-up.
3. All clay mixers should be equipped with local exhaust ventilation to remove fine silica dust particles from the air.
4. Clay mixers should be equipped with proper machine guards so that they cannot be opened to add clay or water while the mixer blades are turning.
5. Wear separate work clothes while in the studio. Choose clothes of material and design that don’t trap dust. Wash these clothes weekly, and separately from other laundry.
6. Avoid contact of clay with broken skin. Use a skin moisturizer.
7. To prevent back problems, always lift with knees bent. Also, use a standup wheel (Cranbrook style treadle wheel), or elevate electric wheels to a height that doesn’t require bending over. Exercise and massage may relieve minor muscular pain.
8. Keep wrists in unflexed position as much as possible to prevent carpal tunnel syndrome. Take frequent work breaks.
9. Be careful of the moving parts on kick wheels.
10. Recondition clay by cutting still-wet clay into small pieces, letting them air-dry, and soak in water.
11. Finish green ware while still wet or damp with a fine sponge instead of sanding when dry. Do not sand greenware containing fibrous talc.
12. Wet mop floors and work surfaces daily to minimize dust levels and prevent dry scraps from becoming pulverized.

Glazes

Glazes used to color or finish clay pieces are a mixture of silica, fluxes and colorants. Common fluxes include lead, barium, lithium, calcium and sodium, and are used to lower the melting point of silica. The actual colorants, which are an assortment of metal oxides usually account for less than 5% of the glaze by weight.

Frits are made of melted minerals and metal compounds that are sintered and ground into powder form. While lead frits are sometimes assumed to be insoluble and nontoxic, leaching tests have shown that many frits are as soluble as raw lead compounds and, in fact, there have been cases of lead poisoning from eitherboth inhalation or ingestion.

High fire porcelain and stoneware techniques eliminate the need for lead as a flux. Also, alkali earth or alkaline earth fluxes can be used for low-fire conditions instead of lead. Silica may also
be removed from leadless type glazes. The substitution can be based on boric oxide as the
glass-former, instead of silica. Alkali earth fluxes include sodium, potassium, and lithium oxides;
alkaline earth fluxes include calcium, magnesium, barium, and strontium oxides. Minerals
containing these fluxes include certain feldspars, nepheline syenite, petalite, bone and plant
ashes, whiting, and dolomite.

An assortment of metal oxides or other metal compounds produce particular colors when
fired. These are added in such small amounts to the glaze, that they aren’t usually a great
hazard. Luster or metallic glazes are fired in a reduction atmosphere. These glazes can
contain mercury, arsenic, highly toxic solvents such as aromatic and chlorinated
hydrocarbons, and oils such as lavender oil. The common metals are often resinates of gold,
platinum, silver, and copper. Some underglazes and over glazes use mineral spirits as the
vehicle instead of water.

Glaze components are weighed, sorted and mixed with water. These materials are often in
fine powdered form, and result in high dust exposures. Glazes can be dipped, brushed,
poured, or sprayed on the ceramic piece.

Hazards

1. Lead compounds are highly toxic by inhalation or ingestion. Symptoms of lead
poisoning include: damage to the peripheral nervous system, brain, kidney, or
gastrointestinal system, as well as anemia, chromosomal damage, birth defects and
miscarriages.
2. Lead-glazed food ware can leach lead if not fired properly, or if the glaze composition is
not correctly adjusted. For example, the addition of copper to lead frits renders a
higher solubility of lead in the final fired ware. Acidic drinks and foods such as tomato
juice, citric juices, sodas, tea, or coffee, can increase this hazard.
3. A glaze label marked "lead-safe" means that the finished ware, if fired properly, will not
release lead into food or drink. The actual glaze is still hazardous to handle and fire and
may contain lead. Adequate control over firing conditions is very difficult in the craft
studio.
4. Other fluxes such as barium and lithium are also highly toxic by inhalation, but less so
than lead.
5. Certain colorant compounds of particular metals are known or probable human
carcinogens, including: arsenic, beryllium, cadmium, chromium (VI), nickel, and
uranium.
6. Antimony, barium, cobalt, lead, lithium, manganese, and vanadium colorant
compounds are highly toxic by inhalation.
7. Antimony, arsenic, chromium, vanadium, and nickel compounds are moderately toxic
by skin contact.
8. Free silica occur in many of the clays, plant ash, flint, quartz feldspars, talcs, etc. used in
glazes. See the discussion above for the hazards of silica and the disease
silicosis. Weighing and mixing glazes can result in the inhalation of these toxic materials.
9. Soda ash, potassium carbonate, alkaline feldspars, and fluorspar used in glazes are skin
irritants.
10. Spray application of glazes is very hazardous because of the potential inhalation of
glaze mists.
11. Dipping, pouring, and brushing certain glazes may cause skin irritation and accidental
ingestion due to careless personal hygiene habits.
12. Glazes containing solvents are both flammable and hazardous.

**Precautions**

1. Use lead-free glazes. If the glaze does not state “lead-free” or “leadless” on the label, assume it contains lead until proven otherwise.
2. Lead glazes should only be used on non-food ware items. Design lead-glazed pieces so that they won’t be used for food or drink. Lead-glazed pottery should be labeled as lead-containing.
3. If possible, don’t use colorants that are known human carcinogens and avoid probable human carcinogens. There is no known safe level of exposure to carcinogens.
4. Consider wearing a respirator when weighing and mixing powdered. Wet glazes are not an inhalation hazard. Good housekeeping procedures and cleanup of spills reduce the risk of inhalation or ingestion of toxic dusts. Wet mop spilled powders.
5. Gloves should be worn while handling wet or dry glazes.
6. Good dilution ventilation or local exhaust ventilation should be available when applying solvent-containing glazes.
7. Basic chemical hygiene rules should be followed including restricting eating, drinking, and wearing personal protective equipment such as gloves or separate work clothes / coveralls. Wash hands after work. Leftover glazes and glaze scrapings can be homogenized, combined, tested, and used as a glaze.

**Kilns**

Electric kilns and fuel-fired kilns are used to heat the pottery to the desired firing temperature. The most common type are the electric kilns. Heating elements heat the kiln as electric current passes through the coils. The temperature rises until the kiln is shut off.

Fuel-fired kilns are heated by burning gas (natural or propane), oil, wood, coke, charcoal or other materials. Propane gas or natural gas is used most often. These kilns can be either located indoors or outdoors. The fuels produce carbon monoxide and other combustion gases. Fuel-fired kilns are usually vented from the top through a chimney.

Firing temperatures can vary from as low as 1382°F for raku and bisque wares, to as high as 2372 °F for stoneware, and 2642 °F for certain porcelains.

The early stages of bisque firing involves the oxidization of organic clay matter to carbon monoxide and other combustion gases. Sulfur breaks down later producing highly irritating sulfur oxides. Also, nitrates and nitrogen-containing organic matter break down to nitrogen oxides.

Galena, cornish stone, crude feldspars, low grade fire clays, fluorspar, gypsum, lepidolite and cryolite can release toxic gases and fumes during glaze firings. Carbonates, chlorides, and fluorides are broken down to releasing carbon dioxide, chlorine, and fluorine gases.

At or above stoneware firing temperature, lead, antimony, cadmium, selenium and precious metals vaporize and the metal fumes can either escape from the kiln, or settle inside the kiln or on ceramic ware in the kiln. Nitrogen oxides and ozone can be generated from oxygen and nitrogen in air.
Hazards

1. Chlorine, fluorine, sulfur dioxide, nitrogen dioxide, and ozone are highly toxic by inhalation. Bisque firings of high-sulfur clay have caused the production of great amounts of choking sulfur dioxide. Other large acute exposures to gases are not common. Inhalation of large amounts of these gases can result in severe acute or chronic lung problems. Long-term inhalation of low levels of these gases can cause chronic bronchitis and emphysema. Fluorine gas can also cause bone and teeth problems.

2. Many metal fumes generated at high temperatures are highly toxic by inhalation. Since lead vaporizes at a relatively low temperature, it is especially hazardous.

3. Carbon monoxide from fuel-fired kilns or the combustion of organic matter in clays is highly toxic by inhalation and can cause oxygen starvation. One symptom of carbon monoxide poisoning is an intense frontal headache, un-relievable by analgesics.

4. Hot kilns produce infrared radiation, which is hazardous to the eyes. There have been reports of cataracts, from years of looking inside the hot kilns.

5. Heat generated by the kiln can cause thermal burns. The Edward Orton Jr. Ceramic Foundation reported that when a kiln was operated at 2370 °F, the surface temperature, was at and above 595 °F, and the temperature one foot away from the peephole was 156 °F.

6. Heat produced by even small electric kilns can cause fires in the presence of combustible materials or flammable liquids.

7. If an electric kiln fails to shut off, the heating elements melt which can cause fires. Gas kilns also generate a lot of heat, and room temperatures often exceed 100 °F.

Precautions

1. Infrared goggles approved by the American National Standards Institute (ANSI) or handheld welding shields should be worn when looking into the operating kiln. Shade number from 1.7 to 3.0 is recommended, but a darker shade may be required if spots appear in front of one’s eyes after looking away from the kiln.

2. Do not use lead compounds at stoneware temperatures since the lead will vaporize.

3. Lumber, paper, solvents, or other combustible and flammable materials should not be stored in kiln areas.

4. Always check that the kiln has shut off.

5. If gas leaks are suspected (e.g. gas odor): shut off gas at the source; shut off power to the kiln room at the circuit breaker; and call the gas company. Test for leaks with nonfat, soapy water or use approved leak-detection solutions.

SPECIAL PROCESSES

While most glaze firings refer to firing a glaze-coated pot in the kiln, special processes sometimes are used. Salt glazing and raku firing are two examples.

Salt Glazing

This process involves throwing wet salt (sodium chloride) into the heated kiln while the bisque ware is being fired. Wet salt at high temperatures decomposed to sodium and chlorine. The sodium reacts with the bisque ware to form a glaze. Large amounts of hydrogen chloride gas
and possibly chlorine are also formed.

Sodium carbonate (washing soda) can also be used. Carbon dioxide is generated instead of hydrogen chloride.

**Hazards**

1. Hydrogen chloride gas is highly toxic by inhalation. Health effects are both similar and more irritating compared with most other kiln gases. Often, local environmental protection laws ban salt kilns.
2. Hydrogen chloride and water vapor form hydrochloric acid, which can corrode metal fittings in the area.

**Precautions**

1. Substitute safer sodium carbonate for sodium chloride.
2. Sodium chloride salt glazing should only be done outdoors. Kilns should be equipped with canopy hoods and chimney stacks that are tall enough to disperse the hydrogen chloride safely.
3. All gas piping, and metal fixtures should be routinely checked for corrosion.

**Raku Firing**

Raku involves first firing ware at a low temperature in a regular gas kiln, and then removing the still hot pieces and placing in them in sawdust, leaves or other organic materials for a reduction phase.

**Hazards**

1. See above for the hazards and safety precautions used with gas kilns.
2. The reduction step produces large amounts of smoke and carbon monoxide.
3. Treated wood or other materials can yield an exposure to highly toxic preservatives or pesticides, such as arsenic and chromium compounds.

**Precautions**

1. Raku should only be done outdoors because of smoke. Be careful to not locate raku near air intakes or open windows of buildings.
2. Do not use materials that have been treated with preservatives or pesticides for the reduction phase.
LEACHING OF FINISHED CERAMIC WARE

Lead Leaching

There is a real concern about lead leaching into food and drink from pottery fired with lead glazes. Both the U.S. Food and Drug Administration (FDA) and the Canadian Consumer and Corporate Affairs have regulated how much lead can leach from food ware into food and drink. Acidic liquids are of particular concern. Similarly, continual microwave reheating, (e.g. a coffee mug at work) can yield greater leaching of lead glazes. Many cases of lead poisoning, and even some fatalities, have occurred from the leaching of lead from lead-glazed pottery.

While commercial ceramics companies routinely test their ware for lead leaching, craft potters do not have the same quality control as does the ceramics industry, and lead leaching is more of a problem.

According to United States regulation, ceramic ware that does not pass the lead leaching tests must have a permanent fired decal stating:

"NOT FOR FOOD USE - MAY POISON FOOD.
FOR DECORATIVE PURPOSES ONLY."

As mentioned earlier, you can also drill a hole in the pottery so it cannot be used for liquids or food.

Preferably, do not use lead glazes, especially for food and drink vessels. Any food ware finished with lead glazes should be tested regularly by certified laboratories.

Other Leachable Metals

Other metals can leach into food and drink such as cadmium and barium both have been seen in some tests to leach in hazardous amounts from certain glaze formulations. If a barium glaze, or other glaze, changes color from contact with food, do not use the vessel for food. Try and use only glazes with calcium, magnesium, potassium, and sodium fluxes and minimize the amounts of toxic metal colorants.
Lithography and Relief Printing

General Chemicals

Inks

Intaglio, lithography and relief inks consist of pigments suspended in either linseed oil or water as a vehicle. There can be additional hazardous binders or preservatives, etc.

Hazards

Oil-based inks contain treated linseed oils. While linseed oil is not considered a hazard by skin contact or inhalation, ingestion of large amounts of some treated linseed oils might be hazardous due to presence of small amounts of toxic heavy metals. Oil vehicles are flammable when heated, and rags soaked in these may ignite by spontaneous combustion.

Precautions

1. Know what materials are used. Obtain the material safety data sheets (MSDSs) on all products used. Use the least toxic inks possible.
2. Do not use an open flame to heat linseed oil, linseed oil, varnishes, or burnt plate oil. Take normal fire prevention measures (e.g. no smoking or open flames in work area).
3. Place oil-soaked rags in self-closing disposal cans and remove from the studio each day. An alternative is to place the oil-soaked rags in a pail of water.

Pigments

Pigments are the colorants used in lithography, intaglio, and relief printing inks. There are two types of pigments: inorganic pigments, and organic pigments.

Hazards

1. Pigment poisoning can occur if pigments are inhaled or ingested. For normal printing with prepared inks, the main hazard is accidental ingestion of pigments due to eating, drinking or smoking while working, or inadvertent hand to mouth contact.
2. The classic example of a toxic inorganic pigment in printmaking is lead chromate (chrome yellow). Lead pigments can cause anemia, gastrointestinal problems, peripheral nerve damage (and brain damage in children), kidney damage and reproductive system damage. Other inorganic pigments may be hazardous also, including pigments based on cobalt, cadmium, and manganese.
3. Some of the inorganic pigments, in particular cadmium pigments, chrome yellow and zinc yellow (zinc chromate) may cause lung cancer if inhaled. In addition, lamp black and carbon black may contain impurities that can cause skin cancer.
4. Chromate pigments (chrome yellow and zinc yellow) may cause skin ulceration and allergic skin reactions.
5. The long-term hazards of the modern synthetic organic pigments have not been well studied.

**Precautions**

1. Obtain MSDSs on all pigments. This is especially important because the name that appears on label of the color may or may not truly represent the pigments present.
2. Use the safest pigments possible. Avoid lead pigments.
3. Avoid mixing dry pigments whenever possible.

**Solvents**

In general, organic solvents are one of the most underrated hazards in art materials. Organic solvents are used in printmaking to dissolve and mix with oils, resins, varnishes, and inks, and to clean plates, rollers, tools, and even hands.

**Hazards**

1. Repeated or prolonged skin contact with solvents can cause defatting of the skin and resultant dermatitis. Many solvents can also be harmful through skin absorption.
2. Inhalation of solvent vapors is the major way in which solvents are harmful. High concentrations of most solvents can cause dizziness, nausea, fatigue, loss of coordination, or coma. This can also increase the chances for mistakes and accidents.
3. Many solvents are toxic if ingested. Swallowing an ounce of turpentine can be fatal.
4. Most solvents, except chlorinated hydrocarbons, are also either flammable or combustible.

**Precautions**

1. Obtain the (M)SDS on all solvent products used. Use the least toxic solvent possible. For example, replace the more toxic methyl alcohol with denatured alcohol or isopropyl alcohol.
2. Use adequate ventilation.
3. Keep minimum amounts of solvents on hand and purchase in smallest practical container size. Large amounts of solvents or solvent-containing materials should be stored in a flammable storage cabinet.
4. Never store solvents or solvent-containing materials in food or drink containers. Always label containers.
5. Do not allow smoking, open flames or other sources of ignition near solvents.
6. Have a class B fire extinguisher in the area. If ordinary combustible materials are present, you may need a Class ABC fire extinguisher.
7. Wear gloves when handling solvents to avoid skin contact. In particular do not use solvents to clean ink off hands. Baby oil is a good substitute.

**Acids**

Acids are used in intaglio (acid etching) and in lithography. Strong acids commonly used include nitric acid, hydrochloric acid, and phosphoric acid, and less commonly carbolic acid (phenol), chromic acid, hydrofluoric and sulfuric acids.
Hazards

1. Concentrated acids are corrosive to the skin, eyes, respiratory system and gastrointestinal system. Dilute acids can cause skin irritation on repeated or prolonged contact.
2. Chromic acid is a skin sensitizer, suspect carcinogen, and oxidizer.
3. Phenol is highly toxic by skin absorption and ingestion. It may cause severe kidney damage, central nervous system effects and even death if absorbed in large amounts.
4. Hydrofluoric acid is highly toxic and can cause severe, deep burns which require medical attention. There is no immediate pain warning from contact with hydrofluoric acid.
5. Concentrated nitric acid is a strong oxidizing agent and can react explosively with other concentrated acids, solvents, etc. Nitric acid gives off various nitrogen oxide gases, including nitrogen dioxide which is a strong lung irritant and can cause emphysema.

Precautions

1. Know what is used. Obtain the (M)SDS for all acids.
2. Whenever possible avoid concentrated acids.
3. Doing acid etching requires working in an enclosed hood, or in front of a slot exhaust hood or window exhaust fan at work level.
4. Store concentrated nitric and chromic acids away from organic materials. Concentrated nitric acid should always be stored separately even from other acids.
5. An important safety rule when diluting concentrated acids is to add the acid to the water, never the reverse.
6. Wear appropriate gloves, goggles and protective apron or lab coat when handling acids.
7. If adequate ventilation is not available, wear a NIOSH-approved respirator with acid gas cartridges.
8. If acid is spilled on your skin, wash with lots of water. In case of eye contact, rinse the eyes with water for at least 15-20 minutes and seek medical attention.

Lithography

Lithography uses either zinc and aluminum metal plates or stones for printing. It involves use of a variety of chemicals to make the image ink-receptive and non-image areas receptive to water and ink-repellent.

Plate and Stone Preparation

A variety of drawing materials with high wax and fatty acid content are used to make the image, including tusche and lithographic crayons. Airbrushing liquid drawing materials or using spray enamel or lacquer is also common. Other materials used in stone or plate processing include etch solution containing acids and gum arabic, counter etch solutions containing acids and sometimes dichromate salts, and fountain solutions containing dichromate salts. Phenol (carbolic acid) has been used for removing grease from stones, and a variety of solvents including lithotine, gasoline, kerosene, and mineral spirits, which are used for diluting drawing materials, washing out images and correction of images. Talc and rosin mixtures are also used. Metal plates are prepared with solvent-based vinyl lacquers.
Hazards

1. Acids used include phosphoric, nitric, acetic, hydrochloric, hydrofluoric and tannic acids. The concentrated acids are corrosive, and even dilute acid solutions can cause skin irritation from prolonged or repeated contact. Hydrofluoric acid and phenol are the most dangerous to use.
2. Lithotine, kerosene, and mineral spirits are skin and eye irritants and inhalation can cause intoxication and respiratory irritation.
3. The solvents contained in vinyl lacquers can include highly toxic isophorone and cyclohexanone. Methyl ethyl ketone (MEK), which is moderately toxic, is often used as a thinner.
4. Dichromate salts may cause skin and nasal ulceration and allergic reactions, and are suspect cancer-causing agents.
5. Rosin dust may cause asthma and allergic dermatitis. There is the hazard of explosion from the buildup of rosin dust, in enclosed rosin boxes, around an ignition source.
6. Talcs may be contaminated with asbestos and silica.
7. Airbrushing drawing materials or using spray enamel paints is more hazardous than drawing with a brush because the inhalation hazard is higher.

Precautions

1. Obtain the (M)SDS for all materials used.
2. Use the least toxic solvents. Gasoline should never be used. Lithotine and mineral spirits are less toxic than the more irritating kerosene.
3. Use asbestos-free talcs such as baby powders.
4. Avoid dichromate-containing counteretches and fountain solutions if possible. Do not use hydrofluoric acid or phenol.
5. Appropriate gloves, goggles and a protective apron should be worn when mixing or using concentrated acids.

Printing and Cleanup

For all types of lithographic inks, solvents are used to make image corrections on the press, to remove images, and to clean the press bed and rollers.

Hazards

Some roller cleaners and glaze cleaners can contain chlorinated hydrocarbons such as perchloroethylene and methylene chloride. Most chlorinated solvents (except 1,1,1-trichloroethane) have been shown to cause liver cancer in animals and are therefore suspect human carcinogens. In addition perchloroethylene can cause liver damage, and methylene chloride heart attacks.

Precautions

1. Know materials used. Obtain the (M)SDS for all solvents.
2. Choose products that do not contain chlorinated solvents whenever possible.
3. For small scale solvent use in correcting images or cleaning the press bed using lithotine or mineral spirits, dilution ventilation (e.g. window exhaust fan) is sufficient.
Intaglio

Intaglio is a printmaking process in which ink is pressed into depressed areas of the plate and then transferred to paper. These depressed areas can be produced by a variety of techniques, including acid etching, dry point, engraving and mezzotint.

Etching

Etching involves use of dilute nitric acid, Dutch mordant (hydrochloric acid plus potassium chlorate) or ferric chloride to etch the zinc or copper (respectively) metal plate. Unetched parts the plate are protected with resists such as stop out varnishes containing ethyl alcohol, grounds containing asphaltum or gilsonite and mineral spirits, rubber cement, and rosin or spray paints for aquatinting. Sometimes, soft grounds contain more toxic solvents.

Hazards

1. See solvents section for the hazards of solvents. 1,1,1- trichloroethane found in some soft grounds is moderately toxic by inhalation under normal conditions but may cause fatalities at very high concentrations.
2. See Acids section for the hazards of acids. In particular nitric acid etching releases the respiratory irritant nitrogen dioxide which has poor odor warning properties. During the etching process, flammable hydrogen gas is also produced.
3. Concentrated nitric acid is a strong oxidizing agent and can react with many other chemicals, especially solvents or other organic compounds, to cause a fire.
4. Mixing hydrochloric acid with potassium chlorate to make Dutch mordant produces highly toxic chlorine gas. Potassium chlorate is a key ingredient in many pyrotechnics, and is a potent oxidizing agent. It can react explosively with organic compounds, sulfur compounds, sulfuric acid or even dirt or clothing. On heating it can violently decompose to oxygen and potassium chloride. Storage and use are very dangerous require special precautions especially when mixing.
5. Rosin dust (and asphaltum dust which is also sometimes used) is combustible. Sparks or static electricity have caused explosions in enclosed rosin and aquatint boxes. Rosin dust may also cause asthma and dermatitis in some individuals.
6. Inhalation of solvents and pigments can result from use of aerosol spray paints.

Precautions

1. Obtain the (M)SDS for all materials used.
2. See Solvents and Acids sections for specific precautions.
3. Use Dutch mordant with extreme caution. A safer substitute for etching copper plates is ferric chloride (iron perchloride). This forms acidic solutions so should be handled accordingly, but does not have the dangers of handling concentrated acids. Ferric chloride solution might cause minor skin irritation from prolonged contact.
4. Application of grounds or stop outs should be done with local exhaust ventilation, (e.g. slot or enclosed hood).
5. Acid etching should be done with local exhaust ventilation. See section on precautions for Acids for more information. Rosin (or asphaltum) boxes should be explosion-proof. Use spark proof metal cranks, explosion-proof motors, or compressed air. Don’t use hair dryers to stir up rosin dust.
Other Techniques

Dry point, mezzotint and engraving use sharp tools to incise lines in metal plates.

Hazards

1. One major hazard associated with these types of processes involves accidents with sharp tools.
2. Long-term use of these tools can cause carpel tunnel syndrome, which can cause numbness and pain in the first three fingers. Severe cases can be incapacitating.

Precautions

1. Keep tools sharp, store them safely and always cut away from yourself.
2. When possible, clamp down plates to avoid slippage.
3. Minimize the chance of carpel tunnel syndrome by choosing tools with wide handles, avoiding tight grips, and doing hand flexing exercises during regular rest periods. Set work table height so wrist flexing motions are minimal.

Printing and Cleanup

Intaglio inks contain pigments, treated linseed oil and modifiers. Printing involves placing the ink on the inking slab, inking the plate by hand, and then printing. Cleanup of inking slab, press bed, and cleaning the plate is done with a variety of solvents including mineral spirits, alcohol, lithotine, turpentine, etc.

Hazards

1. Preparing your own inks from dry pigments can involve inhalation of toxic pigments. See Pigments section for the hazards of pigments.
2. See Solvents section for the hazards of solvents. Plate cleaning is more hazardous than cleaning inking slabs or press beds because larger amounts of solvents are used.
3. Lithotine, turpentine, or oil-soaked rags can be a spontaneous combustion hazard if improperly stored.

Precautions

1. See Pigments and Solvents sections for the specific precautions for pigments and solvents.

Relief and Other Printing Processes

Other printing processes include relief printing, collagraphs, monoprints, and plastic prints.

Relief Printing

Relief printing techniques include woodcuts, linoleum cuts and acrylic plates for plaster relief. These techniques involve the cutting away of plate areas that are not to be
Relief inks can be oil-based or water-based.

**Hazards**

1. Some woods used for woodcuts can cause skin irritation and/or allergies. This is particularly true of tropical hardwoods.
2. Accidents involving sharp tools can result in cuts.
3. Wood carving and cutting tools can cause carpel tunnel syndrome. This was discussed earlier in the section that included dry point and mezzotint.
4. Caustic soda (sodium hydroxide) is sometimes used for etching linoleum. It can cause skin burns and severe eye damage if splashed in the eyes.
5. Eating, drinking or smoking while printing can result in accidental ingestion of pigments.
6. Hazardous solvents are used in stop outs and resists in linoleum etching, and for cleaning up after printing with oil-based inks. See Solvents section for more information on the hazards of solvents.

**Precautions**

1. Obtain the (M)SDS for all materials used.
2. See Acids and Solvents sections for precautions with acids and solvents.
3. Water-based inks are preferable to oil-based inks since solvents are not needed.
4. Wear appropriate gloves, goggles and protective apron when handling caustic soda.
5. If the chemical is spilled on your skin, wash with lots of water. In case of eye contact, rinse the eyes with water for at least 15-20 minutes and contact a physician.
6. Always cut in a direction away from you, with your free hand on the side or behind the hand with the tool.
7. Carpel tunnel syndrome can be minimized or avoided by using tools with wide handles, avoiding tight grips, and rest periods with hand flexing exercises. Linoleum cutting is softer to work, and thus can reduce musculoskeletal injury.

**Collagraphs**

Collagraphs are prints produced by using a collage of different materials glued onto a rigid support. A wide variety of materials and adhesives can be used in making collagraphs.

**Hazards**

1. Rubber cement, a common adhesive used with collagraphs, is extremely flammable and most rubber cements and their thinners contain the solvent n-hexane which can cause damage to the peripheral nervous system (hands, arms, legs, and feet) from chronic inhalation.
2. Epoxy glues can cause skin and eye irritation and allergies.
3. Spraying fixatives on the back of collagraph plates to seal them can involve risk of inhalation of the solvent-containing spray mist.
4. Sanding collagraph plates which have been treated with acrylic modeling compounds or similar materials can involve inhalation of irritating dusts.

**Precautions**

1. Know the hazards of materials used. Obtain the MSDSs from the manufacturer.
2. Use the least toxic materials available. In particular use water-based glues and mediums (e.g. acrylic medium) whenever possible. Some rubber cements are made with the solvent heptane, which is less toxic than n-hexane, primarily because peripheral neuropathy is not associated with its use.

3. Wear gloves when using epoxy glues.

**Plastic Prints**

Plastic prints can involve making prints from a wide variety of plastic materials and resins.

**Hazards**

Plastic prints can involve hazards from inhalation of plastic resin vapors (e.g. epoxy resins) and also from inhalation of decomposition fumes from drilling, machining, sawing, etc. of finished plastics.

**Precautions**

1. Obtain the MSDS for all materials used.
2. See Solvent section for the precautions with solvents.
3. Use the least toxic material available.

**Monoprints**

Monoprints involve standard intaglio, lithographic and other printmaking techniques, but only one print is made. Monoprints have the same hazards involved in plate preparation and printing as the parent techniques.

**Photoprintmaking**

Photoprintmaking involves exposing a light-sensitive emulsion or film to ultraviolet light through a transparent support containing an opaque image to transfer the image to a plate. The transparency through which the photoemulsions are developed can include drawings on a transparent support such as Mylar or acetate, or photographic images processed on graphic arts film to yield a positive image. Several photoprintmaking methods will be discussed.

**Photolithography**

Photolithography involves transferring graphic images to stones or metal plates that are coated with a light-sensitive emulsion. One can coat the stone or metal plate, or use presensitized metal plates. Light-sensitive emulsions used on stone consist of a mixture of powdered albumin, ammonium dichromate, water, and ammonia; commercial emulsions are usually based on diazo compounds. Developing solutions for these mixtures often contain highly toxic solvents. Diazo-sensitizing solutions, developers with highly toxic solvents, plate conditioners containing strong alkali, and other brand name mixtures are used for metal plates.
Hazards

1. Diazode photoemulsions are the least hazardous although they can cause eye irritation.
2. Ammonium dichromate used for stone is a probable human carcinogen, is moderately toxic by skin contact, and may cause allergies, irritation, and external ulcers; it is highly flammable and a strong oxidizer.
3. Ammonia is a skin irritant and highly toxic by inhalation. Ammonia is highly corrosive to the eyes. It has good odor-warning properties.
4. Light exposure sources include photoflood lamps, vacuum Poly-Lite units, and carbon arcs. Carbon arcs produce large amounts of ultraviolet radiation which can cause skin and eye damage and possible skin cancer. Carbon arcs also produce hazardous metal fumes, and ozone and nitrogen dioxide (which can cause emphysema), and toxic carbon monoxide.
5. Screen cleaning solutions include strong caustic solutions, enzyme detergents which can cause asthma, and chlorine bleach. These are skin and respiratory irritants.
6. Many solvents used in developing solutions are highly toxic both by inhalation and skin absorption.

Precautions

1. Obtain a (M)SDS for all materials used.
2. See Solvents section for more precautions with solvents.
3. Avoid ammonium dichromate and use presensitized plates if possible. If you cannot substitute, wear gloves and goggles. Store it away from heat, solvents and other organic materials.
4. Use ammonia solutions or solvent-containing photolithographic solutions inside a laboratory hood, or in front of a slot exhaust hood. Wear gloves, goggles, and if ventilation is inadequate, a respirator.
5. Do not use carbon arcs unless they are equipped with local exhaust ventilation exhausted to the outside. Quartz mercury or metal halide lamps are safer.
6. Wear gloves, goggles and plastic apron or laboratory coat when mixing hazardous chemicals.

Photoetching

Photoetching is usually done using the KPR products. Photoresist dyes often contain a variety of highly toxic solvents, including ethylene glycol monomethyl ether acetate (2-ethoxyethyl acetate, cellosolve acetate), ethylene glycol monoethyl ether, and xylene, and benzaldehyde. The developers contain xylene and ethylene glycol monomethyl ether acetate (2-methoxyethyl acetate or methyl cellosolve acetate). Developers used for safer presensitized plates also contain solvents. Exposure of the plate is done with ultraviolet sources such as carbon arcs, mercury lamps, or metal halide lamps.

Hazards

1. See the Solvents section for the hazards of various solvents. In particular, methyl and ethyl ether acetates of ethylene glycol are highly toxic by skin absorption and inhalation and can cause anemia, kidney damage, testicular atrophy and sterility in men, and miscarriages and birth defects in pregnant women.
2. Xylene is moderately toxic by skin absorption, and highly toxic by inhalation and ingestion. It is a strong narcotic.
3. The Photolithography section discusses carbon arc hazards.

**Precautions**

4. See Solvents section for precautions with solvents.
5. Pregnant or nursing women, children, and men trying to conceive should not work with these materials.
6. Use photofloods or other light sources instead of carbon arcs. Precautions with carbon arcs is discussed in the Photolithography section.
7. Use presensitized plates if possible.
8. Use photoresist solutions with local exhaust ventilation, or wear an organic vapor respirator. Wear butyl rubber gloves when handling KPR solutions.
Photography

Black-and-White Photographic Processing

A wide variety of chemicals are used in black and white photographic processing. Film developing is usually done in closed canisters. Print processing uses tray processing, with successive developing baths, stop baths, fixing baths, and rinse steps. Other treatments include use of hardeners, intensifiers, reducers, toners, and hypo eliminators.

Mixing Photochemicals

Photochemicals can be bought in liquid form, which only need diluting, or powder form, which need dissolving and diluting.

Hazards

1. Developer solutions and powders are often highly alkaline, and glacial acetic acid, used in making the stop bath, is also corrosive by skin contact, inhalation and ingestion.
2. Developer powders are highly toxic by inhalation, and moderately toxic by skin contact, due to the alkali and developers themselves (see Developing Baths below).

Precautions

1. Use liquid chemistry whenever possible, rather than mixing developing powders. Pregnant women, in particular, should not be exposed to powdered developer.
2. When mixing powdered developers, use a glove box (a cardboard box with glass or Plexiglas top, and two holes in the sides for hands and arms), local exhaust ventilation, or wear a NIOSH-approved toxic dust respirator if industrial hygiene data is available.
3. Wear gloves, goggles and protective apron when mixing concentrated photochemicals. Always add any acid to water, never the reverse.
4. In case of skin contact, rinse with lots of water. In case of eye contact, rinse for at least 15-20 minutes, preferably using an eyewash station, seek medical attention.
5. Store concentrated acids and other corrosive chemicals on low shelves so as to reduce the chance of face or eye damage in case of breakage and splashing.
6. Do not store photographic solutions in glass containers.

Developing Baths

The most commonly used developers are hydroquinone, monomethyl para-amino phenol sulfate, and phenidone. Several other developers are used for special purposes. Other common components of developing baths include an accelerator, often sodium carbonate or borax, sodium sulfite as a preservative, and potassium bromide as a restrainer or antifogging agent.

Hazards
1. Developers are skin and eye irritants, and in many cases strong sensitizers. Monomethyl-p-aminophenol sulfate creates many skin problems, and allergies to it are frequent (although this is thought to be due to the presence of para-phenylene diamine as a contaminant). Hydroquinone can cause depigmentation and eye injury after five or more years of repeated exposure, and is a mutagen. Some developers also can be absorbed through the skin to cause severe poisoning (e.g., catechol, pyrogallic acid). Phenidone is only slightly toxic by skin contact.

2. Most developers are moderately to highly toxic by ingestion, with ingestion of less than one tablespoon of compounds such as monomethyl-p-aminophenol sulfate, hydroquinone, or pyrocatechol being possibly fatal for adults. Symptoms include ringing in the ears (tinnitus), nausea, dizziness, muscular twitching, increased respiration, and headache, cyanosis (turning blue from lack of oxygen) due to methemoglobinemia, delirium, and coma. With some developers, convulsions also can occur.

3. Para-phenylene diamine and some of its derivatives are highly toxic by skin contact, inhalation, and ingestion. They cause very severe skin allergies and can be absorbed through the skin.

4. Sodium hydroxide, sodium carbonate, and other alkalis used as accelerators are highly corrosive by skin contact or ingestion. This is a particular problem with the pure alkali or with concentrated stock solutions.

5. Potassium bromide is moderately toxic by inhalation or ingestion and slightly toxic by skin contact. Symptoms of systemic poisoning include somnolence, depression, lack of coordination, mental confusion, hallucinations, and skin rashes.

6. Sodium sulfite is moderately toxic by ingestion or inhalation, causing gastric upset, colic, diarrhea, circulatory problems, and central nervous system depression. It is not appreciably toxic by skin contact. If heated or allowed to stand for a long time in water or acid, it decomposes to produce sulfur dioxide, which is highly irritating by inhalation.

**Precautions**

1. See the section on Mixing Photochemicals for mixing precautions.

2. Do not put your bare hands in developer baths. Use tongs instead. If developer solution splashes on your skin or eyes immediately rinse with lots of water. For eye splashes, continue rinsing for 15-20 minutes and seek medical attention.

3. Do not use para-phenylene diamine or its derivatives if at all possible.

**Stop Baths and Fixer**

Stop baths are usually weak solutions of acetic acid. Acetic acid is commonly available as pure glacial acetic acid or 28% acetic acid. Some stop baths contain potassium chrome alum as a hardener.

Fixing baths contain sodium thiosulfate (“hypo”) as the fixing agent, and sodium sulfite and sodium bisulfite as a preservative. Fixing baths also may also contain alum (potassium aluminum sulfate) as a hardener and boric acid as a buffer.

**Hazards**
1. Acetic acid, in concentrated solutions, is highly toxic by inhalation, skin contact, and ingestion. It can cause dermatitis and ulcers, and can strongly irritate the mucous membranes. The final stop bath is only slightly hazardous by skin contact. Continual inhalation of acetic acid vapors, even from the stop bath, may cause chronic bronchitis.
2. Potassium chrome alum or chrome alum (potassium chromium sulfate) is moderately toxic by skin contact and inhalation, causing dermatitis and allergies.
3. In powder form, sodium thiosulfate is not significantly toxic by skin contact. By ingestion it has a purging effect on the bowels. Upon heating or long standing in solution, it can decompose to form highly toxic sulfur dioxide, which can cause chronic lung problems. Many asthmatics are particularly sensitive to sulfur dioxide.
4. Sodium bisulfite decomposes to form sulfur dioxide if the fixing bath contains boric acid, or if acetic acid is transferred to the fixing bath on the surface of the print.
5. Alum (potassium aluminum sulfate) is only slightly toxic. It may cause skin allergies or irritation.
6. Boric acid is moderately toxic by ingestion or inhalation and slightly toxic by skin contact (unless the skin is abraded or burned, in which case it can be highly toxic).

Precautions

1. All darkrooms require good ventilation to control the level of acetic acid vapors and sulfur dioxide gas produced in photography.
2. Cover all baths when not in use to prevent evaporation or release of toxic vapors and gases.

Intensifiers and Reducers

A common after-treatment of negatives (and occasionally prints) is either intensification or reduction. Common intensifiers include hydrochloric acid and potassium dichromate, or potassium chlorochromate. Mercuric chloride followed by ammonia or sodium sulfite, Monckhoven's intensifier consisting of a mercuric salt bleach followed by a silver nitrate/potassium cyanide solution, mercuric iodide/sodium sulfite, and uranium nitrate are older, now discarded, intensifiers.

Reduction of negatives is usually done with Farmer's reducer, consisting of potassium ferricyanide and hypo. Reduction has also be done historically with iodine/potassium cyanide, ammonium persulfate, and potassium permanganate/sulfuric acid.

Hazards

1. Potassium dichromate and potassium chlorochromate are probable human carcinogens, and can cause skin allergies and ulceration. Potassium chlorochromate can release highly toxic chlorine gas if heated or if acid is added.
2. Concentrated hydrochloric acid is corrosive; the diluted acid is a skin and eye irritant.
3. Mercury compounds are moderately toxic by skin contact and may be absorbed through the skin. They are also highly toxic by inhalation and extremely toxic by ingestion. Uranium intensifiers are radioactive, and are especially hazardous to the kidneys.
4. Sodium or potassium cyanide is extremely toxic by inhalation and ingestion, and moderately toxic by skin contact. Adding acid to cyanide forms extremely toxic hydrogen cyanide gas which can be rapidly fatal.

5. Potassium ferricyanide, although only slightly toxic by itself, will release hydrogen cyanide gas if heated, if hot acid is added, or if exposed to strong ultraviolet light (e.g., carbon arcs). Cases of cyanide poisoning have occurred through treating Farmer's reducer with acid.

6. Potassium permanganate and ammonium persulfate are strong oxidizers and may cause fires or explosions in contact with solvents and other organic materials.

Precautions

1. Chromium intensifiers are probably the least toxic intensifiers, even though they are probable human carcinogens. Gloves and goggles should be worn when preparing and using these intensifiers. Mix the powders in a glove box or wear a NIOSH-approved toxic dust respirator. Do not expose potassium chlorochromate to acid or heat.

2. Do not use mercury, cyanide or uranium intensifiers, or cyanide reducers because of their high or extreme toxicity.

3. The safest reducer to use is Farmer's reducer. Do not expose Farmer's reducer to acid, ultraviolet light, or heat.

Toners

Toning a print usually involves replacement of silver by another metal, for example, gold, selenium, uranium, platinum, or iron. In some cases, the toning involves replacement of silver metal by brown silver sulfide, for example, in the various types of sulfide toners. A variety of other chemicals are also used in the toning solutions.

Hazards

1. Sulfides release highly toxic hydrogen sulfide gas during toning, or when treated with acid.

2. Selenium is a skin and eye irritant and can cause kidney damage. Treatment of selenium salts with acid may release highly toxic hydrogen selenide gas. Selenium toners also give off large amounts of sulfur dioxide gas.

3. Gold and platinum salts are strong sensitizers and can produce allergic skin reactions and asthma, particularly in fair-haired people.

4. Thiourea is a probable human carcinogen since it causes cancer in animals.

Precautions

1. Carry out normal precautions for handling toxic chemicals as described in previous sections. In particular, wear gloves and goggles. See also the section on mixing photochemicals.

2. Toning solutions must be used with local exhaust ventilation.

3. Take precautions to make sure that sulfide or selenium toners are not contaminated with acids. For example, with two bath sulfide toners, make sure you rinse the print well after bleaching in acid solution before dipping it in the sulfide developer.

4. Avoid thiourea whenever possible because of its probable cancer status.
Other Hazards

Many other chemicals are also used in black and white processing, including formaldehyde as a pre-hardener, a variety of oxidizing agents as hypo eliminators (e.g., hydrogen peroxide and ammonia, potassium permanganate, bleaches, and potassium persulfate), sodium sulfide to test for residual silver, silver nitrate to test for residual hypo, solvents such as methyl chloroform and freons for film and print cleaning, and concentrated acids to clean trays.

Electrical outlets and equipment can present electrical hazards in darkrooms due to the risk of splashing water.

Hazards

1. Concentrated sulfuric acid, mixed with potassium permanganate or potassium dichromate, produces highly corrosive permanganic and chromic acids.
2. Hypochlorite bleaches can release highly toxic chlorine gas when acid is added, or if heated.
3. Potassium persulfate and other oxidizing agents used as hypo eliminators may cause fires when in contact with easily oxidizable materials, such as many solvents and other combustible materials. Most are also skin and eye irritants.

Precautions

1. See previous sections for precautions in handling photographic chemicals.
2. Cleaning acids should be handled with great care. Wear gloves, goggles and acid-proof, protective apron. Always add acid to the water when diluting.
3. Do not add acid to, or heat, hypochlorite bleaches.
4. Keep potassium persulfate and other strong oxidizing agents separate from flammable and easily oxidizable substances.
5. Install ground fault interrupters (GFCIs) whenever electrical outlets or electrical equipment (e.g. enlargers) are within six feet of the risk of water splashes.

Color Processing

Color processing is much more complicated than black and white processing, and there is a wide variation in processes used by different companies. Color processing can be either done in trays or in automatic processors.

Color Developing Baths

The first developer of color transparency processing usually contains monomethyl-p-aminophenol sulfate, hydroquinone, and other normal black and white developer components. Color developers contain a wide variety of chemicals including color coupling agents, penetrating solvents (such as benzyl alcohol, ethylene glycol, and ethoxydiglycol), amines, and others.
Hazards

1. See the developing section of black and white processing for the hazards of standard black and white developers.
2. In general, color developers are more hazardous than black and white developers. Para-phenylene diamine, and its dimethyl and diethyl derivatives, are known to be highly toxic by skin contact and absorption, inhalation, and ingestion. They can cause very severe skin irritation, allergies and poisoning. Color developers have also been linked to lichen planus, an inflammatory skin disease characterized by reddish pimples which can spread to form rough scaly patches. Recent color developing agents such as 4-amino-N-ethyl-N-[P-methane-sulfonamidoethyl]-m-toluidine sesquisulfate monohydrate and 4-amino-3-methyl-N-ethyl-N-[3-hydroxyethyl]-aniline sulfate are supposedly less hazardous, but still can cause skin irritation and allergies.
3. Most amines, including ethylene diamine, tertiary-butylamine borane, the various ethanolamines, etc. are strong sensitizers, as well as skin and respiratory irritants.
4. Although many of the solvents are not very volatile at room temperature, the elevated temperatures used in color processing can increase the amount of solvent vapors in the air. The solvents are usually skin and eye irritants.

Precautions

1. Wear gloves and goggles when handling color developers. Wash gloves with an acid-type hand cleaner (e.g. phIsoderm (R)), and then water before removing them.
2. Mix powders in a glove box, or wear a NIOSH-approved toxic dust respirator if industrial hygiene data is available.
3. Color processing needs more ventilation than black and white processing due to the use of solvents and other toxic components at elevated temperatures.

Color Processing: Bleaching, Fixing, and Other Steps

Many of the chemicals used in other steps of color processing are essentially the same as those used for black and white processing. Examples include the stop bath and fixing bath. Bleaching uses a number of chemicals, including potassium ferricyanide, potassium bromide, ammonium thiocyanate, and acids. Chemicals found in prehardeners and stabilizers include succinaldehyde and formaldehyde; neutralizers can contain hydroxylamine sulfate, acetic acid, and other acids.

Hazards

1. Formaldehyde is moderately toxic by skin contact, and highly toxic by inhalation and ingestion. It is a skin, eye and respiratory irritant, and strong sensitizer, and is a probable human carcinogen. Formaldehyde solutions contain some methanol, which is highly toxic by ingestion.
2. Succinaldehyde is similar in toxicity to formaldehyde, but is not a strong sensitizer or carcinogen.
3. Hydroxylamine sulfate is a suspected teratogen in humans since it is a teratogen (causes birth defects) in animals. It is also a skin and eye irritant.
4. Concentrated acids, such as glacial acetic acid, hydrobromic acid, sulfamic acid and p-toluenesulfonic acids are corrosive by skin contact, inhalation and ingestion.
5. Acid solutions, if they contain sulfites or bisulfites (e.g., neutralizing solutions), can release sulfur dioxide upon standing. If acid is carried over on the negative or transparency from one step to another step containing sulfites or bisulfites, then sulfur dioxide can be formed.

6. Potassium ferricyanide will release hydrogen cyanide gas if heated, if hot acid is added, or if exposed to strong ultraviolet radiation.

**Precautions**

1. Local exhaust ventilation is required for mixing of chemicals and color processing.
2. Use premixed solutions whenever possible.
3. Avoid color processes using formaldehyde, if possible.
4. Wear gloves, goggles and protective apron when mixing and handling color processing chemicals. When diluting solutions containing concentrated acids, always add the acid to the water. An eyewash should be available.
5. A water rinse step is recommended between acid bleach steps and fixing steps to reduce the production of sulfur dioxide gas.
6. Do not add acid to solutions containing potassium ferricyanide or thiocyanate salts.
7. Control the temperature carefully according to manufacturer's recommendations to reduce emissions of toxic gases and vapors.
Waste Disposal

Evaluating Paint and Ink Wastes
There are several types of wastes that can be generated in the studios. Some examples include:

<table>
<thead>
<tr>
<th></th>
<th>Solvent wastes (paint thinner, OMS, etc.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paints</td>
<td></td>
</tr>
<tr>
<td>Baby oil</td>
<td>Ceramic glaze</td>
</tr>
<tr>
<td>Sharp implements</td>
<td>Lubricating oils</td>
</tr>
</tbody>
</table>

Many of these wastes are considered hazardous waste by the US Environmental Protections Agency (EPA) and Mo DNR and require special handling. The materials also may be considered priority pollutants under the clean water act/ MSD (Metro Sewer District). These materials may not be poured down the drain.

Some pigments/inks/glazes may contain toxic metals at or above regulatory limits. Solvents are also generally used during cleanup that may also be: hazardous wastes, priority pollutants under the sewer ordinances, and may also be considered an air pollutant under the clean air act. Wastes improperly managed can harm human health and the environment.

State and federal law requires any company or business producing a waste to evaluate the waste to determine whether it is hazardous. Waste may be hazardous because it is specifically listed in the law by name or because it displays a hazardous characteristic. Consider paint and ink wastes to be hazardous until properly evaluated and shown and documented to be nonhazardous. Examples of paint and ink wastes which are frequently hazardous waste include:

- unusable liquid paints, stains, or inks;
- paint-thinner wastes of all types;
- linseed oil
- paint spray-booth filters and arrestors;
- scrapings from paint booth walls and floors;
- paint-stripping waste;
- rags containing paint, ink, and/or solvent;
- sludge from distilling paint-thinner waste;
- Ceramic glazes;
- Fired ceramic pieces containing lead, barium, or cadmium (Note: Lead, cadmium and barium have been studied and have been found to leach even when fired);
- blanket and fountain washes and other clean up materials;

Check the (Material) Safety Data Sheet (SDS) to see if your paint thinners, strippers, or wash-up materials contain any of the solvents that appear on the F list of hazardous wastes:

- F001: tetrachloroethylene, trichloroethylene, methylene chloride, 1,1,1-trichloroethane and carbon tetrachloride used as degreasers;
• F002: spent solvents listed above that are not used as degreasers; 1,1,2-trichloro-1,2,2-
trifluoroethane and chlorobenzene;
• F003: xylene (xylol), acetone, methanol and methyl isobutyl ketone (MIK)
• F004: cresols, cresylic acid and nitrobenzene;
• F005: toluene (toluol), methyl ethyl ketone(MEK), carbon disulfide and benzene; and

Any spent solvent mixtures/blends containing 10 percent of F001, F002, F004 and/or F005
before use is listed hazardous waste.

• If the product is either a pure solvent with an F003 waste code, or if it is an F003 solvent in
combination with 10 percent or more of another solvent or combination of solvents on
the F list, waste resulting from its use is listed.
• If unused discarded thinners, washes, strippers, etc., appear on the P or U lists of
hazardous wastes, they are listed. (P and U lists are found in the Hazardous Waste
Resource Guide)
• Rags containing listed wastes are generally listed themselves, but may fall under a
conditional exemption
• If spray guns are cleaned by spraying a solvent into paint booth filters or arrestors, the
filters or arrestors are listed.
• If other hazardous or nonhazardous wastes are mixed with wastes resulting from using
solvents or solvent mixtures the entire mixture becomes listed.
• Pure, discarded paint or ink is not listed; it however may display a hazardous
characteristic.
• Unused thinners, washes or strippers are not on one of these lists, they may display a
hazardous characteristic.

Paint and ink wastes often display one of three hazardous characteristics: ignitability,
corrosively, or Toxicity Characteristic (TCLP).

A paint or ink waste is ignitable if it has a flash point below 140° Fahrenheit. Oil- or solvent-
based paint or ink wastes are usually ignitable. Some latex (water-based) paints can also be
ignitable because of the drying agents they contain. To determine the flashpoint of your
paint, ink, stain, thinner or solvent, check your SDS. When making this determination be
cautious if the SDS lists the flash point close to 140° degrees as slight variations in the
manufacturing process, age, humidity, or the addition of additional oils/solvents, outside
mineral spirits/turpoids may lower the flash point. A solid waste is also ignitable if it can cause
fire through friction, absorption of moisture, or spontaneous chemical changes, and when
ignited, burns so persistently and vigorously that it creates a hazard, such as the case with
linseed oil soaked rags.

A waste is corrosive if it has a pH of 2.0 or less, or 12.5 or more. Typically, corrosive wastes are
produced from paint-stripping processes that use a highly caustic (pH 12.5 or more) liquid
stripper. To help determine the pH of a waste, check the MSDS to find the pH of the stripper
used. Glass etching and ferric acid (ferric chloride mixture) has a PH under 1 and is highly
corrosive.

Toxicity Characteristic (T.C.) Toxic wastes are wastes which, when tested with the Toxicity
Characteristic Leaching Procedure (TCLP), allow certain constituents (contaminants) to leach
(dissolve and wash) out of a test solution at levels greater than the maximum allowable
concentrations (see Table below).

<table>
<thead>
<tr>
<th>Pigment Name</th>
<th>Hazardous Constituent</th>
<th>RCRA Waste Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barium Yellow</td>
<td>Barium and Chromates</td>
<td>D005, D007</td>
</tr>
<tr>
<td>Cadmium: Red, Yellow, or Orange</td>
<td>Cadmium</td>
<td>D006</td>
</tr>
<tr>
<td>Cadmium Ceramic Glaze</td>
<td>Cadmium</td>
<td></td>
</tr>
<tr>
<td>Chromium: Green, Orange, Yellow</td>
<td>Chromium: Green, Orange, Yellow</td>
<td></td>
</tr>
<tr>
<td>Chromium Ceramic Glaze</td>
<td>Chromium Ceramic Glaze</td>
<td>D007</td>
</tr>
<tr>
<td>Lithol Red</td>
<td>Barium</td>
<td>D005</td>
</tr>
<tr>
<td>Manganese Violet</td>
<td>Barium and manganese</td>
<td></td>
</tr>
<tr>
<td>Naples Yellow</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Strontium Yellow</td>
<td></td>
<td>D007</td>
</tr>
<tr>
<td>Zinc: White and Yellow</td>
<td>Chromates and Zinc</td>
<td>D007</td>
</tr>
<tr>
<td>Green 17, Olive Green, or Permanent Green</td>
<td>Chromic Oxide</td>
<td>D007</td>
</tr>
<tr>
<td>Prussian Blue, Iron Blue, Milori Blue, Bronze Blue, or Blue 27</td>
<td>Barium sulfate and cyanide compounds</td>
<td>D005</td>
</tr>
<tr>
<td>Viridian, Green 18, or Emerald Green</td>
<td>Chromic Oxide</td>
<td>D007</td>
</tr>
<tr>
<td>Silver paints, glazes, and fixatives</td>
<td>Silver</td>
<td>D011</td>
</tr>
</tbody>
</table>

Paint and ink wastes are assumed to be toxic unless documented otherwise using one of the following options:

- **Certification** — Ask the manufacturer or supplier of the paints or inks you use to certify in writing that none of the products leach any TCLP Toxic constituents at levels greater than the maximum allowable concentrations. If the manufacturer or supplier is unwilling or unable to give this type of written certification, use the testing option outlined below.

- **Testing** — Have a representative sample of the paint or ink waste tested by an environmental testing laboratory using the TCLP test. There are several parts to the TCLP – metals, volatile organics and pesticides. Test for metals (one or all, depending upon what you know about the waste). You may also need to test for organics. The waste is not T.C. Toxic if the tested levels fall below the maximum allowable concentrations.

**Cleaning Brushes**

It is very important that paints and solvents from cleaning brushes does not go done the drain. If a water source is needed there are two options:

1. A Nalgene container with an eco-funnel (pictured left) placed in the drain will allow the use of the spigot while catching the rinsate.
2. A parts washer.
**Disposal of Photochemicals**

There is considerable concern about the effect of dumping photographic chemicals and solutions down the drain.

1. Old or unused concentrated photographic chemical solutions, toning solutions, ferricyanide solutions, chromium solutions, color processing solutions containing high concentrations of solvents, and non-silver solutions should be treated as hazardous waste.
2. Film photo processing will always result in silver in the mixture of used developer solution due to the process of the developer selectively reducing silver halide crystals in the emulsion to metallic silver which will end up in the used developer solution. This material may not be disposed down the sink.
3. Stop bath left over from neutralization of developer can be poured down the drain after pH has been confirmed and mixed with wash water.
4. Fixing baths should never be treated with acid (e.g., mixing with stop bath), since they usually contain sulfites and bisulfites which will produce sulfur dioxide gas.
5. Fixing baths contain large concentrations of silver thiocyanate, well above the 5 ppm of silver allowed by the clean water act. Collect fixers and either pour into the silver recovery unit or dispose as hazardous waste.

**Oily Rags**

Oily rags must be placed in the oily rag container. Do not leave oily rags lying around the floor. Linseed oil, in particular, can ignite on its own if left out, causing fire that may spread to other areas. Please make sure the container is closed before you leave the studio.

**Solvents**

Solvents, such as paint thinner, turpentine, toluene, xylene, and alcohols are considered hazardous waste. DO NOT DUMP them down the drain. Follow the instructions for handling hazardous waste.

**Paints**

Oil-based paints are considered hazardous waste. DO NOT DUMP oil-based paint down the drain or place in regular trash. Oil-based paints may be combined with solvents and linseed oil for disposal. Follow the instructions for handling hazardous wastes. Water-based paints may be dried out and disposed of assuming they are certified as not containing TCLP levels of metals.

**Linseed Oil**

Because of its potential for fire, linseed oil should be handled as a hazardous waste, in a similar manner as solvents. Linseed oil can be combined with oil-based paints and solvents for disposal. Follow the instructions for handling hazardous waste.

**Aerosol Cans**

Aerosol cans if not collected and recycled as scrap metal, due to the can being under pressure and possibly exploding when compressed (Reactive Characteristic waste- D003) are hazardous waste. Aerosol cans should be collected, marked as scrap metal, and recycled.
Ceramic Glaze
Many ceramic glazes contain metals that are considered hazardous waste. Unused portions of the glazes should be disposed as hazardous waste.

Acids and Bases
Materials with a pH of less than 2 or more than 12.5 are considered hazardous waste. Do not mix these wastes with the solvent or oil wastes. Use care when handling acids and bases and follow the instructions for handling hazardous waste.

Broken Glass Sharp Implements
Sharp objects, such as razor blades, knives, and broken glass should be packaged in a puncture-proof jar or box and placed in the regular trash. Pre-packaging helps to avoid injury to janitors or others handling the trash.

Handling Hazardous Waste
Materials that are to be disposed of as hazardous waste must be placed in sealable containers. Sealable drums for you to dispose of your hazardous waste area available. There is should be a container for oil based paint, oil, mediums and solvents, one for water media and another, metal one, for painting rags. Please make sure the drums are sealed and that you dispose of your waste in the correct container.

Procedure
1. Place the waste materials in the appropriate waste container.
2. Seal the container.

When the waste containers at are not available to you. Your hazardous waste must be placed in sealable containers. Containers should be filled, leaving a headspace for expansion of the contents. Often the original container is perfectly acceptable. You should label the container as hazardous waste and contact your local waste management about safe disposal of your waste.

General Recommendations
- Don’t purchase more of a material than you expect to use in the foreseeable future. The costs of disposal often exceed the purchase cost by a considerable margin.
- Substitute with a less hazardous material whenever possible.
- Keep all chemical containers clearly and unambiguously labeled.
- Dispose of your wastes at the completion of a project - don’t abandon them for someone else to deal with later.
**Painting Terminology**

**Achromatic** – Black, white and grays. An artwork executed without color.

**Acrylic** – fast-drying, water-based paint containing pigment suspended in an acrylic polymer emulsion. Acrylic paints can be diluted with water, but become water-resistant when dry.

**Analogous Colors** – Red and Orange, Blue and Green, etc. These are colors right next to each other on the color wheel.

**Bristle Brush** – Stiff, course natural-hair brush that is resilient and tough. The stiff hairs of the brush create a texture or trace in the paint. Best for thick paint or when brushstrokes are preferred seen.

**Brushes**

Brush styles are designated by a letter following a series number. Some basic brushes to meet your needs:

- F - Flats, square edge, long bristle
- B - Brights, flat, square-edged, long sable
- R - Rounds, pointed bristle
- L - Longs, flat, square-edge, long sable
- Filberts - Flat, oval edge, long fibre

**Canvas** – Fabric usually made from cotton or linen fiber, which are prepared for painting. Available in panels, stretched on frames, or obtained by the yard.

**Chroma** – the intensity, or strength, or purity of a color. Squeezing paint directly from the tube to the palette is ‘full chroma'. Also referred to just as intensity.

**Color** – When light is reflected off an object, color is what the eye sees. The primary colors are red, yellow and blue. The secondary colors are orange, purple and green.

**Color Temperature** – Colors are warm, hot or cold in appearance; ex. Orange (warm), red (hot), blue (cool). This is true within each category of color. There are hotter and colder colors in every category.

**Complementary Colors** – Red and Green, Blue and Orange, Purple and Yellow. These are the colors directly across from each other on the color wheel.

**Composition** – The arrangement of lines, colors and form.

**Glaze** – Color that is thinned to a transparent state and applied over previously painted areas to modify the original color.

**Gesso** – An acrylic primer for oil painting and acrylics to protect the underlying surface from paint soaking into it.
Highlight – Small areas on a painting or drawing on which reflected light is the brightest.

Hue – Another term for color. In paint manufacturing hue refers to an artificial replication of a natural mineral color. Ex. Cadmium Red vs. Cadmium Red (Hue). Generally the properties of the paints work differently than the genuine mineral. Often they are less potent, when mixed the color reacts differently and are less opaque. There have been growing advances in Hue colors though and most are non-toxic or less so.

Impasto – A manner of painting where the paint is laid on thickly so texture stands out in relief.

Intensity – the brightness or dullness of hue. Adding a color’s complimentary (the color directly across on the color wheel) will reduce its intensity. Also referred to as “Chroma” or “Saturation”.

Linseed Oil – The most commonly used carrier in oil paint. It can also be used as a painting medium, making oil paints more fluid, transparent and glossy. It is available in varieties such as Cold Pressed, alkali refined, sun bleached, sun thickened, and polymerized (stand oil).

Mineral Spirits – A petroleum distillate commonly used as a paint thinner and mild solvent. It is an alternative to turpentine, one that is both less flammable and less toxic. Because of interactions with pigments, artists require a higher grade of mineral spirits than many industrial users, including the complete absence of residual sulphur. Odorless Mineral Spirits are mineral spirits that have been further refined to remove the more toxic aromatic compounds.

Monochrome – Using only one color to create a variety of values. Often times understood as being black and white but can be made using any one color.

Oil Paints – A type of slow-drying paint consisting of small pigment particles suspended in a drying oil that will gradually harden, forming a stable, impermeable film.

Painting Mediums – Any number of materials, usually liquid, that carry and bind pigment or paint together. Depending on their unique chemistry they can be combined to make a finish (or skin) of a painting more or less glossy, thicker, thinner, etc. Additionally, mediums can either speed up or slow down the drying time of paints.

Palette Knife – A trowel-type flexible knife used for mixing colors and painting impasto effects.

Pigment – Pigment is the material used to create the effect of color on any surface. It is made from a number of materials generally a mineral or other organic material (though many new synthetic pigments are made).

Polychrome – Using multiple colors to create a variety of values, shades, tints and tones.
**Primary Colors** – Red, Yellow, Blue. These 3 colors are the base colors for every other color on the color wheel. This is why they’re called “primary.” When you mix two primaries together, you get a secondary color.

**Sable Brush** – A natural-hair brush that allows for smooth brushstrokes and superior detail.

**Shades** – Using a mixture of color to create a black (or straight black) mixed with a color to make it darker. The opposite of shade is tint.

**Secondary Colors** – Orange, Green, Purple (Violet). The 3 colors created by mixing the primary colors together.

**Solvent** – In Painting, a liquid that dissolves a solid or liquid resulting in a solution. Such as turpentine or mineral spirits.

**Support** – This refers to any surface on which a painting is made. For ex. Canvas, masonite, paper, etc.

**Synthetic Bristle Brush** – Brushes made with synthetic polymer bristles. Most can be used with a variety of mediums.

**Tertiary Colors** – Made by mixing one primary color and one secondary color together. There can be endless combinations of tertiary colors, depending on how they’re mixed. These are the “in-between” colors like Yellow-Green and Red-Violet.

**Tints** – Created by mixing white to a hue. Also referred to as pastel colors. The opposite of tint is shade.

**Turpentine (or Grumtine)** – Used for cleaning equipment and to thin mediums. It is highly toxic.

**Tones** – The lightness or brightness (as well as darkness) of a color. Tones can be created by mixing a color with its complement.

**Underpainting** – An initial layer of paint applied to a ground, which serves as a base for subsequent layers of paint. Underpaintings are often monochromatic and help to define color values for later painting. If underpainting is done properly, it facilitates overpainting.

**Value** – The lightness or darkness of a hue. Shadows, darkness, contrasts and light are all values in artwork.

**Wash** – A highly fluid application of color.

**Watercolor** – Paints made of pigments suspended in a water-soluble vehicle (usually Gum Arabic).
Some Commercially available Alkyd Based Mediums

Gel Mediums

**Chroma Archival Oils Gel Mediums**
Use these gel mediums from Chroma with a variety of oil painting techniques.
Prices range from $3.98 - $4.92

**Da Vinci Alkyd Gel Quick Dry**
Mix Da Vinci Alkyd Gel Quick Dry one to one with oil colors to accelerate drying time and increase color transparency. Colors will maintain a soft and creamy consistency.

**Gamblin Galkyd Gel Medium**
This gelied alkyd resin painting medium creates transparent impasto of approximately a quarter inch thick. Holds marks and brush strokes. It does not dry as fast as most gel mediums, and it can be applied in multiple layers.

**Sennelier Gel 'N Dry**
This is the gel version of Flow 'N Dry alkyd medium. Use it to speed drying and improve fluidity and gloss by adding 15-20% to paint. Suitable for impasto techniques, it comes in a 40 ml tube that travels well into the field for plain air painting.

**Weber Res-N-Gel Quick Drying Extender Gel**
This full-strength, ready-to-use, synthetic resin gel produces transparent, full-bodied colors. Extends expensive oil colors, prevents color running, retains brush strokes, holds sharply defined detail, adds luminosity and brilliance, and accelerates drying.
Some Commercially available Alkyd Based Mediums

Liquid Mediums

**Chroma Archival Oils Fat Medium**
Recommended for experienced painters who work all day on the same painting, this syrupy, heavy-bodied liquid medium contains high solids to promote faster, more thorough drying of oils, and increase gloss and flow for enamel-like effects.

**Kinstler Alkyd Oil Painting Medium**
More than just a paint thinner, Kinstler Alkyd Painting Medium is a semi-synthetic polymer that significantly accelerates the drying time of oil colors. It can be mixed in any ratio to extend colors and is the ideal medium for creating transparent glazes.

**Da Vinci Liquid Alkyd Medium**
Mix one to one with oil colors to accelerate drying time and reduce viscosity.

**M. Graham Walnut Alkyd Medium**
This special medium was developed to provide a non-toxic, environmentally responsible alternative to solvent based, rapid drying alkyd mediums. It closely resembles combinations of sun-thickened oil and natural resins.

**Gamblin Galkyd Mediums**
Gamblin offers a great range of contemporary mediums. Using today's safer materials, they recreate the properties of traditional mediums.

**Williamsburg Artist Alkyd Resin**
Similar in consistency to a thick Stand Oil, this medium is made from pure alkyd resin and a small amount of odorless thinner. Fast-drying and non-yellowing, it produces a flexible paint film. Use it to make other mediums or undiluted as a glazing and general painting medium.

**Gamblin Neo-Meglip**
Soft, silky gel that gives body to paint, decreases viscosity, and can produce a luminous atmosphere. Base of alkyd resin, without toxic lead or other materials. Will not turn yellow or darken.

**Winsor & Newton Liquid Mediums**
Durable, non-yellowing medium for thinning oil and alkyd colors, and for speeding drying time. Excellent for glazing and producing fine detail. TOXIC.
Linseed and Drying Oils

Alakali Refined Linseed Oil

**Da Vinci Linseed Oil**
Linseed oil increases the brilliance and transparency of colors, and helps to eliminate brush strokes. Da Vinci’s oil mediums are formulated especially for Da Vinci oil paints but can be used with any oil paint.

**Maimeri Linseed Oil**
Maimeri Linseed Oil, a high-viscosity, alkali refined oil, spreads out the brush stroke, reducing brush marks. It increases the brightness and glossiness of colors. Like all linseed oils, it has a tendency to yellow. It's housed in a glass bottle.

**Eco-House 910 Light Refined Linseed Oil**
This very light, purified linseed oil is made without additives. It’s used as a fine oil painting medium, or as a raw material ingredient.

**Reeves Artist Linseed Oil**
Reeves Artist Linseed Oil can be used to thin oil color, increase flow, reduce consistency, and decrease thickness. This medium also increases gloss and transparency. 75 ml (2.5 oz.) bottle.

**Gamblin Refined Linseed Oil**
Gamblin’s Refined Linseed Oil is pressed from American flax seeds and refined using an alkali process. This low acid oil is about as light and pure as it gets. Use linseed oil to thin oil colors and increase their brilliance and transparency.

**Shiva Linseed Oil**
A refined, white linseed oil which contains no free mineral acids, lead, or artificial dryers. It serves to diminish the thickness of paint. The consistency is thinner than that of sun-thickened linseed (stand oil), and the oil may darken with age.

**Grumbacher Linseed Oil**
Our professional select alkali-refined linseed oil provides excellent blending and adhesion for the professional artist.

**Weber Linseed Oil**
Weber Linseed Oil is widely used in diluting oil or alkyd colors. It is also used in preparing painting mediums, and is even good for cleaning brushes. This fine quality, purified and refined linseed oil is pressed from flaxseed.
Williamsburg Artist Linseed Oil
This is a genuine linseed oil, pressed from flax seeds. Used as a drying oil, it forms a tough, resilient film on paintings.

Winsor & Newton Linseed Oils
Natural oil of low viscosity, pressed from flax seeds without heat. Regular heated linseed oil lacks the purity and clarity of cold-pressed oils.

Cold Pressed Oils
Gamblin Cold Press Linseed Oil
Gamblin’s Cold Pressed Linseed Oil is pressed from flax seeds in Canada without using heat or chemicals. Use linseed oil to thin oil colors and increase brilliance and transparency. Linseed oil increases the tendency of lighter colors to yellow.

Old Holland Bleached Linseed Oil
This cold pressed linseed oil increases fluidity of oil colors and enables brushstrokes to be removed. It enhances the flow, increases the gloss, and lengthens drying time of oil paints.

Old Holland Windmill Cold Pressed Linseed Oil
This cold pressed oil is made from linseeds that have been pressed in a windmill. It enhances the gloss and flow of oil paint, lengthens drying time, and allows brushstrokes to be removed. It can be diluted using turpentine and white spirit.

Williamsburg Artist Cold Pressed Linseed Oil
Extracted through pressure alone, this genuine, cold-pressed linseed oil is less processed than alkali-refined linseed oil and much truer to what was used by early artists.

Winsor & Newton Refined Linseed Oil
Winsor & Newton’s most popular oil offers many of the same qualities as Winsor & Newton Cold-Pressed Linseed Oil, but is slower-drying. Refined Linseed Oil is an alkali-refined oil of pale color that reduces oil color consistency and increases gloss and transparency. Hung Liu’s favorite.

Winsor & Newton Bleached Linseed Oil
Winsor & Newton Bleached Linseed Oil is a refined pale oil of slightly increased viscosity that improves the flow of colors and dries slightly faster than Winsor & Newton Refined Linseed Oil. It dries slightly slower than Thickened Linseed Oil, and is thinner and paler.

Winsor & Newton Drying Linseed Oil
Winsor & Newton Drying Linseed Oil possesses a darker color than Refined Linseed Oil. It promotes the fastest drying rate of all drying oils while increasing gloss.

Winsor & Newton Cold Pressed Linseed Oil
Winsor & Newton Cold-Pressed Linseed Oil is a slightly yellow oil that is extracted without the use of heat. Add it to colors to reduce their consistency, improve flow, and increase gloss and transparency, while reducing brush marks.
Poppy Seed Oils

**Daler-Rowney Poppy Oil**
Poppy Oil is a clear oil medium to mix with and reduce white and lighter colours. It is less inclined to yellow than linseed oil, but is slower drying. Enhances gloss and flow, but too high a proportion slows the drying of oil colors.

**Gamblin Poppy Oil**
Slows down drying time. Especially useful for painters using “wet into wet” techniques. Add 10% by volume to slow down the drying time of Gamblin Galkyd painting mediums. 8 oz. (237 ml) bottle. AP non-toxic.

**Maimeri Poppy Oil**
Poppy oil has extreme purity and lightfastness. It will not yellow, and it dries slowly. Similar to safflower oil, it is suited for whites and very light colors.

**Old Holland Refined Poppy Oil**
Old Holland Refined Poppy Oil is made from the first pressing of poppy seeds. Used to increase the fluidity and enhance the flow of oil paints, it’s great for use with light colors.

Safflower Oils

**Da Vinci Safflower Oil**
Da Vinci’s Safflower Oil is pure and refined, useful for diluting white oil paints. Using safflower oil to dilute whites, rather than linseed oil, will help reduce yellowing.

**Maimeri Safflower Oil**
Use safflower oil to soften oil colors and make oil paints more fluid. It has similar characteristics to poppy seed oil. It won’t yellow, it dries slowly, and it is particularly suitable for white and light colors.

**Sennelier Refined Safflower Oil**
The finest first-pressed safflower oil, purified to lower acidity while increasing clarity. Use to increase oil fluidity and transparency, or in medium recipes. Won’t yellow or alter pigments' natural hue as linseed does.
**Stand Oils**

**Eco-House 912 Linseed Stand Oil**
A light-colored, pre-polymerized linseed oil, adds elasticity and moisture to the paint coat, improving flow and leveling of paints. It has less of a tendency to yellow than plain linseed oil.

**Gamblin Stand Oil**
Gamblin's Stand Oil, manufactured by heating a pure refined linseed oil, is an oil that wets pigments well. Stand oil is linseed oil that has been polymerized by heating. Thicker than cold pressed or alkalai refined oils. Has almost no tendency to yellow.

**Maimeri Stand Oil**
Maimeri Stand Oil is a high viscosity linseed oil, polymerized through heating, which imparts a very glossy texture and allows you to spread out your brushstrokes. Stand oil has very little tendency to yellow. It's housed in a glass bottle.

**Weber Stand Oil**
This pale-colored, heavy-bodied, polymerized linseed oil improves the characteristics of painting mediums. It's slower drying than conventional linseed oil, and the performance results include a more durable film with less tendency to after-yellowing.

**Williamsburg Artist Stand Oil**
This thick-bodied, polymerized linseed oil is heated in the absence of oxygen to a honey-like consistency. It levels well and produces an enamel-like sheen.

**NEW! Old Holland Stand Oil**
This boiled, polymerized linseed oil enhances the flow of oil paints and allows brushstrokes to be removed. An elastic medium, it also enhances gloss and lengthens drying time. It can be thinned using turpentine and white spirit and is suitable for the practice of the glacis technique.

**Shiva Stand Oil**
A medium-viscosity polymerized oil suitable for glazing when thinned with rectified turpentine. It produces harder films with less tendency to yellow than thinned linseed oil. It improves the fluidity and gloss of colors when used sparingly.

**Winsor & Newton Stand Oil**
Winsor & Newton Linseed Stand Oil is a pale, viscous oil that can be mixed with turpentine or white (mineral) spirits to improve the flow and leveling of oil colors. It retards drying but imparts a tough, elastic finish.
**Thickened Linseed Oils**

**Winsor & Newton Thickened Linseed Oil**
A pale refined oil of syrupy consistency, Winsor & Newton Thickened Linseed Oil speeds drying time even more than Winsor & Newton Bleached Linseed Oil. It improves flow and gloss, and increases the durability of the film. This oil behaves like Linseed Stand Oil but dries quicker and darker.

**Grumbacher Sun- Thickened Linseed Oil**
A heavy-bodied purified oil that is thicker than regular linseed oil but not as thick as stand oil, Grumbacher Sun-Thickened Linseed Oil is designed for use in preparing oil painting mediums.

**Holbein Sun- Thickened Linseed Oil**
Still made by the orthodox method of exposure to the sun for prolonged periods, this oil is very heavy and thick, with a viscosity that improves drying, leveling and protective characteristics. Used with oil mediums, varnishes and glazes.

**Weber Process Thickened Linseed Oil**
Faster drying than Stand Oil, this pale, heavy-bodied oil has the properties of a sun-thickened oil. It’s superior to other heat-treated linseed oils when used with painting mediums.

**Walnut Oils**

**M. Graham Walnut Oil**
M. Graham Oil Mediums offer the following excellent quality mediums. Use their specially developed, non-toxic Walnut Alkyd Medium or their classic Walnut Oil.

**Maimeri Walnut Oil**
Increases the brightness of colors. It has similar properties to linseed oil, but it won’t yellow as much. Good drying power.
BIBLIOGRAPHY, SOURCES AND RESOURCES

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The Artist’s Handbook, fifth edition
Author: Ralph Meyer
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ISBN-10: 0670837016

WEB RESOURCES

City of Tucson Health & Safety Guide
http://www.tucsonaz.gov/arthazards/

Gamblin Artist’s Oil Colors Studio Safety