



ART SAFETY MANUAL

Introduction

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.

Responsibility for Safety in the Arts

Faculty

Faculty are responsible for ensuring students attend training, conduct their work safely and:

- Ensure artists understand the potential health and physical hazards of the chemicals and equipment used;
- Explain proper and safe procedures for handling, under all circumstances, the hazardous substances used;
- Provide appropriate equipment to allow students and faculty workers to conduct work safely

Artists

Each student, faculty and staff member is expected to attend training and:

- Follow procedures and practices outlined in this training guide
- Report all accidents, near misses, and potential chemical exposures to the Art Department Faculty and/or Technicians.

Topics covered in this manual:

- Common Safety Concerns
- Painting and Drawing
- Ceramics
- Lithography and Relief Printing
- Photography
- Sculpture
- Waste Disposal: Visual Arts

Common Safety Concerns

Chemicals, compressed gases, machines and electrical hazards are the most common health and safety risks associated with the visual arts. Below, are the topics we will summarize, if more detailed information is needed contact the EH&S Department.

- Emergency procedures
- Chemical Safety
- Hazard Communication
- Personal Protective Equipment
- Safety Data Sheets
- Compressed Gas Safety
- Electrical Safety
- Flammable Liquid Safety

Anyone who is pregnant or nursing should consult with their physician prior to utilizing or being exposed to chemicals utilized as part of visual art instruction.

EHS can, provide training for Art students and/or faculty. This training is also available upon request for any member of the University community.

When work involves any chemical, paint, glaze or material that contains or may contain hazardous chemicals, food and drinks are not allowed in the lab/room. Good chemical hygiene must be followed at all times when/where chemicals are present.

Painting and Drawing

Topics to be covered:

- Chemical Safety Basics
- Pigments
- Water-Based Paints
- Airbrush, Spray Cans and Spray Guns
- Dry Drawing Media
- Liquid Drawing Media

Introduction

The health hazards associated with painting and drawing have been known since Ramazzini described such illnesses in 1713. Working safely can involve changes in how you select your art materials and how you handle them.

NOTE: For turpentine and thinners, use secure glass or metal containers with secure lids and label them appropriately. Keep containers sealed or covered when not in use. **DO NOT** use food or beverage containers.

Chemical Safety Basics

- Read the label. Be sure you understand what you are working with and the associated hazards.
- When transferring thinners and other chemicals from the original stock container to a new container:
 - Do not use drink containers. The Art Department will provide labels and answer questions to ensure appropriate labeling.
 - Cover or place a lid on the container when not in use to avoid evaporation and potential spillage.
 - Label the new container with the contents and associated hazards. Visual Arts supplies labels for this purpose.
 - Ensure you have a Safety Data Sheets for any media or chemicals utilized.
 - Utilize Personal Protective Equipment when work involves chemicals.

Pigments

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-marbling and in the fabrication of paint products, and will be discussed more thoroughly in the section below on pastels.

Pigments vs. Hues

Most paints used in visual arts contain metal pigments and are considered toxic. These are most easily identified by the product name. If the paint is described, such as "chromium yellow hue", there is little to be concerned about the toxicity of the metal contained in the product, if using good chemical hygiene.

Hazards

1. Poisoning can occur if 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 paintbrush with the lips. If methods such as spraying, heating, or sanding are employed then there is an opportunity for inhalation of 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.
3. Some 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 rash).
5. The long-term hazards of the modern synthetic organic pigments have not been well studied.

Precautions

1. Obtain Safety Data Sheets (SDSs) on your paints to find out what pigments you are using. This is especially important because the name that appears on the tube of color may or may not truly represent the pigments present. Manufacturers may keep the name of a color while reformulating the ingredients.
2. Use the least toxic pigments possible. Do not use lead or carcinogenic pigments.
3. Avoid mixing dry pigments whenever possible. If dry pigments are mixed, do it inside a glove box or inside a laboratory-type fume hood.
4. Wet mop and wipe all surfaces when using dry pigments.
5. Avoid using dishes, containers or utensils from the kitchen to mix and store paints and pigments.

Water-Based Paints

Water-based paints include watercolor, 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 amounts 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 or localized ventilation 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 and safety shower should be available when handling ammonia or any chemical.

Non Water-Based Paints

Oil paints, encaustic and egg tempera use linseed oil, wax and egg respectively as vehicles, although solvents are often used as a thinner and for cleanup. Turpentine and mineral spirits (paint thinner), for example, are used in oil painting mediums, for thinning, and for cleaning brushes.

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 be 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, 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 and 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.
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 suspected 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 easels in an area of good ventilation.
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 should be provided while solvents are being utilized.
6. Wear double nitrile gloves while cleaning brushes with mineral spirits or turpentine.
7. Paint can be removed from your hands with baby oil, and then soap and water.
8. Wax should only be 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, consult with your physician before beginning any work or instruction involving chemicals, pigments, etc.

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 and pigments, you can be inhaling liquid droplets.
2. Aerosol spray paints have an additional hazard besides pigments and solvents. They contain propellants, usually isobutane and propane, which are extremely flammable and has 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 potential inhalation hazard, because artists work so close to their art work. Airbrushing solvent-containing paints is especially of concern.
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. 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 and there is no significant risk of exposure.
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 considered a nuisance dust, it can become a potential inhalation hazard when created in large amounts. 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 can have problems, however, 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 dust is a potential health concern. Pastels can contain toxic pigments such as chrome yellow (lead chromate), and cadmium pigments. Blowing excess pastel dust off the drawing is the leading source of inhalation of pastel pigments.
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, and may be a hazard by accidental ingestion.
6. Both permanent and workable spray fixatives used to fix drawings contain toxic solvents. There is significant exposure by inhalation to these solvents because the products are sprayed in the air, often right on a desk or easel.
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.
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 in the proper waste receptacle.
4. Wet-mop and wet-wipe all surfaces clean of dust.
5. If inhalation of dust is a problem, explore other methods of dust control(i.e. wet method or similar process).

Liquid Drawing Media

This includes both water-based and solvent-based pen and ink and felt tip markers.

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).

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 in an area with local ventilation.
4. Never paint on the body with markers or drawing inks. Body painting should be done with cosmetic colors.

Ceramics

Topics to be Covered:

- Clay
- Glazes
- Kilns
- Special Processes
- Leaching of Finished Ceramic Ware

Introduction:

Ceramic art and pottery have a wide variety of hazards. The specific hazards and precautions are divided into four areas:

1. Working with clay
2. Glazing and coloring
3. Firing in a kiln
4. Potential leaching of finished ware

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 as 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 materials. Ensure you read the SDS for talcs and whether or not it contains any fibrous materials. Pfizer has some fiber-free talcs.

Hazards

1. Silica dust exposure is not hazardous by skin contact or ingestion; however, it is a potential inhalation hazard. Repeated long-term exposure may result in silicosis.
2. Kaolin is an inhalation hazard and may result in kaolinosis, a disease in which the lungs become mechanically clogged.
3. Sand, perlite, grog, and vermiculite contain free silica and are a potential inhalation hazard.
4. Adding clay or water while the mixer is in operation is dangerous and may result in serious injury.
5. Bags of clay and glaze materials can be very heavy, and lifting can cause back strain.
6. Be aware if mold grows in wet clay that is being soured or aged in a damp place, in slips that stand for months. There are artists that are sensitive to skin and/or inhalation exposures to mold.
7. Throwing on a potter's wheel for long periods of time can result in hand and wrist fatigue or injury. Back problems can occur from bending over the potter's wheel for long periods.
8. Hand contact with wet clay can result in abrasion and dryness of fingertips and hands. Moving parts of kickwheels can cause cuts and abrasions.
9. Clay scraps on the floor, stools 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 greenware can create silica dust.

Precautions

1. Use premixed clay to avoid exposure to large quantities of clay dust. Good handling practices will also reduce the production of clay dust during mixing. Utilize local exhaust ventilation whenever possible.
2. Clay storage and mixing should take place in a separate room. Bags of clay (and other pottery materials) should be stacked on pallets 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 do not 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.
8. Keep wrists and hands in a straight position as much as possible to avoid strain and fatigue. Take frequent work breaks.
9. Be careful of the moving parts on kickwheels.
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.

An assortment of metal oxides or other metal compounds produce particular colors when fired. These are added in such small amounts to the glaze, and do not pose an increased hazard. Luster or metallic glazes are fired in a reduction atmosphere. These glazes can contain mercury, arsenic, solvents such as aromatic and chlorinated hydrocarbons, and oils such as lavender oil. The common metals are often resins of gold, platinum, silver, and copper. Some underglazes and overglazes 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 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 foodware 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 hazardous due to 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-foodware 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 or probable human carcinogens.
4. Use a ventilation fume hood 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 must 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 personal hygiene rules should be followed including restricting eating, drinking, in the studio, and wearing personal protective equipment such as gloves, and separate work clothes or coveralls. Wash hands after work. Leftover glazes and glaze scrapings can be 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 like a chimney to the outside

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.

Galena, cornish stone, crude feldspars, low grade fire clays, fluorspar, gypsum, lepidolite and cryolite can release gases and fumes during glaze firings.

Hazards

1. Chlorine, fluorine, sulfur dioxide, nitrogen dioxide, and ozone are a potential inhalation hazard. Bisque firings of high-sulfur clay result in the production of sulfur dioxide.
2. Many metal fumes generated at high temperatures are a potential inhalation hazard. 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 can cause oxygen deficiency.
4. Hot kilns produce infrared radiation, which is hazardous to the eyes, and may cause cataracts.
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 hand-held 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 temperature, 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 University Police at 911. Test for leaks with 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 are sometimes used. *Salt glazing* and *raku firing* are two examples.

Raku Firing

Raku involves first firing bisque-ware at a low temperature in a regular gas kiln, and then removing the still hot pieces and placing 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 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

Lead leaching into food and drink from pottery fired with lead glazes is a real concern. Both the U.S. Food and Drug Administration (FDA) has regulated how much lead can leach from foodware 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 foodware finished with lead glazes should be tested regularly by certified laboratories.

Other Leachable Metals

Other metals can leach into food and drink. Cadmium is the single metal besides lead presently regulated in the United States. However, other possible toxic metals in glazes can leach. Barium has 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. For food and drink ware, use food-safe products and colorants. Routine testing for other metal leaching should be done.

Lithography and Relief Printing

Topic to be Covered:

- General Chemicals

- Lithography
- Intaglio
- Relief and Other Printing Processes

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, it is also not recommended to ingest any amounts of linseed oil. Oils are flammable when heated, and rags soaked in these will ignite by spontaneous combustion.

Precautions

1. Know and understand what materials are used. Obtain the Safety Data Sheets (SDSs) on all products utilized. Use the least toxic ink possible.
2. Do not use an open flame to heat 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
4. Chromate pigments (chrome yellow and zinc yellow) may cause skin ulceration and allergic skin reactions.

Precautions

1. Obtain SDSs on all pigments. This is especially important because the name that appears on the label of the color may or may not truly represent what the pigments contain.
2. Use the safest pigments possible. Avoid lead pigments.
3. Avoid mixing dry pigments whenever possible. If dry pigments are mixed, utilize a local exhaust hood.

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 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 most likely route of exposure to solvents. High concentrations of most solvents can cause dizziness, nausea and fatigue.
3. Many solvents are toxic and fatal if ingested.
4. Most solvents are also either flammable or combustible.

Precautions

1. Obtain the 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 ABC fire extinguisher in the area.
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 SDS for all acids.
2. Whenever possible avoid concentrated acids.
3. Doing acid etching requires working in a well-ventilated area or enclosed hood.
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. Use only where there is adequate ventilation.
8. If acid is spilled on your skin, wash with copious amounts 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 may contain isophorone and cyclohexanone, which is considered toxic. 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 suspected 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 when stored 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 there is a potential inhalation exposure.

Precautions

1. Obtain the SDS for all materials used.
2. See Acids and Solvents sections for the precautions with acids and solvents.
3. Use the least toxic solvents. Gasoline should never be used. Lithotine and mineral spirits are less toxic than the more irritating kerosene.
4. Use asbestos-free talcs such as baby powders.
5. Avoid dichromate-containing counter etches and fountain solutions if possible. Do not use hydrofluoric acid or phenol.
6. 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 cancer in animals and are therefore suspect human carcinogens. Less toxic alternative should be utilized.

Precautions

1. Know materials used. Obtain the SDS for all solvents. See Solvents section for the precautions with 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, local exhaust ventilation 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, drypoint, 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 of the plate are protected with resists such as stopout 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 an inhalation hazard 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 nitrogen dioxide, which can be a respiratory irritant, and has poor odor warning properties.
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 chlorine gas. Potassium chlorate 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 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 the use of aerosol spray paints.

Precautions

1. Obtain the 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 stopouts 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.

Other Techniques

Drypoint, 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.

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 hand fatigue by choosing tools with wide handles, avoiding tight grips.

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 a potential inhalation hazard. See Pigments section for the hazards of pigments.
2. See Solvents section for the hazards of solvents.
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.
2. Ensure local ventilation is utilized.

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 printed. 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. Caustic soda (sodium hydroxide) is sometimes used for etching linoleum. It can cause skin burns and severe eye damage if splashed in the eyes.
4. Eating, drinking or smoking while printing are not allowed.
5. Hazardous solvents are used in stopouts 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 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 chemical is spilled on your skin, wash with copious amounts 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. Hand fatigue can be minimized or avoided by using tools with wide handles, avoiding tight grips, and rest periods.

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, 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 be a potential inhalation hazard of the solvent-containing spray mist.

Precautions

1. Know the hazards of materials used. Obtain the SDSs 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.
3. Wear gloves when using epoxy glues.
4. When sanding collagraph plates use a localized ventilation hood.

Plastic Prints

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

Hazards

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

Precautions

1. Obtain the SDS 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.

Photo Printmaking

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 photo emulsions 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 photo printmaking 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 pre-sensitized 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. Diazo photo emulsion 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 a potential inhalation hazard. Ammonia is highly irritating to the eyes.
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, and carbon monoxide.
5. Screen cleaning solutions include strong caustic solutions. These are skin and respiratory irritants.
6. Many solvents used in developing solutions are a skin and inhalation hazard.

Precautions

1. Obtain a SDS for all materials used.
2. See Solvents section for more precautions with solvents.
3. Avoid ammonium dichromate and use pre-sensitized 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.

Photo Etching

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 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 toxic by skin absorption and inhalation.
2. Xylene is toxic by skin absorption, and by inhalation and ingestion. It is a strong narcotic.
3. The Photolithography section discusses carbon arc hazards.

Precautions

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

Photography

Topics to be Covered:

- Black & White Photographic Processing
- Mixing Photo Chemicals
- Developing Baths
- Stop Baths & Fixer
- Intensifiers & Reducers
- Toners
- Other Hazards
- Color Processing
- Color Developing Baths
- Color Processing: Bleaching, Fixing, and Other Steps
- Disposal of Photo chemicals

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 Photo Chemicals

Photo chemicals 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 corrosive by skin contact, inhalation and ingestion.
2. Developer powders are a potential skin and inhalation hazard, 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 avoid exposure to powdered developer.
2. When mixing powdered developers, use a glove box or local exhaust ventilation. If needed, wear a NIOSH-approved particulate respirator.
3. Wear gloves, goggles and protective apron when mixing concentrated photochemicals. Always add acid to water, never the reverse.
4. In case of skin contact, rinse with copious amounts of water. In case of eye contact, rinse for at least 15-20 minutes using an eyewash station and seek medical attention.
5. Store concentrated acids and other corrosive chemicals on low shelves to reduce the chance of exposure of burns to the face or eye 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 anti fogging agent.

Hazards

1. Developers are skin and eye irritants, and in many cases strong sensitizers. Monomethyl-p-aminophenol sulfate creates allergies to it (although this is thought to be due to the presence of para-phenylene diamine). Hydroquinone can cause depigmentation and is a mutagen.
2. Most developers are toxic and potentially fatal if ingested.
3. Para-phenylene diamine and some of its derivatives are a skin, ingestion and inhalation hazard.
4. Sodium hydroxide, sodium carbonate, and other alkalis used as accelerators are corrosive to the skin and can cause chemical burns.
5. Potassium bromide is a potential skin, ingestion and inhalation hazard.
6. Sodium sulfite is a potential ingestion and inhalation hazard.

Precautions

1. See the section on Mixing Photo chemicals 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 copious amounts 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.

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 a skin, ingestion and inhalation hazard. It can cause dermatitis and irritate the mucous membranes. The final stop bath is a skin irritant when in direct contact.
2. Potassium chrome alum or chrome alum (potassium chromium sulfate) is a skin, ingestion and inhalation hazard. Upon heating or long standing in solution, it can decompose to form sulfur dioxide, which can be a respiratory irritant. Many asthmatics are particularly sensitive to sulfur dioxide.
3. 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.
4. Alum (potassium aluminum sulfate) may cause skin allergies or irritation.

Precautions

1. All darkrooms require good ventilation to control the level of acetic acid vapors and sulfur dioxide gas produced in photography.
2. Wear gloves and goggles.
3. Cover all baths when not in use to prevent evaporation or release of 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 been 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 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 absorption/contact. They are also toxic by inhalation and ingestion. Uranium intensifiers are radioactive, and are especially hazardous.

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, 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 using local exhaust ventilation or in a glove box. 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 acids, 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. A variety of other chemicals are also used in the toning solutions.

Hazards

1. Sulfides release 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 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.
4. Thiourea is a probable human carcinogen.

Precautions

1. Carry out normal precautions for chemicals as described in the previous sections. In particular, wear gloves and goggles. See also the section on mixing photo chemicals.
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 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 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 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. 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 toxic by skin contact and absorption, inhalation, and ingestion. Recent color developing agents such as 4-amino-N-ethyl-N-[P-methane- sulfonamido ethyl]-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.

Precautions

1. Wear gloves and goggles when handling color developers. Wash gloves with soap and water before removing them.
2. Mix powders in a glove box, or with local exhaust ventilation (fume hood).
3. Color processing needs more ventilation than black and white processing due to the use of solvents and other 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 toxic by skin contact, inhalation and ingestion. It is a skin, eye and respiratory irritant, and strong sensitizer, and is a probable human carcinogen.
2. Succinaldehyde is similar in toxicity to formaldehyde, but is not a sensitizer or carcinogen.
3. Hydroxylamine sulfate is a suspected teratogen in humans. 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.

Disposal of Photochemicals

There is considerable concern about the effect of dumping photographic chemicals and solutions down the drain. The following recommendations are for disposing small volumes of photographic solutions daily.

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. 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.
3. Fixing baths contain large concentrations of silver thiocyanate, well above the 5 ppm of silver ion allowed by the U.S. Clean Water Act. Collect fixers and either pour into the silver recovery unit or dispose as hazardous waste.

Sculpture

Topics to be covered:

- Plaster and Plaster Molds
- Wax
- Woodworking
- Carving and Machining Wood

Many artists work with traditional sculptural materials including plaster, stone, lapidary, clay, wax, and modeling materials. See Ceramics for information on some other sculpting media.

Plaster and Plaster Molds

Plaster can be carved, modeled, and casted. Varieties of plaster include: Plaster of Paris, casting plaster, white art plaster, molding plaster, and Hydrocal. These are all varieties of calcined gypsum, composed of calcium sulfate. Mold releases used with plaster include vaseline, tincture of green soap, auto paste wax, silicone-grease, and mineral oil-petroleum jelly. In waste molding, the plaster mold is chipped away.

Hazards

1. Plaster dust (calcium sulfate) is slightly irritating to the eyes and respiratory system.

2. Potassium sulfate and potassium alum is a skin irritant.
3. Burnt lime (calcium oxide) is a skin and respiratory irritant.
4. Careless use and storage of sharp tools can cause accidents. Chipping set plaster can result in eye injuries from flying chips.
5. Benzene used with many mold releases is toxic by skin contact and inhalation. It is also flammable.
6. Making plaster casts of hands, legs, and other body parts can be very hazardous due to the heat released during the setting process.

Precautions

1. Wear gloves and goggles when mixing acetic acid and burnt lime.
2. Always carve or cut in a direction away from you, and keep hands behind the tool. If the tool falls, don't try to catch it.
3. Wear safety goggles when chipping plaster.
4. Wear gloves and goggles when pouring benzene. Store in safety containers and do not use near open flames.
5. Do not use plaster for body part casts. Instead, use a plaster-impregnated gauze or material, along with vaseline or similar mold release as protection.

Wax

Many different types of waxes are used for modeling, carving, and casting. These include beeswax, ceresin, carnauba, tallow, paraffin, and micro-crystalline wax. In addition, there are synthetic chlorinated waxes. Solvents used to dissolve various waxes include alcohol, acetone, turpentine. Waxes are often softened for carving or modeling by heating in a double boiler, by sculpting with warmed tools or by the use of soldering irons. Wax can be melted for casting in a double boiler. Additives used with waxes include rosin, dyes, petroleum jelly, mineral oil, and other solvents.

Hazards

1. Overheating wax can result in the release of flammable wax vapors, as well as in the decomposition of the wax to release acrolein. Explosions have occurred from heating wax that contained water.
2. Alcohol and acetone are solvents with a potential skin contact and inhalation hazard.
3. Chlorinated synthetic waxes when absorbed by the skin, can cause a severe form of acne (chloracne).

Precautions

1. Do not overheat waxes. Use a double boiler and a temperature-controlled hot plate. Do not use an open flame to melt waxes.
2. Use the least hazardous solvent to dissolve your wax. Store solvents safely, do not smoke or have open flames near solvents. Dispose of solvent-soaked rags in an approved waste disposal container which is emptied daily.
3. Do not use chlorinated synthetic waxes.

Woodworking

Wood sculpture uses a large number of different types of hard and soft woods, including many exotic tropical woods. Some of these woods can pose a potential health hazard. Sometimes woods are treated with preservatives or pesticides.

Hazards

1. Many **hardwood** dusts, especially those from exotic woods, are common sensitizers and can cause allergic skin reactions. **Softwoods** do not cause as high a frequency of skin and respiratory sensitivities as hardwoods.
2. Contact with the dust of many hardwoods can cause conjunctivitis (eye inflammation), hay fever, asthma and coughing. .
3. Some hardwoods contain chemicals that are toxic, and can cause a variety of symptoms, including headaches, salivation, thirst, giddiness, nausea, irregular heartbeat, etc. A classic example is hemlock.

Precautions

1. Whenever possible, use common hardwoods rather than rare tropical hardwoods.
2. If you have a history of allergies, you should avoid common sensitizing woods.
3. If you are handling woods that can cause skin irritation or allergies, wear gloves.

Carving and Machining Wood

Wood can be hand carved with chisels, rasps, files, handsaws, sandpaper, and the like, or machined with electric saws, sanders, drills, lathes and other woodworking machines.

Hazards

1. Woodworking machinery and tools also present physical hazards. Machinery accidents are often due to missing machine guards, faulty equipment, or using the wrong type of machine for a particular operation. Tool accidents are often caused by dull tools or improper use.
2. Electrical equipment can also present electrical shock and fire hazards from faulty or inadequate wiring.
3. Sawdust and wood are fire hazards. In addition, fine sawdust is an explosion hazard if enclosed.

Precautions

1. Wear goggles when using machines that create dust. For lathes and similar machines, which may produce wood chips, use a face shield and goggles, and make sure the machines are properly shielded.
2. Be sure that all woodworking machines are equipped with proper guards to prevent accidents. Use the proper machine for particular operations and repair defective machines immediately. Do not wear ties, long loose hair, loose sleeves, necklaces, long earrings or other items that could catch in the machinery.

3. Keep hand tools sharpened, and cut away from your body. Do not place your hands in front of the tool or blade.

Gluing Wood

A variety of glues are used for laminating and joining wood. These include contact adhesives, casein glue, epoxy glues, formaldehyde-resin glues (e.g., formaldehyde-resorcinol), hide glues, and white glue (polyvinyl acetate emulsion), and the cyanoacrylate "instant" glues.

Hazards

1. Epoxy glues are a potential skin, eye and respiratory hazard. Amine hardeners (as well as other types of hardeners) can cause skin allergies and irritation.
2. Cyanoacrylate glues: These are a skin, eye and respiratory hazard. Eye contact can cause severe eye irritation
3. Formaldehyde-resin glues: Resorcinol-formaldehyde and urea-formaldehyde glues are toxic by eye contact and by inhalation, and moderately toxic by skin contact. Formaldehyde can cause skin and respiratory irritation and allergies, and is a known human carcinogen. Formaldehyde can be a concern when working with fiber-board and plywood.
4. Contact adhesives: Flammable contact adhesives contain hexane, mineral spirits or naphtha, which are potential skin and respiratory hazards.
5. Water-based glues: Water-based contact adhesives, casein glues, hide glues, white glue (polyvinyl acetate), and other water-based adhesives are not hazardous.

Precautions

1. Avoid formaldehyde resin glues because of allergic reactions and the carcinogenicity of formaldehyde.
2. Use water-based glues rather than solvent-type glues whenever possible.
3. Wear gloves when using epoxy glues, solvent-based adhesives, or formaldehyde-resin glues.