



Environment

I N F O R M A T I O N F R O M K O D A K

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Use of Perchloroethylene in Motion Picture Wet-Gate Printing



INTRODUCTION

This publication addresses the most commonly asked environmental, health, and safety questions about the use of perchloroethylene in Motion Picture wet-gate printing applications.

Perchloroethylene, or simply 'perc', is regulated extensively by existing health, safety, and environmental laws. While using perc as a chemical processing aid, workers must be protected against the vapors caused by fugitive losses from the process. Likewise, existing

regional and local (e.g., southern California) air pollution regulations may impose further restrictions on usage and emission controls. At the end of its useful life, waste perc is subjected to a strict waste management regime that may include many regulatory restrictions associated with recycling activities. Furthermore, national and local 'right-to-know' laws may require facilities that use perc to disclose information to the public regarding the usage and subsequent management of the chemical.

Kodak's health, safety, and environmental publications are available to help you manage your photographic processing operations in a safe, environmentally sound and cost-effective manner.



Despite strict regulatory controls, controls, perchloroethylene remains the solvent of choice for Motion Picture wet-gate printing applications. This is due to its unique combination of physical properties: perchlorethylene is non-combustible, is not an Ozone Depleting Substance, has a refractive index very similar to film base, and dries relatively quickly. This combination of physical properties make perchlorethylene a very effective wet-gate printing liquid, and a 'drop-in' replacement material has not been identified.

The information in this publication is subject to change. Rules, regulations, and laws can change almost overnight, particularly within international markets. While most of the prohibitions on perchlorethylene are at the local level (domestically) having to do with residential chemical exposure and safety, there is no way to predict the likelihood of abrupt changes to U.S. and international policy that would alter or ban the usage of perchloroethylene.

This publication is divided into three sections:

1. General health, safety, and environmental information and best-management practices specific to using perchloroethylene in wet-gate printing,
2. Appendix I – country- or region-specific regulatory information, if applicable or appropriate, and
3. Appendix II – Kodak, Health, Safety, or Environment Resources.

FUNCTION OF PERCHLOROETHYLENE IN WET-GATE PRINTING

One of the most troublesome problems encountered by handlers of motion picture films are scratches (digs, abrasions, cinch marks, etc.) sometimes encountered on origination films from which prints must be made. Handling problems cause these scratches. They print through visually to the print stage, and degrade the quality of the projected image by introducing picture image artifacts that have no relationship to the originally photographed scene.

Scratches on the support side of a negative film, printed onto positive film, usually produce more objectionable effects on the screen than scratches on reversal originals printed onto reversal print films. This is because scratches on the support of negative films appear white on the positive film, and are generally of lower density than other surrounding image material in the picture frame. In reversal printing, scratches on the support of the original appear black on the screen print and tend to more easily blend in with the picture.

Scratches on the emulsion side of negative films present another situation. Shallow emulsion scratches on the clear supercoat of a black-and-white or color negative will appear white on the positive film. Emulsion scratches that penetrate to the support on a black-and-white negative will print black. Scratches on the emulsion side of color negative films may appear colored on the print, depending upon how deep the scratch is and whether or not image-bearing layers have been disturbed.

When base or emulsion scratches exist, a "wet" or "liquid" gate is often used to minimize or eliminate the resultant optical effect, depending on severity. In wet-gate printing, a liquid (such as perchloroethylene) having a refractive index close to that of the film base and the gelatin emulsion is applied to the original. The liquid fills in the scratches and reduces the light scatter. Wet-gate printing is generally applicable to any printing configuration, step or continuous, contact or optical. Wet printing is of little or no benefit to deep emulsion-side scratches.

In addition, wet-gate printing can reduce the visibility of white "sparkle" on interpositives or prints, caused by dirt particles on the negative by reducing the light-scattering ability of these particles in a manner similar to that occurring in scratches.

SAFE HANDLING, STORAGE, AND TRANSPORTATION OF PERCHLOROETHYLENE

Handling and Storage

Perchloroethylene is a colorless liquid with a mild chloroform-like odor. Perchloroethylene is listed as a suspected carcinogen by the International Agency for Research on Cancer (IARC). Disposal and recycling of perchloroethylene is also regulated within many regions of the world. It is important to be aware of the hazards associated with the handling and storage of this chemical in your facility.

There are fundamental safety measures you can follow. Use this chemical in a cool, well-ventilated area away from sources of heat, flame, or ignition. Store in tightly closed containers and minimize the exposure of the liquid to air while using.

Wet-gate printers should be designed to contain the vapor of perchloroethylene to prevent its inhalation by the operator, and to extract it safely to an efficient recovery system, such as one using carbon adsorption.

Know the proper personal protective equipment requirements when handling perchloroethylene. As a minimum requirement, operators should wear impervious gloves, safety goggles, and lab coats or aprons. Examples of impervious gloves are polyvinyl alcohol, Teflon rubber gloves, and Viton synthetic rubber gloves. Gloves made of butyl rubber, natural rubber, and neoprene are not recommended.

Transportation

Identifying and classifying a material so that it can be packaged, marked, labeled, and documented in compliance with regulatory requirements are important parts of doing business. The transport of hazardous materials requires special consideration. Refer to Appendix I for country-specific regulatory information on transportation.

END-OF-LIFE MANAGEMENT

Disposal and recycling of perchloroethylene are regulated in many regions of the world. This material must be managed in accordance with applicable local, regional, and national regulations. For other country-specific details, please refer to Appendix I.

USE OF CARBON ADSORPTION TO CONTROL AIR AND WASTEWATER EMISSIONS

Activated carbon adsorption is a method of recovering organic solvents from air and wastewater streams. It is one of the most economical methods of air emissions control from operations such as wet-gate printing

Activated carbon is obtained from any carbon containing material including wood, coal, coke, and peat. The carbon is activated through a three-step heat treatment process (dehydration, carbonization, oxidation) that enables it to adsorb organic material such as perchloroethylene. During use, a stream of solvent laden wastewater or exhaust air is passed through a bed of activated carbon. When the activated carbon is near saturation, heat is used to desorb the organic materials for recovery. The desorption process can be done

either in-place (for large operations) or at an off-site facility. Contact national and local authorities regarding on-site treatment (regeneration) of spent carbon. Saturated carbon filters or media may be considered a regulated waste and trigger specific regulatory requirements for regeneration, reuse, or disposal of the material. Failure to comply with national and local waste laws can result in unwanted penalties and poor public perception.

Activated carbon adsorption can also be used as one element of a perchloroethylene air emissions compliance strategy. Additional benefits of carbon adsorption technology include: recovery of valuable solvents that would otherwise be lost, and potential reductions to worker exposure to solvent fumes. Refer to your local authority for recommendations on the use of carbon adsorption as a compliance strategy. It is likely that some type of record-keeping will be required by the authority to ensure the carbon is desorbed periodically, based on supplier recommendations.

Two manufacturers of activated carbon adsorbers are:

AMCEC Inc.
2525 Cabot Drive - Suite 205
Lisle, Illinois 60532 - USA
(630) 577-0400
www.amcec.com

US Filter
181 Thornhill Rd.
Warrendale, PA 15086
1-800-525-065
www.usfilter.com

This list is not an endorsement of any of the specific manufacturers listed. Waste generators are advised to thoroughly evaluate the services and compliance status of any company that they use to manage their regulated waste.

ALTERNATIVES TO USE OF PERCHLOROETHYLENE

Use of Isobutylbenzene

Some labs have had success using isobutylbenzene (2-Methyl-1-phenylpropane) as a wet-gate printing solvent. Isobutylbenzene has a refractive index (1.49) very similar to that of perchloroethylene (1.50). It is generally considered less toxic than perchloroethylene, and fewer regulatory restrictions apply to its transportation, use, and disposal.

There are several drawbacks to isobutylbenzene:

- unlike perchloroethylene, it is combustible
- it has a strong odor that may be unpleasant to some
- it dries more slowly than perchloroethylene

While it may not be suitable for all wet-gate printing applications, isobutylbenzene is a potential alternative to perchloroethylene. You should consider using it in low-to-medium throughput printing situations where drying speed is not critical.

Handling and Storage

Combustible liquids, such as isobutylbenzene, may be used in photographic processing facilities. It is important to be aware of the hazards associated with the handling and storage of combustible chemicals in your facility.

Combustible liquids do not “cause” fires; they are contributing factors. A spark or some other ignition source causes fire or explosion in the presence of the right concentration of flammable vapors.

Always try to maintain small inventories of combustible liquids on-site. Store in properly closed containers and minimize the exposure of the liquid to air while using. These are fundamental safety measures you can follow.

Isobutylbenzene is considered a strong skin and eye irritant. Effective personal protective equipment must be used when handling this material. As a minimum requirement, operators should wear impervious gloves, goggles, and lab coats or aprons when handling isobutylbenzene. Impervious gloves will prevent absorption into the skin. A good brand of gloves to use is Responder.

FUTURE ALTERNATIVES TO USE OF PERCHLOROETHYLENE

Digital Scratch Removal

Digital technology is highly likely to become a practical alternative to scratch removal through wet-gate printing in the long-term. In fact, the digital technology does exist today. It generally involves scanning film with a high-quality film scanner, removing scratches in the digital domain through the use of a software algorithm, and writing the “repaired” images back to film using a high-speed film recorder.

Although digital scratch removal is expensive when compared to wet-gate printing today, costs are expected to decline rapidly as the technology matures, and scanning and recording speeds are increased.

In 1992, Cinesite, a wholly owned subsidiary of Eastman Kodak Company, worked with the Walt Disney Company on the restoration of the 1937 classic SNOW WHITE AND THE SEVEN DWARFS. This was the first theatrical feature fully restored with the aid of state-of-the-art digital technology. This massive undertaking encompassed scanning over 119,550 individual frames of film with a Cineon scanner into digital format. Cinesite also repaired scratches and eliminated cell dust, color fringing, cell scuffs, flares, and light reflection photographed in the original animation negative and other damage caused by handling and aging of the film.

The Snow White project was the beginning of a convergence of film and digital technologies as complementary tools. Cinesite has subsequently played a role in the restoration of many other classic films. Various tools from additional suppliers (e.g. Cintel's OLIVER system) provide additional means for digitally mitigating scratches.

APPENDIX I - COUNTRY-SPECIFIC REGULATORY INFORMATION

APPENDIX I-A UNITED STATES OF AMERICA

Handling and Storage

Wash hands thoroughly after handling. Remove contaminated clothing and wash before reuse. Use with adequate ventilation. Do not reuse the container. Avoid breathing vapors from heated material. Avoid contact with skin and eyes. Keep container tightly closed. Keep away from flames and other sources of high temperatures that may cause material to form vapors or mists. Store in a cool, dry place.

Transportation

Both the USDOT and the United States Environmental Protection Agency (USEPA) regulate the transportation of perchloroethylene. Shipping papers must include the following information:

Shipping Name: TETRACHLOROETHYLENE

Hazard Class: 6.1

UN Number: UN1897

Packing Group: III

End-of-Life

The management of waste perchloroethylene is subject to RCRA (Resource Conservation and Recovery Act) regulations (as a spent solvent – F001/2, as a characteristic hazardous waste – D039, or as a discarded commercial chemical product – U210). A licensed waste hauler and/or a permitted treatment facility may be required for the off-site transport, disposal, and/or recycling of perchloroethylene.

Whenever possible, you should recycle perchloroethylene instead of disposing of it (i.e., incinerating). Contracts with recycling firms should consider all applicable federal, state, and local laws. Where recycling is not viable, disposition must be consistent with existing federal, state, and local laws.

Permitted Releases

Small or trace amounts of perchloroethylene can escape the process via air or wastewater routes. In either case, state and local jurisdictions should be consulted and, where necessary, permits secured.

Wastewater discharges are regulated by one of two federally mandated programs, depending on the receiving body of water. Direct discharges or release to U.S. bodies of water (i.e., streams, lakes, oceans) must secure a NPDES permit (or SPDES, as required by individual states). Such releases may be subject to strict discharge limits (often referred to as 'loading') unique to the receiving body of water as well as local public input. Many direct discharge permits require pollution abatement processes. Installing capital equipment for abatement purposes can be expensive.

The other route is known as an indirect discharge. Indirect discharges involve wastewater releases to a local 'Publically Owned Treatment Works' (POTW) or public sewage treatment plant. These releases require a user permit issued by the local POTW. In most applications, the discharger is required to meet numerical limits through periodic testing. On-site pretreatment is not typically required.

In many cases, releases of perchloroethylene to the air also require securing a permit. Such permits are usually issued by a local or state air pollution control board or agency that has authority to implement the requirements of the federal Clean Air Act. These permits are developed to address any federal, state, or local performance standards as well as any technology-driven requirements. In some cases, such as in southern California, you may be required to install and properly operate air pollution control devices. Check with your air pollution control agency for details on these programs.

APPENDIX I-B EUROPEAN UNION

Handling and Storage

Consult the current local material safety data sheet to obtain details of the hazards associated with this material. Use risk assessment to specify steps needed to control identified risks.

Transportation

IATA Shipping Name: TETRACHLOROETHYLENE

Hazard Class: 6.1

UN Number: 1897

Packing Group: III

IMO Shipping Name: TETRACHLOROETHYLENE

Hazard Class: 6.1

UN Number: 1897

Packing Group: III

RID / ADR Shipping Name:

TETRACHLOROETHYLENE

Dangerous Goods Code: 6.1(15C)

UN Number: 1897

End-of-Life

Waste tetrachloroethylene is likely to be classified as hazardous under the EU Directive on Hazardous Waste. Dispose of it according to local regulations.

APPENDIX I-C CANADA

Handling and Storage

Wash hands thoroughly after handling. Remove contaminated clothing and wash before reuse. Use with adequate ventilation. Do not reuse this container. Avoid breathing vapors from heated material. Avoid contact with skin and eyes. Keep container tightly closed. Keep away from flames and other sources of high temperatures that may cause material to form vapors or mists. Keep away from heat and flame. Store in a cool, dry place. Keep containers tightly closed.

Transportation

The Canada TDG regulates the transportation of Perchloroethylene. Shipping papers must include the following information:

Shipping Name: TETRACHLOROETHYLENE

Hazard Class: 6.1

UN Number: UN1897

Packing Group: III

End-of-Life

The management of waste perchloroethylene is subject to provincial waste regulations and must be managed by a licensed hauler or recycled.

Discharges to local sewers are not permitted.

NPRI and CEPA Information

Perchloroethylene is included on the NPRI (National Pollutant Release Inventory). Owners or operators of facilities that manufacture, process or otherwise use a NPRI-listed substance, under prescribed conditions, are required to report to the NPRI.

Perchloroethylene is also included on the List of Toxic Substances under CEPA (Canadian Environmental Protection Act) and therefore the regulatory framework is in place for future establishment of specific legislation relating to its use in Canada.

APPENDIX II – KODAK HEALTH, SAFETY, AND ENVIRONMENTAL RESOURCES

Country	HSE Web Assistance	Phone Assistance
United States and Canada	www.kodak.com/go/planet www.kodak.com/go/kes	HSE-related inquiries: Kodak Environmental Services: Call: 585-477-3194 EI WW Technical Services: Call: 1-800-621-FILM E-mail: kes@kodak.com
Europe	www.kodak.com/go/planet www.kodak.com/go/kes	Contact your local Kodak representative for additional information. Or E-mail: kes@kodak.com

The products and services described in this publication may not be available in all countries. Contact your local Kodak representative, or your usual supplier of Kodak products.



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