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## Photographic Fixer Disposal

The processing of photographic film and paper requires the use of various chemicals to develop and produce finished goods. The photosensitive medium used for black and white processing is an emulsion of fine silver halide crystals in a matrix of gelatin, which is applied in a layer approximately 1/1000 of an inch thick on either paper or clear plastic film. The silver from this process is in concentrations that prohibit its drain disposal. Used fixer must be processed as a hazardous waste through Environmental Health and Safety.

### How can I reduce the amount of hazardous photographic fixer I use?

Waste minimization options can be classified as source reduction and recycling (resource recovery). Source reduction is the most preferred method of waste minimization, followed by recycling and resource recovery. Source reduction methods include inventory control, producing only necessary amounts of processing solutions, preventing the loss of potency and reducing evaporation by using floating lids or balls on developer solutions, and improvements in quality control for all processes to reduce discharges. Contamination of process baths by chemical carry over can be reduced by the use of squeegees to remove the excess liquids from film and paper. Reducing chemical contamination of process baths will not only result in increased recyclability of chemicals, but an extension of process bath life; decreased quantity of replenisher chemicals required; and increased product quality. Chemical waste may be reduced by precision monitoring and adding of chemical replenishment to the process baths.

Resource recovery and recycling includes silver recovery, color developer reuse, ferricyanide recovery, ion exchange, reverse osmosis, precipitation, and rinse water recycling. Silver recovery, which is practiced by most labs, varies in efficiency depending on the type of recovery method used. Major sources of recoverable silver are photoprocessing solutions, spent rinse water, scrap film, and scrap printing paper. The silver in these materials may exist as insoluble silver halide, soluble silver thiosulfate complex, silver ion, or elemental silver depending on the type and stage of the recovery method being used. A large percentage of the silver processed in black-and-white positives and almost the entire amount of silver used in color processing will be present in the fixer or bleach-fix due to carry-over. Silver will also be found in the rinse water following the fixer or bleach-fix due to carry-over. The Waste Water Treatment Plant has set a limit of 5mg/L as the maximum silver concentration that can be disposed of to the sewer.

### Methods for Silver Recovery

A few of the most common methods of silver recovery from the fixer and bleach fix processing solutions are electrolytic recovery and metallic replacement. In the electrolytic method, a direct current is applied across two electrodes in a silver-containing solution. This method can achieve up to 98 percent recovery of the recoverable silver. The silver ions ( $\text{Ag}^+$ ) become reduced and are deposited on the cathode where they are collected as metallic silver and the sulfite ( $\text{SO}_3^{2-}$ ) and thiosulfate ( $\text{S}_2\text{O}_3^{2-}$ ) ions are oxidized at the anode.

Metallic replacement may be combined with electrolysis to recover the remaining silver ions. This process involves the use of an active solid metal, such as iron, which contacts a solution containing ions of a less active metal such as silver. Ions of the more active metal are released into solution, while atoms of the less

active metal replaces them in the solid state. Silver ions will displace many of the common metals from their solid state. Iron, in the form of steel wool, is used for economy and convenience in this process.

Other methods of recycling and resource recovery are the use of color developers which can be regenerated, allowing the photoprocessor to reduce replenisher purchases by about 50 percent. Spent ferrocyanide can be regenerated either electrically or chemically and reused in photo processing. Chemical chelation combined with filtration can be used to recover the silver as a non-hazardous waste which can be sent out for refining. Commercial rinse water recycling systems are available for photoprocessing operations in which spent rinse water can be treated to restore purity and recycled for rinsing. Several photoprocessing units can be served with a single recycling system.

A rapidly advancing technology such as digital imaging makes it important to continually educate ourselves concerning the improvements in waste reduction and pollution prevention. Potential waste minimization methods are summarized in the table below.

<b>Waste Minimization Methods for Photoprocessing</b>	
<b>Waste Streams</b>	<b>Method</b>
<b>Aqueous Waste</b>	
	Use squeegees to minimize chemical carryover
	Recover silver from effluent
	Reuse fixer
	Regenerate developer
	Regenerate bleach
	Use counter current rinsing
<b>Expired or Off-Spec Chemicals</b>	
	Control inventory carefully
	use "First In-First Out" method
	Store chemicals away from heat
<b>Solid Waste</b>	
	Store paper at cool temperature
	Recover silver from off-spec paper and from excess film
	Recycle cartridges, cassettes and photographic paper spools to film manufacturer
<b>Air Emissions</b>	
	Use floating covers on solution tanks

*Portions of this information used with permission from California Dept. of Toxic Substance Control, Office of Pollution Prevention and Technology Development, Factsheet: Waste Minimization for the Photoprocessing Industry, November 14, 1995*