



Best Management Practice (BMP) Program for X-Ray and Photo Processors

City of Tulsa Quality Assurance Section Silver Pollution Prevention Program

September 1, 2005

I. Introduction

This **Best Management Practice (BMP) program** is for diagnostic x-ray and photo processors. It contains recommendations for reducing the amount of silver in waste solutions discharged into the sanitary sewer. The BMP program is intended to assist businesses complying with Federal, State, and Local environmental regulations, specifically, the City of Tulsa's Ordinance #19991. This program attempts to do this with the least burden to the business. It is also a key element in the Partners for a Clean Environment (PACE) program that educates consumers about the steps businesses are taking to protect and conserve our infrastructure and natural resources.

Participation in this BMP program will result in the issuance of a certificate of participation by the City of Tulsa and potential membership in the PACE program, along with its associated benefits. Details of the PACE program can be found at www.tulsapublicworks.com.

There are four steps required to adopt and follow this program.

1. First, the facility must determine its category (small, medium or large).
2. Second, the facility must install a silver management technique that meets the recovery efficiency required for the appropriate category.
3. Third, proper testing and record keeping must be maintained.
4. Fourth, the facility must submit a completed "Letter of Participation" to the City of Tulsa, signed by an authorized facility representative.

II. Definitions

The definitions listed in this section apply throughout this document.

1. **Authorized Representative** – The president, secretary, treasurer, or a vice-president of the corporation; the general manager of the facility, a general partner, a director or highest official appointed or designated to oversee the operation (if a public agency).
2. **Electrolytic Silver Recovery** - A method of recovering silver in which a direct current is applied across two electrodes immersed in a silver-rich solution. In this process, silver plates onto the cathode and the thiosulfate are oxidized at the anode.
3. **Metallic Replacement** – A method of recovering silver from silver-rich solutions by an oxidation-reduction reaction, with elemental iron and silver thiosulfate, to produce ferrous iron and metallic silver. The device used is commonly called a metallic replacement cartridge (MRC).
4. **Pollution Prevention** - Any practice that reduces or eliminates waste at the source.
5. **POTW (Publicly Owned Treatment Works)** - A wastewater treatment facility and underground collection system owned by the public (municipality or service authority).
6. **Sanitary Sewer** - An underground conduit for carrying wastewater to a POTW.
7. **Silver Recovery System** - A device that reclaims silver from silver-rich solutions, such as fixers.
8. **Silver-Rich Solution** - A solution containing sufficient silver that cost effective recovery could be done either on-site or off-site. Fixer, bleach-fix, and washless stabilizers are common silver-rich solutions.
9. **Silver Estimating Test Strips** - A test paper or metal strip is coated with cadmium, sulfide, or copper, which changes color on reaction with silver in solution. A reference color code allows users to estimate the amount of silver in solution.

III. Determining the Category

The first step in this program is to determine which of the three categories best describes the facility's process: **small, medium, or large**.

For the purposes of this guide, the only silver-rich solution for x-ray processors is **fixer**. The only silver-rich solutions for photo processors are **fixer, bleach-fixers, and stabilizers**.

- A **small** processor is a business that produces less than two gallons per day of silver-rich waste solutions and no more than 1,000 gallons per day of total process effluent. Small processors must recover silver at least **90%** efficiency.
- A **medium** processor is a business that produces no more than 20 gallons per day of silver-rich waste solutions and no more than 10,000 gallons per day of total process effluent. Medium processors must recover silver at least **95%** efficiency.
- A **large** processor is a business that produces more than 20 gallons per day of silver-rich waste solutions and more than 10,000 gallons per day of total process effluent. Large processors should recover silver to at least **99%** efficiency.

IV. Category Specific Requirements

A. Small Processors

- No analytical testing is required for small processors, although field screening is required (see Section V).
- The following options are recommended for recovering at least **90%** of the silver from silver-rich solutions:
 1. One or two metallic replacement cartridges (MRCs) with manufacturer specified flow control*. Businesses generating less than 0.5 gallons per day of waste silver-rich solutions may use only one MRC. Facilities that generate more than 0.5 gallons per day should use two MRCs##.
 2. Alternative technology providing at least 90% silver recovery.

B. Medium Processors

- Annual analytical testing performed by a state-certified laboratory is required for medium size processors. The samples should be taken from both the influent and effluent sides of the silver recovery unit to assure that the 95% recovery

efficiency is being achieved. The facility shall retain records of sampling results for at least three years.

- The following options are recommended for recovering at least **95%** of the silver from silver-rich solutions:
 1. Terminal electrolytic unit followed by a metallic replacement cartridge (MRC) with manufacturer-specified flow control*.
 2. In-line electrolytic unit followed by a metallic replacement cartridge (MRC) with manufacturer specified flow control*.
 3. Two or more MRCs in series with manufacturer-specified flow control*##.
 4. Alternative technology providing at least 95% silver recovery.

C. Large Processors

- Semi-annual analytical testing performed by a state-certified laboratory is required for large size processors. The samples should be taken from both the influent and effluent sides of the silver recovery unit to assure that the 95% recovery efficiency is being achieved. The Facility shall retain records of sampling results for at least three years.
- The following options are recommended for recovering at least **99%** of the silver from silver-rich solutions:
 1. Terminal electrolytic unit followed by two metallic replacement cartridges (MRCs) in series with manufacturer-specified flow control*##.
 2. In-line electrolytic unit followed by two metallic replacement cartridges (MRCs) in series with manufacturer-specified flow control*##.
 3. Alternative technology providing at least 99% silver recovery.

** Flow control may be gravity feed or a metering pump, depending upon the design capacities of the cartridge and the processing workload. Work with your supplier to determine the flow control appropriate for your system.*

Newer technology MRCs have rendered one of them as affective as two of the older versions. Check with the manufacturer and/or supplier to confirm that a single MRC will be sufficient.

V. Screening and Maintenance of Silver Recovery Systems

- Monthly screening (field testing) of the silver recovery unit from the effluent (unit discharge tube) is required. Silver-estimating test paper is sufficient for this purpose. If the paper shows any color change, the system needs adjustment or replacement.
- The silver recovery unit should be checked daily for leaks or any other signs of malfunctions. The unit should be kept away from floor drains or have secondary containment to protect the sanitary sewer from illicit discharges.
- Record all test results and maintenance performed in a Silver Recovery System Log (examples, see Appendix 1).
- The facility must obtain a silver recovery unit operation and maintenance manual. The manufacturer should have data that demonstrates the recovery efficiency required for the facility's size category.

VI. Silver Treatment Options

1. Metallic Replacement Cartridge (MRC)

- As the MRC removes silver from the solution, the iron metal filter becomes depleted and must be replaced. The spent cartridge is then sent to be refined.
- The MRC must be properly sized and installed to handle the processor's flow rate allowing adequate contact time and avoiding channeling (consult with the supplier).

2. Electrolytic Silver Recovery

- The electrolytic unit must be sized properly for peak volumes and properly set the amperage for efficient silver recovery.
- Manufacturer and supplier recommendations must be followed for proper installation and maintenance.

3. Off-Site Management

- Off-site management means that the silver-rich solution is properly labeled (see Appendix 2) and stored for later pick up and reclamation by an outside contractor.
- All three-size categories (small, medium, and large) can utilize the "Off-site Management" option.
- Records must be maintained documenting removal & disposal of the silver-rich solution.

