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Document management — Environmental and work place safety regulations affecting microfilm processors

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TECHNICAL REPORT

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Document management — Environmental and work place safety regulations affecting microfilm processors

Gestion des documents — Réglementations relatives à la sécurité environnementale et du lieu de travail affectant les processeurs de microfilms

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Contents

Page

Foreword ..... **v**
Introduction ..... **vi**
1 Scope **1**
2 Terms and definitions **1**
3 International standard industrial classification **4**
4 Effluent pretreatment requirements **4**
5 Stream standards **5**
6 Disposal of photo processing effluents using septic tanks and leach fields **5**
7 Trade effluents consents **5**
8 Photographic processing effluent characteristics **6**
8.1 General 6
8.2 Temperature 9
8.3 Oxygen demand 9
8.3.1 General 9
8.3.2 BOD_5 9
8.3.3 COD 10
8.4 Suspended solids 10
8.5 Chlorine demand 10
8.6 pH 10
8.7 Heavy metals 10
8.7.1 General 10
8.7.2 Silver 11
8.7.3 Chromium compound 11
8.7.4 Iron complexes 11
8.7.5 Zinc 12
8.7.6 Cadmium 12
8.7.7 Other heavy metals 12
8.8 Phenols 12
8.9 Cyano complexes 12
8.10 Thiocyanate 13
8.11 Hydroquinone 13
8.12 Ammonium 13
8.13 Phosphates and nitrates 13
8.14 Detergents, oils, and tars 13
8.15 Colour and odour 13
8.16 Flammable and explosive materials 13
8.17 Volatile organic compounds (VOC) 14
9 Effluent sampling **14**
9.1 General 14
9.2 Sampling techniques 15
9.2.1 General 15
9.2.2 Grab sampling 15
9.2.3 Composite sampling 16
9.2.4 Continuous sampling 16
10 Handling samples for analysis **16**
11 Pollution prevention **16**
11.1 General 16
11.2 Squeegees 17
11.2.1 General 17
11.2.2 Types of squeegees 17

AVA Documents
Document Sharing Hub

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Full document details: PD ISO/TR 18159:2015

11.3 Replenishment rates ... 17
11.4 Good housekeeping ... 18

12 Dilution (equalization) ... 18
12.1 General ... 18
12.2 Holding tank ... 18

13 Silver recovery ... 19
13.1 General ... 19
13.2 Regulatory compliance ... 19
13.3 Silver recovery techniques ... 20

14 Commercial disposal services ... 20

15 Current issues in environmental and work place safety regulations affecting microfilm processing laboratories ... 20

16 Hazardous waste resulting from photo processing ... 21

17 Container storage requirements and labelling ... 22

18 Emergency contingency plans and procedures ... 22

19 Land disposal criteria ... 23

20 Storm water regulations ... 23

21 Air pollution considerations ... 23

22 General guidelines for ventilating photographic processing areas ... 24
22.1 General ... 24
22.2 Ventilation guidelines ... 24

23 Regulation of photographic processing air emissions ... 26

Annex A (informative) **Assistance from manufacturers ... 27**

Annex B (informative) **Sample written Hazard Communication Programme in the United States of America(Provided by U.S. Department of Labour/OSHA) ... 28**

Annex C (informative) **References, statutes, and regulations applicable to the United States of America ... 30**

Annex D (informative) **General guidelines for ventilating photographic processing areas ... 44**

Annex E (informative) **Environmental protection in France ... 46**

Annex F (informative) **Environmental protection in the United Kingdom ... 48**

Bibliography ... 50

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

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Introduction

This Technical Report was developed to help microfilm processing laboratories understand characteristics of effluent resulting from film processing, regulations, comply with regulations, and report on regulation compliance. The intended audience of this technical report includes those people responsible for maintaining an organization's awareness of environmental regulations and those people responsible for implementing procedures for compliance (such as training and record keeping) and reporting their implementations.

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Document management — Environmental and work place safety regulations affecting microfilm processors

1 Scope

This Technical Report provides information about environmental laws and regulations that can affect microfilm processing laboratories. These laws and regulations control the following microfilm processing activities:

— storage and disposal of effluents;

— storage and disposal of hazardous waste, employee safety training;

— notification of the public regarding hazardous waste incidents.

NOTE This Technical Report includes in an Annex, for information purposes, a discussion of The United States Environmental Protection Agency (EPA) Guidance Manual on the Development and Implementation of Local Discharge Limitations Under Pretreatment Programme and that guidance manual's relationship with state and local requirements in the United States. Also included in this Technical Report are examples of typical discharge limitations.

2 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

2.1
bath
chemical solution in water used in wet processing

2.2
bleaching
converting the reduced silver of an image to soluble silver sulphate salts, in black-and-white reversal processing, that will be removed by clearing in colour processing (reversal or negative)

Note 1 to entry: This is the step that converts the reduced silver of an image to silver halide that will be removed by fixing and washing.

2.3
bleaching/fixing
combining, in a single bath, the bleaching and fixing steps

Note 1 to entry: This is a step in colour processing.

2.4
clearing
<bath> removing the soluble silver sulphate salts and the stains, in black-and-white reversal processing, resulting from bleaching action in colour processing (reversal or negative)

Note 1 to entry: This is the step that removes the stains resulting from bleaching action.

2.5
coupler
<coupling agent> chemical compound (e.g. phenols, naphthols, pyrazolones) that combines during colour development with the oxidation products of the developing agent to form a dye

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2.6
coupler
<diazo film> compound that combines with the unexposed diazonium salts to form dyes

2.7
developing agent
active agent of the developer

2.8
development
processing step in which the latent image is made visible

2.9
developer
chemical solution used in the development process

2.10
diazo film
photographic film containing one or more photosensitive layers composed of diazonium salts in a polymeric material which react with coupler(s), contained either in photosensitive layer(s) or in the processing solution, to form an azo dye image after film processing

2.11
drying
removing unwanted moisture from photographic materials

Note 1 to entry: This is a step in processing.

2.12
effluent
fluid discharged from a given source into the external environment

[SOURCE: ISO 29464:2011, 3.2.32]

2.13
fixer
chemical used in fixing

2.14
fixing
converting the residual light sensitive silver halides into soluble salts removed by washing to make the developed image stable

Note 1 to entry: This is a step in processing.

2.15
International Standard Industrial Classification
ISIC
International Standard Industrial Classification of all economic activities

Note 1 to entry: ISIC is the international reference classification of productive activities. Its main purpose is to provide a set of activity categories that can be utilized for the collection and reporting of statistics according to such activities (United Nations Statistics Division).

2.16
leach field
leaching field
filter that consists of layers of coarse gravel, fine gravel, coarse sand, and fine sand arranged over one another so that a liquid flowing through one material does not carry it into the next to clog it

[SOURCE: ISO 6707-1:2014, 5.4.45, modified.]

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2.17
micrographics
techniques associated with the production, handling, and use of microforms

2.18.1
microfilm processing
treatment of exposed photographic material by chemical or physical means to make the latent image clearly visible and ultimately usable

2.18.2
conventional processing
processing, including development, fixing, washing, and drying of silver film in which the polarity of the original is reversed in the image

2.18.3
reversal processing
processing of silver film in which the polarity of the original is maintained in the image

2.18.4
full reversal processing
reversal processing that requires secondary exposure and development, or a secondary development using fogging agents

2.18.5
colour processing
processing in which the oxidation products of the developing agent react with a coupler incorporated in the developer or film to produce a dye close to each silver grain

2.18.6
dry processing
processing in which chemicals incorporated in the film react to heat or gas or both

2.18.7
wet processing
processing using chemicals in liquid form

2.18.8
deep-tank processor
deep-tank microfilm photoprocessor
developing machine containing 30 litres to 60 litres of liquid in each bath, wherein the chemicals are automatically replenished, and with a built-in hot air dryer

2.19
replenishment
replacing exhausted chemistry, in photographic film and paper processing, in a continuous or per-batch fashion using fresh chemistry

Note 1 to entry: This is a process used in chemical processing.

2.20
sludge
accumulated settled solids separated from various types of water as a result of natural or artificial processes

[SOURCE: ISO 6707-1:2014, 10.27]

2.21
squeegee
device for scraping the excess water from the film, consisting e.g. of a holder and a blade

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2.22
toxicity characteristic leaching procedure
TCLP
soil sample extraction method for chemical analysis employed as an analytical method to simulate leaching through a landfill

2.23
TSDF
Treatment, Storage, and Disposal Facility
facility that is permitted to treat, store, and/or dispose hazardous waste in special units

Note 1 to entry: These units are commonly called hazardous waste management units. A facility may be permitted to accept hazardous wastes for treatment, storage, and/or disposal from outside generators (a commercial TSDF) or be permitted to treat, store, or dispose of its own hazardous waste (a private TSDF).

2.24
UN number
UN ID four-digit number that identifies hazardous substances and articles (such as explosives, flammable liquids, toxic substances, etc.) in the framework of international transport

Note 1 to entry: Some hazardous substances have their own UN numbers (e.g. acrylamide has UN2074), while sometimes groups of chemicals or products with similar properties receive a common UN number (e.g. flammable liquids, not otherwise specified, have UN1993). A chemical in its solid state may receive a different UN number than the liquid phase if their hazardous properties differ significantly; substances with different levels of purity (or concentration in solution) may also receive different UN numbers.

Note 2 to entry: UN numbers range from UN0001 to about UN3506 and are assigned by the United Nations Committee of Experts on the Transport of Dangerous Goods. They are published as part of their Recommendations on the Transport of Dangerous Goods, also known as the Orange Book. These recommendations are adopted by the regulatory organization responsible for the different modes of transport.

Note 3 to entry: There is no UN number allocated to non-hazardous substances. These will simply not have a UN number.

2.25
washing
removing unwanted soluble chemicals from photographic materials using water

Note 1 to entry: This is a step in processing.

3 International standard industrial classification

Microfilm processing falls under International Standard Industrial Classification, Rev. Four (ISIC) M 7420 — Photographic activities. This ISIC number is often requested for permits and survey forms.

4 Effluent pretreatment requirements

Although microfilm processing laboratories may not be specifically regulated, guidelines exist for water discharge. The applicable regulation is for silver and affects those microfilm processing laboratories that directly discharge to a receiving body of water. One can determine the amount of silver discharged from a specific microfilm processing laboratory by collecting a representative sample of the photo processing waste water and having it analysed by a certified analytical laboratory. Because most microfilm processing laboratories do not discharge directly to surface water but discharge to a municipal treatment system instead, they are not directly affected by these limits.

Microfilm processing laboratories which discharge to receiving bodies of water may be required to have a permit. If the microfilm processing laboratory discharges directly to a surface stream, contact the local water pollution control agency.

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5 Stream standards

Discharge permits are required by regulatory agencies. Water quality standards regulate direct discharges into receiving bodies of water. These standards are usually stricter than sewer codes because they reflect the quality of water after treatment. Nearly all standards include a clause that prohibits discharging any substance that will injure fish or other aquatic life.

6 Disposal of photo processing effluents using septic tanks and leach fields

Most locations specifically prohibit the use of septic tanks for anything other than domestic waste, and most manufacturers of photographic materials and chemistries do not recommend discharge to a septic system. Septic tanks are used for the disposal of domestic waste primarily in areas where municipal sewers are unavailable. Septic tanks operate with anaerobic biological action; that is, the wastes are broken down by living organisms in the absence of an adequate oxygen supply.

One of the concerns about using a septic tank/leach field system is that, photographic effluents can adversely affect the anaerobic digestion system unless the effluents are heavily diluted with domestic wastes. Another concern is that, the soil may not have adequate capacity to absorb the leach field runoff. With a septic tank/leach field system, care needs to be taken to prevent contamination of ground water.

Most governments have regulations governing industrial discharges (for example, photo processing effluent) to ground waters. In addition, many governments have regulations on the design, installation, and testing of septic tank systems.

Microfilm processing laboratories using septic tank/leach field systems or spray irrigation systems should be aware of permit requirements and potential limitations on discharges from such systems. Contact the appropriate environmental regulatory agency for additional information.

7 Trade effluents consents

A permit to discharge photo processing waste to a municipal sewer system can be required. Trade effluent consents to discharge can specify limits for concentrations of some parameters, such as the following:

— biochemical oxygen demand (BOD);

— chemical oxygen demand (COD);

— suspended solids;

— metals.

Because most microfilm processing laboratories are located in urban areas and discharge their effluent directly to public sewers, municipal sewer code regulations are of high concern. Pollutants most frequently regulated and their typical limits are shown in Table 1. The consent issued will set limits for pollutants likely to be in the discharge and the limits will be set to prevent adverse impacts on the sewers and treatment processes and the people operating them. The rate of discharge and maximum volume discharged per day is also likely to be specified in the consent.

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Table 1 — Typical trade effluent limits

Parameter	Range of regulations
pH	6 to 10
Temperature (Maximum)	43 °C
Biochemical oxygen demand (BOD) (Maximum)	1 000
Chemical oxygen demand (COD)	2 000
Total suspended solids (TSS)	1 000
Total dissolved solids (TDS)	2 000
Phenols	10
Total cyanide	2
Oil and grease	200
Chromium	3
Iron	50
Silver	1
Zinc	3
NOTE All units except temperature and pH are specified in mg/L (ppm).	

8 Photographic processing effluent characteristics

8.1 General

Photographic processing effluents vary in composition among microfilm processing laboratories because of the different processes available and the laboratories' operating differences, such as

— daily operating time of each process,

— number of processes,

— chemical replenishment rates,

— amount of wash water used,

— volume of effluent,

— ratio of processing wastes to non-processing wastes, and

— recycling, reuse, and regeneration.

The general characteristics that are typical of conventional processing effluents are shown in Table 2. Table 3 to Table 4 show effluent characteristics for conventional process deep-tank microfilm photo processing, replenishment rates for conventional process deep-tank microfilm photo processing, effluent characteristics for full-reversal deep-tank microfilm photo processing, and replenishment rates for full-reversal deep-tank microfilm photo processing.

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Table 2 — General characteristics of microfilm effluent

Characteristic	Typical concentrations
Temperature	27 °C to 43 °C
Biochemical oxygen demand (BOD_5)	200 to 3 000
Chemical oxygen demand (COD)	400 to 5 000
Suspended solids (Total)	<50
pH	6,5 to 9,0
Flammable; explosive	None
Detergents	Minimal
Oils and grease	0 to 50
Phenol	0 to 10
Odour	Scarcely detectable
Silver[a]	0,5 to 100
Cadmium	<0,02
Chromium[b]	<0,5 to 50
Copper	<0,5
Iron	<0,5
Lead	<0,05
Lithium	<0,5
Mercury	<0,002
Nickel	<0,5
Zinc	<0,5
Barium	<0,5
TKN - nitrogen	200 - 500
NH_3 - nitrogen	150 - 400
Total phosphorus	<0,5

NOTE All units expressed in mg/L unless otherwise noted.

[a] A notification requirement exists for discharge of hazardous waste down the sewer, e.g. greater than 5,0 parts per million (ppm) of silver. Silver content depends upon processing system and silver recovery technique.

[b] Depends upon process solutions used.

Table 3 — Conventional process deep-tank microfilm photo processing effluent characteristics

Parameter	Concentration
pH	7,6
Temperature	30 °C
Biochemical oxygen demand (BOD_5)	350

NOTE All units are in mg/L unless otherwise specified.

[a] ND = Not detected (detection limit).

[b] Before silver recovery.

[c] Estimated concentration mg/L after silver recovery.

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Table 3 *(continued)*

Parameter	Concentration
Chemical oxygen demand (COD)	1 900
Total suspended solids	<2
Total dissolved solids (TDS)	1 660
Ammonia - nitrogen	380
Total Kjeldahl Nitrogen (TKN)	410
Sulphite	250
Thiosulphite	1 600
Sulfate	135
Phenol	None
Colour	25 Hazen units
Flammable; explosive	None
Detergents	Minimal
Odour	Scarcely detectable
Chloride demand	940 to 1100
Total phosphorous	<0,03
Total metals	
Aluminium	11
Boron	ND[a] < 0,1
Barium	ND[a] < 0,2
Cadmium	ND[a] < 0,4
Chromium	ND[a] < 0,5
Copper	ND[a] < 0,5
Iron	ND[a] < 0,5
Lead	ND[a] < 2
Lithium	ND[a] < 0,5
Manganese	0,18
Magnesium	9,4
Mercury	ND[a] < 0,2 ng/L
Nickel	< 1
Selenium	ND[a] < 50 ng/L
Silver	72[b] < 5[c]
Sodium	110
Tin	ND[a] < 4
Zinc	ND[a] < 0,5

NOTE All units are in mg/L unless otherwise specified.

[a] ND = Not detected (detection limit).

[b] Before silver recovery.

[c] Estimated concentration mg/L after silver recovery.

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Table 4 — Conventional process deep-tank microfilm photo processing effluent characteristics — Replenishment rates

Product	Replenishment rate (metric equivalents)
Microfilm developer	187,3 mLs/m^2
Microfilm fixer	233,6 mLs/m^2
Wash rate	12,9 L/m^2
Machine speed	7,7 M/min

8.2 Temperature

The temperature of some of the most widely used photographic processes is in the 26,7 °C to 43,3 °C range. This temperature range from a microfilm processing laboratory is unlikely to present a problem to a municipal sewer system.

8.3 Oxygen demand

8.3.1 General

BOD_5 and COD are procedures used to determine the amount of oxygen that will be consumed by effluent.

8.3.2 BOD_5

The BOD_5 test measures the quantity of oxygen that the effluent, chemical, or solution will consume over a five-day period through biological degradation. It is important to know the oxygen demand of discharged waste because the waste can overload the aeration capacity of a municipal secondary waste water treatment plant if the waste demands too much oxygen. Discharging improperly treated wastes could deplete the amount of dissolved oxygen in a receiving body of water.

Normally, water contains 7 mg/L to 9 mg/L of dissolved oxygen at 21 °C. (This concentration decreases as the temperature increases.) Most fish and other aquatic life require 5 mg/L to 7 mg/L of dissolved oxygen for survival. Amounts of dissolved oxygen below these levels can affect aquatic life and can also result in the production of strong smelling gases. A BOD_5 of 400 mg/L or 400 parts per million (ppm) means that 1 l of the effluent would consume 400 mg of oxygen in five days in a natural body of water.

The BOD_5 analysis attempts to duplicate in the laboratory the environmental conditions in a receiving body of water and to measure the oxygen demand that the discharged material places on the body of water. The test is highly dependent on several variables, including the following:

— temperature;

— appropriate microorganisms being present;

— sample dilution;

— storage condition for the sample;

— toxicity;

— length of time between sampling and analysis.

Despite the dependency on these variables, a BOD_5 analysis can be included as a consent requirement. The oxygen demand of photographic effluent, as measured by a BOD_5 test, will also vary widely depending on the amount of wash water used, the composition of the processing solutions, and the varying combinations of processing and non-processing waste. The BOD_5 of effluent from various

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photographic processing laboratories typically has been found to be in the range of 300 mg/L to 3 000 mg/L.

8.3.3 COD

In the Chemical Oxygen Demand (COD) test, the photographic effluent in question is subjected to a strong oxidizing chemical which oxidizes not only the biodegradable organic material but also non-biodegradable material.

The COD value will be larger or similar to the BOD_5; the ratio of the two values gives an indication of the biodegradability of the sample. The COD test does not suffer from the many variables of the BOD, so it is more reproducible, hence, it is generally used for trade effluent consents.

8.4 Suspended solids

Suspended solids are undissolved matter carried in effluent. These solids are removed during primary and secondary waste water treatment. Left untreated, they can build up sufficient sediment over a period of time to fill stream channels and reservoirs, erode power turbines and pumping equipment, plug water filters, and reduce available sunlight to aquatic plants. Photographic processing effluent is typically very low in suspended solids (less than 50 mg/L) and therefore should not present a problem to municipal treatment plants.

8.5 Chlorine demand

One operation a sewage treatment plant may perform is to chlorinate the effluent after the other treatment stages used in the plant. Chlorination can be used to destroy any pathogenic organisms and disinfect the effluent after treatment, thus, providing an additional measure of health protection.

Chlorine demand is the amount of chlorine needed to provide a certain residual chlorine content (usually 0,5 mg/L) after a specific time (often 15 min). The chlorine demand test is no longer widely used because water-quality experts have begun to recognize that excessive chlorination can produce chloramines and other harmful, persistent products from wastes that were originally less harmful by themselves.

8.6 pH

The pH level is an indication of how acidic or alkaline (basic) the solution is. It is a measurement of the hydrogen ion concentration and is expressed as the negative logarithm of the hydrogen ion concentration. The pH values run from 0 to 14,0, with the lower numbers indicating acidic materials, higher numbers indicating basic materials, and 7,0 representing neutrality. Almost every sewer code contains restrictions on the minimum and maximum pH of mixed effluent discharge. Most are in the range of 6 to 10. The pH of photographic effluent does not present a problem to waste treatment systems because it is generally in the range of 6 to 10.

8.7 Heavy metals

8.7.1 General

Materials classified as heavy metals are commonly regulated by local sewer authorities. These metals include cadmium, chromium, cobalt, copper, gold, iron, lead, manganese, mercury, molybdenum, nickel, silver, and zinc.

The concentration of heavy metals in the effluent is regulated because of the toxicity of these metals or their compounds. The toxicity can vary with the particular metal or compound and with the form in which the metal exists (for example, as a free ion, a complex, or a precipitate). Some photosensitive photographic products do contain small amounts of metals that may appear in the effluent. Heavy

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metals frequently found in photographic processing effluent and commonly regulated include the following:

— silver;

— iron complexes, zinc.

8.7.2 Silver

Silver compounds are the light-sensitive material used in most of today's photographic films and papers. Neither elemental silver nor silver compounds are packaged components of processing solutions. Many silver compounds are toxic to some extent.

During processing, primarily in the fixing bath, silver is removed from the film or paper and is carried out in the solution or wash overflow, usually in the form of a silver thiosulphate complex.

Recovering the silver before discharge is recommended as a practice that is sound both environmentally and economically. Not only does silver recovery have environmental benefits and conserve a natural resource, but selling the recovered silver becomes a source of revenue to a microfilm processing laboratories.

Local sewer authorities regulate the compound because they cannot distinguish between toxic and non-toxic forms of silver. In some locations, the discharge standards for silver can be lower than conventional silver recovery equipment can achieve.

8.7.3 Chromium compound

Some process systems cleaners contain chromium compounds. However, many microfilm processing laboratories do not use any products that contain chromium. Hexavalent chromium (Cr^{+6}) as present in chromates, etc., can be harmful to treatment systems and requires tight control. Some municipal sewer codes have specific limits for Cr^{+6}, Cr^{+3} (trivalent chromium), and total chromium. Non-chromium systems cleaners are quite prevalent in today's market, thus, the use of chromium containing solutions is avoidable.

Cr^{+6} can be reduced to Cr^{+3}, which is less hazardous. When a dichromate bleach is mixed with other alkaline processing solutions and with solutions that contain reducing agents, such as thiosulphate, the $Cr^{\pm 6}$ is reduced to Cr^{+3} and precipitated as chromium hydroxide. Chromium hydroxide would be removed during primary or secondary clarification at the waste water treatment plant in sludge; since sludge is often intended to go to agriculture, sewage treatment plants limits the amount of chromium allowed in trade effluent. Remove chromium before discharge by collecting the chromium-bearing liquid in tanks and reducing the hexavalent chromium to the trivalent form by adding bisulphate. By adding an alkaline material to adjust the solution to pH 8, the chromium can be precipitated as chromium hydroxide. This chromium hydroxide sludge may have to be managed as a hazardous waste under local government regulations. Microfilm processing laboratories currently using a bleach containing chromium should check with their supplier for an alternative non-chromium process.

8.7.4 Iron complexes

Iron complexes are commonly used in colour photographic processing bleaches or bleach-fixers. Also, the use of cartridges (steel wool metallic replacement cartridges) for silver recovery results in photographic effluents containing iron. Iron is not a typical component of processing solutions for microfilm processing.

Iron concentration in effluent is commonly regulated because it affects the appearance and taste of water and it readily oxidizes to the reddish ferric (Fe^{+3}) form, which precipitates and causes rust stains. Iron can also clog the gills of fish. The iron in photographic effluent is not generally a problem because it is usually present only in the form of stable iron complexes.

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