



9.4. Exposure scenario 4: Service life (professional worker) - Processing of silver containing films and photopapers by professionals

Market sector: Photography

Article categories:

AC 0: Other

(TARIC Codes 3704 (Photographic plates, film, paper, paperboard and textiles, exposed but not developed) and 3705 (Photographic plates and film, exposed and developed, other than cinematographic film))

Environment contributing scenario(s):		
CS 1	Processing of silver containing films and photopapers by professionals	ERC 11a
Worker contributing scenario(s):		
CS 2	Manual processing in closed tanks	PROC 21
CS 3	Manual processing in open trays or deep tanks	PROC 21
CS 4	Automatic processing in closed tanks including Cleaning and maintenance	PROC 21

Exposure scenario(s) of the uses leading to the inclusion of the substance into the article(s):

ES2: Use at industrial sites - Industrial use of silver bromide emulsion in the photographic industry

Further description of the use:

Silver (in the form of halides) is contained in photographic articles, such as films, plates and papers. During the photographic processing silver does dissolve from the film emulsion layer into the bleach or fixing or bleach/fixing solution (usually in the form of silver thiosulfate). The majority of silver containing photographic articles (films, plates, photopapers, etc...) are processed in fully enclosed automatic machines, called e.g. "minilabs", "dip and dunk machines", or "(wholesale) photofinishing machines". Few so called "table-top paper processors" are still in use and this use is rapidly decreasing.

9.4.1. Env CS 1: Processing of silver containing films and photopapers by professionals (ERC 11a)

Assessment entity group used for the assessment of this contributing scenario: ERA

9.4.1.1. Conditions of use

Amount used, frequency and duration of use (or from service life)
<ul style="list-style-type: none"> Daily local widespread use amount: $\leq 5.5E-5$ tonnes/day <i>All the amounts are expressed as Ag as this is the driver for the environmental risk assessment. In this scenario, no differentiation is made between the physical form (solid, in solution) and the chemical form (halides, thiosulfates..) of silver. Instead, the generic term "silver" is used.</i>
Technical and organisational conditions and measures
<ul style="list-style-type: none"> The substance should not be released to air <i>Silver halides are only used in a gelatine matrix or in solutions as a result there are no emissions to air.</i> The substance should not be released to water <i>There is a very limited potential for emissions of silver halides to the environment from the uses of photographic film and paper. Recycling of silver containing photographic processing fluids from industrial and professional uses is obligatory in EU countries. The used photographic solution containing silver ions should be properly collected in closed containers and waste solutions returned to the chemical supplier or professional recyclers. Appropriate containment measures should be taken to avoid spilling of used developers' fluid into the sewer system, when filling the recycling receptors.</i>
Conditions and measures related to biological sewage treatment plant
<ul style="list-style-type: none"> Biological STP: Standard [Effectiveness Water: 80.1%]
Conditions and measures related to external treatment of waste (including article waste)



• Particular considerations on the waste treatment operations: Dedicated recollection infrastructure required
Recycling of silver containing photographic processing fluids from industrial and professional uses is obligatory in EU countries. The used photographic solution containing silver ions should be properly collected in closed containers and waste solutions returned to the chemical supplier or professional recyclers.

9.4.1.2. Releases

The local releases to the environment are reported in the following table. Note that the releases reported do not account for the removal in the modelled biological STP.

Table 9.24. Local releases to the environment

Release	Assessment entity	Release estimation method	Explanations
Water	Ag dissolved	ERC	Release factor before on site RMM: 0.05% Release factor after on site RMM: 0.05% Local release rate: 2.75E-5 kg/day
Air	Ag dissolved	ERC	Release factor before on site RMM: 0.05% Release factor after on site RMM: 0.05%
Non agricultural soil	Ag dissolved	ERC	Release factor after on site RMM: 0%

9.4.1.3. Exposure and risks for the environment and man via the environment

The exposure concentrations and risk characterisation ratios (RCR) are reported in the following table. The exposure estimates have been obtained with EUSES 2.1.2 unless stated otherwise.

Table 9.25. Exposure concentrations and risks for the environment and man via the environment

Protection target	Assessment entity	Exposure concentration	Risk quantification
Fresh water	Ag dissolved	Local PEC: 6.13E-6 mg/L RCR = 0.133	Final RCR = 0.133
Sediment (freshwater)	Ag dissolved	Local PEC: 1.168 mg/kg dw RCR = 2.67E-3	Final RCR < 0.01
Marine water	Ag dissolved	Local PEC: 1.92E-6 mg/L RCR = 2.23E-3	Final RCR < 0.01
Sediment (marine water)	Ag dissolved	Local PEC: 0.365 mg/kg dw RCR = 8.34E-4	Final RCR < 0.01
Sewage Treatment Plant	Ag dissolved	Local PEC: 2.74E-6 mg/L RCR = 1.09E-4	Final RCR < 0.01
Agricultural soil	Ag dissolved	Local PEC: 0.096 mg/kg dw RCR = 0.092	Final RCR = 0.092
Man via environment - Inhalation (systemic effects)	Ag dissolved	Concentration in air: 8.53E-8 mg/m³ RCR = 5.69E-7	Final RCR < 0.01
Man via environment - Oral	Ag dissolved	Exposure via food consumption: 3.84 µg/kg bw/day (Measured data: See section 9.0.3.6) RCR = 0.035	Final RCR = 0.035
Man via environment - combined routes			Final RCR = 0.035

Remarks on measured exposure:



See section 9.0.3.6 for Ag dissolved:

Identity of the substance used: Ag

Explanation: Worst case exposure of 3.84 µg Ag/kg bw/day from food (section 9.0.3.6) was taken forward to the risk characterisation.

The intake via drinking water calculated with CHESAR was 3-4 orders of magnitudes lower compared to the intake via food and has thus not been taken into account.

9.4.2. Worker CS 2: Manual processing in closed tanks (PROC 21)

Assessment entity group used for the assessment of this contributing scenario: HHRA

The films are put in a light-tight container. This allows the operator to develop photographic films in day light environment. The photographic solutions (developers, stop bath, bleach or fixing or bleach/fixing) are added and removed one after another. During film development the filled tank is shaken/inverted periodically during the process in order to distribute the solution evenly. During the shaking process the tank is closed. Exposure of the user is therefore not expected. Potential exposure to silver in the solution is only possible during disposal of the fluid.

9.4.2.1. Conditions of use

	Method
Product (article) characteristics	
• Physical form of the used product: Solid (material with no or very low dustiness) <i>The physical form "massive object" is used as surrogate to reflect the very low exposure potential of the coated paper/film articles.</i>	MEASE 1.02.01
• Percentage (w/w) of substance in mixture/article: <= 100 %	MEASE 1.02.01
Amount used (or contained in articles), frequency and duration of use/exposure	
• Duration of activity: <= 8 h/day	MEASE 1.02.01
Technical and organisational conditions and measures	
• Occupational Health and Safety Management System: Basic	MEASE 1.02.01
• Local exhaust ventilation: No	MEASE 1.02.01
• Pattern of use: Non-dispersive use	MEASE 1.02.01
• Pattern of exposure control: Direct handling <i>To avoid stains and spots on the photographic end product, the films and papers are not touched directly with the hands. Instead, pliers or forceps are used.</i>	MEASE 1.02.01
• Contact level: Extensive	MEASE 1.02.01
Conditions and measures related to personal protection, hygiene and health evaluation	
• Dermal protection: Chemical resistant dermal protection with basic employee training. (effectiveness >= 90%)	MEASE 1.02.01
• Face/eye protection: Eye protection	
• Respiratory protection: No	MEASE 1.02.01
Other conditions affecting workers exposure	
• Place of use: Indoor	
• Operating temperature: <= 40 °C	

9.4.2.2. Exposure and risks for workers

The exposure concentrations and risk characterisation ratios (RCR) are reported in the following table.

Table 9.26. Exposure concentrations and risks for workers

Route of exposure and type of effects	Assessment entity	Exposure concentration	Risk quantification
Inhalation, systemic, long term	Silver bromide	0.05 mg/m ³ (MEASE 1.02.01) RCR = 0.047	Final RCR = 0.047



Route of exposure and type of effects	Assessment entity	Exposure concentration	Risk quantification
Dermal, systemic, long term	Silver bromide	0.141 mg/kg bw/day (MEASE 1.02.01) RCR = 0.381	Final RCR = 0.381
Combined routes, systemic, long-term			Final RCR = 0.428

Risk characterisation

Potential dermal exposure to silver from the bleach or fixing or bleach/fixing solution is theoretically possible during disposal. If appropriate gloves are worn as foreseen no exposure to the skin needs to be expected. Furthermore, there is also the aspect of maximising the quality of the photographic images being produced. Chemical contamination has serious adverse effects on unprocessed materials, leading to spots, stains, fingerprints etc, on negatives or prints. Therefore users will usually not allow chemicals to end up outside the designate tank.

9.4.3. Worker CS 3: Manual processing in open trays or deep tanks (PROC 21)

Assessment entity group used for the assessment of this contributing scenario: HHRA

Introduction of films or papers into trays or deep tanks is done manually. When using trays, pliers or forceps are usually used to hold the articles. When processing in deep tanks, spiral holders or supporting frames are typically used to hold the articles. Nevertheless, immersion of parts of the hands in the solutions can occur at each stage of the process (development, stop bath, bleach, fixing or bleach/fixing. The dermal route is the most relevant route of exposure, although touching of the film or papers with the hands is usually avoided to avoid stains or spots occurring on the photographic end product.

9.4.3.1. Conditions of use

	Method
Product (article) characteristics	
• Physical form of the used product: Solid (material with no or very low dustiness) <i>The physical form "massive object" is used as surrogate to reflect the very low exposure potential of the coated paper/film articles.</i>	MEASE 1.02.01
• Percentage (w/w) of substance in mixture/article: <= 100 %	MEASE 1.02.01
Amount used (or contained in articles), frequency and duration of use/exposure	
• Duration of activity: <= 8 h/day	MEASE 1.02.01
Technical and organisational conditions and measures	
• Occupational Health and Safety Management System: Basic	MEASE 1.02.01
• Local exhaust ventilation: No	MEASE 1.02.01
• Pattern of use: Non-dispersive use	MEASE 1.02.01
• Pattern of exposure control: Direct handling <i>To avoid stains and spots on the photographic end product, the films and papers are not touched directly with the hands. Instead, pliers or forceps are used.</i>	MEASE 1.02.01
• Contact level: Extensive	MEASE 1.02.01
Conditions and measures related to personal protection, hygiene and health evaluation	
• Dermal protection: Chemical resistant dermal protection with basic employee training. (effectiveness >= 90%)	MEASE 1.02.01
• Face/eye protection: Eye protection	
• Respiratory protection: No	MEASE 1.02.01
Other conditions affecting workers exposure	
• Place of use: Indoor	
• Operating temperature: <= 40 °C	



9.4.3.2. Exposure and risks for workers

The exposure concentrations and risk characterisation ratios (RCR) are reported in the following table.

Table 9.27. Exposure concentrations and risks for workers

Route of exposure and type of effects	Assessment entity	Exposure concentration	Risk quantification
Inhalation, systemic, long term	Silver bromide	0.05 mg/m ³ (MEASE 1.02.01) RCR = 0.047	Final RCR = 0.047
Dermal, systemic, long term	Silver bromide	0.141 mg/kg bw/day (MEASE 1.02.01) RCR = 0.381	Final RCR = 0.381
Combined routes, systemic, long-term			Final RCR = 0.428

Risk characterisation

Potential dermal exposure to silver from the bleach or fixing or bleach/fixing solution is theoretically possible during manual dipping of film/paper and during disposal. If appropriate gloves are worn as foreseen no exposure to the skin needs to be expected. Furthermore, there is also the aspect of maximising the quality of the photographic images being produced. Chemical contamination has serious adverse effects on unprocessed materials, leading to spots, stains, fingerprints etc, on negatives or prints. Therefore users will usually not allow chemicals to end up outside the designate tank and use pliers and forceps to avoid toughing the film, papers or solutions.

9.4.4. Worker CS 4: Automatic processing in closed tanks including Cleaning and maintenance (PROC 21)

Assessment entity group used for the assessment of this contributing scenario: HHRA

Operators do only have direct contact with the photographic article when the article is either dry and not yet processed, or dry after being processed. There is very limited contact with the uses liquid photochemicals. Exposure to silver containing liquids is only possible during occasional cleaning and maintenance operations. The instruction manuals prescribe that personal protective (gloves and safety glasses) need to be worn during such operations.

This includes work on the opened, non-operating machine, such as removal of paper jams, changing waste containers or cleaning. The latter is only conducted a couple of times per year.

9.4.4.1. Conditions of use

	Method
Product (article) characteristics	
• Physical form of the used product: Solid (material with no or very low dustiness) <i>The physical form "massive object" is used as surrogate to reflect the very low exposure potential of the coated paper/film articles.</i>	MEASE 1.02.01
• Percentage (w/w) of substance in mixture/article: <= 100 %	MEASE 1.02.01
Amount used (or contained in articles), frequency and duration of use/exposure	
• Duration of activity: <= 8 h/day	MEASE 1.02.01
Technical and organisational conditions and measures	
• Occupational Health and Safety Management System: Basic	MEASE 1.02.01
• Local exhaust ventilation: No	MEASE 1.02.01
• Pattern of use: Non-dispersive use	MEASE 1.02.01
• Pattern of exposure control: Direct handling <i>To avoid stains and spots on the photographic end product, the films and papers are not touched directly with the hands. Instead, pliers or forceps are used.</i>	MEASE 1.02.01
• Contact level: Extensive	MEASE 1.02.01



	Method
Conditions and measures related to personal protection, hygiene and health evaluation	
• Dermal protection: Chemical resistant dermal protection with basic employee training. (effectiveness $\geq 90\%$)	MEASE 1.02.01
• Face/eye protection: Eye protection	
• Respiratory protection: No	MEASE 1.02.01
Other conditions affecting workers exposure	
• Place of use: Indoor	
• Operating temperature: ≤ 40 °C	

9.4.4.2. Exposure and risks for workers

The exposure concentrations and risk characterisation ratios (RCR) are reported in the following table.

Table 9.28. Exposure concentrations and risks for workers

Route of exposure and type of effects	Assessment entity	Exposure concentration	Risk quantification
Inhalation, systemic, long term	Silver bromide	0.05 mg/m ³ (MEASE 1.02.01) RCR = 0.047	Final RCR = 0.047
Dermal, systemic, long term	Silver bromide	0.141 mg/kg bw/day (MEASE 1.02.01) RCR = 0.381	Final RCR = 0.381
Combined routes, systemic, long-term			Final RCR = 0.428

Risk characterisation

Potential dermal exposure to silver from the bleach or fixing or bleach/fixing solution is theoretically possible during cleaning and maintenance operations. If appropriate gloves are worn as foreseen no exposure to the skin needs to be expected. The eyes of the operators are protected by safety glasses.