9.7 Use of silver nitrate as a dissolution agent on oil platforms

1. Title of Exposure Scenario number 9.7: Use of silver nitrate as a dissolution agent on oil platforms	
List of all use descriptors	SU: 2b PC: 20 ERC: 7 PROCs: 1, 3, 4, 5, 8a, 8b
Name of contributing environmental scenario and corresponding ERC	**Contributing scenario 1** Environmental exposure scenario for the use of silver nitrate as a dissolution agent on oil platforms ERC 7
Names of contributing occupational scenario and corresponding PROCs	**Contributing scenario 2** Handling of solutions containing silver nitrate during industrial use PROCs: 1, 3, 4, 5, 8a, 8b
Assessment Method	Qualitative environmental assessment based on information provided by downstream user. Occupational exposure was based on the exposure estimation tool MEASE.
2.1 Contributing exposure scenario 1 (environmental exposure scenario 1): Environmental exposure scenario for the use of silver nitrate as a dissolution agent on oil platforms	
2.1.1 Operational conditions and risk management measures	
ERC	**REACH description**
ERC 7	Industrial use of substances in closed systems
2.1.2 Control of environmental exposure	
Product characteristics	
Liquid (silver nitrate solution)	
Amounts used	
Maximum site tonnage 0.1 tpa based on maximal reported site tonnage for this DU sector	
Frequency and duration of use	
Intermittent use (used as necessary) based on information provided by user	
Monitored Emissions	
No – used in closed system and waste collected on site for treatment at licensed facility	
Annual measured tonnage emitted to air/water	
None	
Environment factors not influenced by risk management	
Not relevant.	
Technical onsite conditions and measures to reduce or limit discharges, air emissions and releases to soil	
Air: *No measured emission data (it is stated that any emissions would be captured by HVAC and Carbon filter installed on-site)* *Waste water:* *Used in a closed system and it is assumed that there are no waste-water emissions to marine environment* *Soil:* *Not relevant for use in closed system in marine environment* *Modelled release factors to air 0%, water 0% & soil 0%.*	
Conditions and measures related to municipal sewage treatment plant	
Not relevant	

Conditions and measures related to external treatment of waste for disposal
Waste generated under the form of insoluble silver solids following precipitation and filtration/separation is retained on site and transported back to shore for disposal via authorised waste treatment company. *Brine containing residual quantities of silver nitrate is also retained and transported to an authorised waste-water treatment facility.* *The focus of the silver industry is on the minimisation of waste by optimising the process and by utilizing residues and wastes as far as possible. The residues arising from different stages of the production process are therefore used as raw materials for other processes and an extensive network of metallurgical operators has been established for many years to increase the recovery of metals and eliminate the quantities of waste for disposal.* *With regards to the end of life, silver is fully recyclable and the silver content in the end of life material often determines the value of the waste.*
Conditions and measures related to external recovery of waste
Waste generated under the form of sweeps, emission cleaning dusts and off spec material should be recycled into the processing system. *The focus of the silver industry is on the minimisation of waste by optimising the process and by utilizing residues and wastes as far as possible. The residues arising from different stages of the production process are therefore used as raw materials for other processes and an extensive network of metallurgical operators has been established for many years to increase the recovery of metals and eliminate the quantities of waste for disposal.* *With regards to the end of life, silver is fully recyclable and the silver content in the end of life material often determines the value of the waste.*

2.2 Contributing exposure scenario 2 (occupational exposure scenario 1): Handling of solutions containing silver nitrate during industrial use

2.2.1 Operational conditions and risk management measures

PROCs	REACH definition	Involved tasks
PROC 3	Use in closed batch process (synthesis or formulation)	Blending and transfer operations
PROC 4	Use in batch and other process (synthesis) where opportunity for exposure arises	
PROC 5	Mixing or blending in batch processes for formulation of preparations and articles (multistage and/or significant contact)	
PROC 8b	Transfer of substance or preparation (charging/ discharging) from/to vessels/large containers at dedicated facilities	
PROC 8a	Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at non-dedicated facilities	Transfer operations and cleaning (i.e. removal of splashes)
PROC 1	Use in closed process, no likelihood of exposure	Use in oilfield application

2.2.2 Control of workers exposure

Product characteristics

According to the MEASE approach, the substance-intrinsic emission potential is one of the main exposure determinants. This is reflected by an assignment of a so-called fugacity class in the MEASE tool. For operations conducted with solid substances at ambient temperature the fugacity is based on the dustiness of that substance. To determine the dustiness of a substance, a dustiness test may be performed. The rotating drum (modified Heubach) method can be used, to reflect potential dustiness during handling of a substance. In hot metal operations, fugacity is temperature based, taking into account the process temperature and the melting point of the substance. As a third group, abrasive tasks are based on the level of abrasion instead of the substance intrinsic emission potential. Although handling of aqueous solutions is usually associated with a very low emission potential, the spraying of aqueous solutions is assumed to be involved with medium emission. Further information can be found in the glossary of the MEASE tool (www.ebrc.de/mease.html).

PROC	Use in preparation	Content in preparation	Physical form	Emission potential
All applicable PROCs	not restricted		aqueous solution	very low

Amounts used

The actual tonnage handled/used per shift is not explicitly considered to influence the exposure as such for this scenario. Instead, the combination of the scale of operation (industrial vs. professional) and level of containment/automation (as reflected in the PROCs and technical conditions) is the main determinant of the process-intrinsic emission potential.

Frequency and duration of use/exposure

PROC	Duration of exposure (per shift/day)
All applicable PROCs	480 minutes (not restricted)

Human factors not influenced by risk management

The shift breathing volume covering all process steps is assumed to be 10 m^3/shift (8 hours).

Technical conditions and measures at process level (source) to prevent release		
PROC	**Level of containment**	**Level of segregation**
PROC 1	closed process	not required
PROC 3	closed process	not required
All other applicable PROCs	Risk management measures at the process level (e.g. containment or segregation of the emission source) are generally not required in the processes.	

Technical conditions and measures to control dispersion from source towards the worker				
PROC	**Level of separation**	**Localised controls (LC)**	**Efficiency of LC (according to MEASE)***	**Further information**
PROC 4	Separation of workers is generally not required.	local exhaust ventilation	78 %	-
PROC 5		local exhaust ventilation	78 %	-
All other applicable PROCs		not required	na	-

*It has to be assured that localised controls like local exhaust ventilation systems are inspected and maintained at appropriate frequencies to guarantee the functionality and efficiency.

Organisational measures to prevent /limit releases, dispersion and exposure

General good occupational hygiene practices are required to ensure safe handling of the substance. These include (i) measures to avoid any contamination of private households via the work-home-interface (e.g. shower and change clothes at end of work shift), (ii) good housekeeping practices in the workplace (i.e. regular cleaning with suitable cleaning devices and immediate cleaning in case of splashes and overspill), and (iii) measures to minimise inadvertent ingestion exposure (e.g. no eating and smoking in the workplace). In general, inhalation and ingestion of the substance should be avoided. Certified working clothing and shoes should be worn during work. In addition, the following principles should be followed: (i) ensure good general ventilation in the workplace, and (ii) do not blow dust (including dust remaining from dried splashes) off with compressed air. Regular training of workers in workplace hygiene practice and proper use of personal protective equipment is required.

Conditions and measures related to personal protection, hygiene and health evaluation

PROC	**Specification of respiratory protective equipment (RPE) and assigned protection factor (APF)**	**Specification of gloves**	**Further personal protective equipment (PPE)**
PROC 8a	FFP2 mask APF=10	Since silver nitrate is classified as corrosive to skin, protective gloves according to EN 374 have to be worn at all workplaces unless any contact with the substance can be excluded by the emission potential of silver nitrate resulting from the nature of the process, applied exposure prevention measures and physical appearance of silver nitrate in the specific type of application (e.g. protecting from splashes by containment of emission source). Gloves have to be changed according to manufacturer's information or when damaged, whatever is the earlier.	Due to the eye damaging properties of silver nitrate, direct contact with the eyes is to be avoided including hand to eye transfer after touching contaminated surfaces. Suitable eye protection equipment (e.g. goggles or visors) must be worn, unless contact of the substance with the eye can be excluded. Such exclusion is determined by: (i) the physical appearance of the substance in the specific type of application (e.g. wetting the substance can effectively prevent from the emission of dust), (ii) the emission potential resulting from the nature of the process (e.g. splashes, emission of dust can be excluded in a closed process) and (iii) applied exposure prevention measures (segregation of the emission source or separation of the worker from the emission source). Additionally, face protection, protective clothing and safety shoes are required to be worn as appropriate.
All other applicable PROCs	not required		

The use of personal protective equipment should always be seen as a last resort after operational conditions and further risk management measures have been improved.
Any RPE as defined above shall only be worn if the following principles are implemented in parallel: The duration of work (compare with "duration of exposure" above) should reflect the additional physiological stress for the worker due to the breathing resistance and mass of the RPE itself, due to the increased thermal stress by enclosing the head. In addition, it shall be considered that the worker's capability of using tools and of communicating are reduced during the wearing of RPE.
For reasons as given above, the worker should therefore be (i) healthy (especially in view of medical problems that may affect the use of RPE), (ii) have suitable facial characteristics reducing leakages between face and mask (in view of scars and facial hair). The recommended devices above which rely on a tight face seal will not provide the required protection unless they fit the contours of the face properly and securely.
The employer and self-employed persons have legal responsibilities for the maintenance and issue of respiratory protective devices and the management of their correct use in the workplace. Therefore, they should define and document a suitable policy for a respiratory protective device programme including training of the workers.
An overview of the APFs of different RPE (according to BS EN 529:2005) can be found in the glossary of MEASE.

3. Exposure estimation and reference to its source

3.1 Environmental emissions (Contributing scenario 1)

Silver nitrate solution is blended and transported to offshore oil/gas production/exploration sites and used in a closed loop system for a maximum of 24 hours (used as a dissolver in oilfield equipment/piping).Spent dissolver is precipitated and solids/brine are collected onsite and transported to licensed treatment facilities.

Air mg/m^3 (RCR)	*Fresh water mg/l (RCR)*	*Marine water mg/l (RCR)*	*Sediment freshwater mg/kg wwt (RCR)*	*Sediment marine water mg/kg wwt (RCR)*	*Soil mg/kg wwt (RCR)*	*STP mg/l (RCR)*
NA	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*

3.2a Occupational exposure (Contributing scenario 2), Handling of solutions containing silver nitrate during industrial use - Exposure estimation, reference to its source and quantitative risk characterisation

The exposure estimation tool MEASE (version 1.02.01) was used for the assessment of occupational exposure. The risk characterisation ratio (RCR) is the quotient of the exposure estimate and the DNEL (derived no-effect level) and has to be below 1 to demonstrate a safe use. For inhalation exposure, the RCR is based on the DNEL (long-term, systemic) for silver nitrate of 0.016 mg/m^3 (corresponding to 0.01 mg Ag/m^3).

PROC	**Method used for inhalation exposure assessment (refer to introduction)**	**Inhalation exposure estimate (RCR)**
PROC 1	MEASE	0.001 mg/m^3 (0.06)
PROC 3	MEASE	0.01 mg/m^3 (0.63)
PROC 4	MEASE	0.011 mg/m^3 (0.69)
PROC 5	MEASE	0.011 mg/m^3 (0.69)
PROC 8a	MEASE	0.005 mg/m^3 (0.31)
PROC 8b	MEASE	0.01 mg/m^3 (0.63)

3.2b Occupational exposure (Contributing scenario 2), Handling of solutions containing silver nitrate during industrial use - Qualitative risk characterisation

In the table on the scope of risk characterisation above, human health effects were identified for which a qualitative risk characterisation has to be conducted. For all identified routes and types of effects, the qualitative risk characterisation can be found in the table below.

Route of exposure and type of effects	**Prescribed Risk Management Measures and Operational Conditions**	**Risk characterisation**
Dermal, local effect / long-term	Due to the potential of the substance to cause local effects, appropriate personal protective equipment is prescribed to be worn unless any contact with the substance can be excluded by the emission potential of the substance resulting from the nature of the process, applied exposure prevention measures and physical appearance of the substance in the specific type of application (e.g. protecting from splashes by containment of emission source).	Although the quantitative risk characterisation, already demonstrated that the prescribed operational conditions and risk management measures effectively control exposure well below the respective DNELs, it cannot be excluded that residual exposure concentrations may lead to local effects. As a precautionary measure, it is therefore prescribed to use personal protective equipment in situations in which such residual exposure concentrations cannot be excluded. The risk of local effects is therefore adequately controlled.
Dermal, local effect / acute		
Eyes, local effect		

4. Guidance to DU to evaluate whether he works inside the boundaries set by the ES

4.1 Environmental emissions (Contributing scenario 1)

The user works inside the boundaries set by the ES (e.g. intermittent use within a closed system with no emissions to water) if:the proposed operational and risk management measures as described above are met.

4.2 Occupational exposure (Contributing scenario 2)

The downstream user (DU) works inside the boundaries set by the ES if the proposed operational conditions (OCs) and risk management measures (RMMs) as described in the exposure scenario (ES) are met (including substance/product characteristics). If the DU's conditions slightly deviate (such deviations are specified below) from the conditions as described in the ES, the DU may either inform the supplier of the substance to reflect the DU's conditions in a modified exposure scenario or has to ensure his slightly modified OCs and implemented RMMs are adequate. Depending on the basis for the exposure assessment (EA) conducted for the ES, this needs to be done in different ways:

Use of measured data as basis for assessment: If the EA in the ES is based on measured data, the same approach can be used at DU level. Please note that 6 measurements per workplace are required for an EA as a minimum. Depending on the variability of the data sets (expressed as the geometric standard deviation) and the level of the resulting risk characterisation ratio (RCR), additional measurements may be required. Only measurements of personal exposure of the inhalable fraction of airborne dust (according to EN 481) should be used. The exposure data shall either be applicable to the length of a specific task to be assessed or to a full-shift (i.e. sampled over a duration of at least 120 min) if the task to be assessed is conducted for a significant portion of the work shift. From the exposure data set the 90th percentile is to be used as a reasonable worst case (RWC) estimate for comparison with the relevant DNEL. RPE may be taken into account by applying the assigned protection factor applicable to the equipment used as given in EN 529:2005.

It is noted that deviations from the ES are only allowed for the efficacy of installed RMMs (but not the type of RMM), exposure duration and personal protective equipment used. However, due to the acute local (corrosive) effects of silver nitrate, exposure duration should not be used as a risk management measure when assessing exposure using MEASE.

Use of exposure models: If the EA in the ES is based on modelled data, the same model can be used to justify specific slight deviations from the conditions as described. All parameters needed to run the exposure estimation tool MEASE (available on www.ebrc.de/mease.html) can be found in the ES. It is noted that the installation of the described RMMs is mandatory and that exclusively the modification of the used PPE is allowed as deviation. The only parameters which may therefore be modified in the MEASE-calculation are consequently exposure duration, efficacy of the installed RMMs and PPE.

Generic to both assessment bases: Safe use is demonstrated, if the calculated exposure level is below the relevant DNEL (RCR <1). It is noted that smaller RCRs provide additional margin of safety and should therefore be envisaged.

$DNEL_{inhalation}$: 0.016 mg/m³ (as silver nitrate)