



9.3. Exposure scenario 3: Formulation or re-packing - Formulation

Environment contributing scenario(s):		
CS 1	Formulation	ERC 2
Worker contributing scenario(s):		
CS 2	Handling of solid material	PROC 26
CS 3	Formulation in batch process	PROC 4
CS 4	Mixing, blending	PROC 5
CS 5	Handling of solutions/suspensions	PROC 8b
CS 6	Wet cleaning	PROC 8a
CS 7	Vacuum cleaning	PROC 26

9.3.1. Env CS 1: Formulation (ERC 2)

Assessment entity group used for the assessment of this contributing scenario: Pd dissolved for ENV assessment

9.3.1.1. Conditions of use

Amount used, frequency and duration of use (or from service life)
<ul style="list-style-type: none"> Annual use amount at site: ≤ 2.2 tonnes/year <i>3.67 tonnes palladium dichloride (2.20 tonnes Pd metal equivalent)</i> Daily use amount at site: $\leq 7.86E-3$ tonnes/day <i>Based on 280 days per year per site (standard for sector; see ESI)</i>
Conditions and measures related to biological sewage treatment plant
<ul style="list-style-type: none"> Biological STP: Site specific [Effectiveness Water: 73.4%] Discharge rate of STP: $\geq 2E3$ m³/day Application of the STP sludge on agricultural soil: No <i>The sludge is incinerated (with ash going to landfill)</i>
Conditions and measures related to external treatment of waste (including article waste)
<ul style="list-style-type: none"> Particular considerations on the waste treatment operations: Other <i>Dihydrogen tetrachloropalladate- and other Pd -containing waste suitable for recycling may be recycled either internally or at licensed recycling facility.</i> <i>The sludge from the on-site treatment plant is processed for metal reclamation (recycling).</i>
Other conditions affecting environmental exposure
<ul style="list-style-type: none"> Receiving surface water flow rate: $\geq 1.8E4$ m³/day Discharge to: Freshwater only

Fate (release percentage) in the biological sewage treatment plant

The biological STP is site specific and the releases to the various compartments have been set by the assessor for some assessment entities. They are distributed in the following way:

Assessment entities	Pd dissolved
Release to water	26.6%
Release to air	0%
Release to sludge	73.4%
Release degraded	0%

Explanation for Pd dissolved:

Stutt E, Wilson I, Merrington G & Rothenbacher K (2016) Determining the Removal of Platinum Group Metals in Industrial Effluent during Sewage Treatment.



9.3.1.2. 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 9.27. Local releases to the environment

Release	Assessment entity	Release estimation method	Explanations
Water	Pd dissolved	Estimated release factor	Release factor before on site RMM: 0.02% Release factor after on site RMM: 0.02% Local release rate: 1.57E-3 kg/day Explanation: On-site wastewater treatment by chemical precipitation, sedimentation and/or filtration. Efficiency >99 % (sector data) Release factor after on-site treatment: 200 g/T (99% treatment WWTP efficiency applied to 2% RF before on-site treatment)
Air	Pd dissolved	Estimated release factor	Release factor before on site RMM: 1E-3% Release factor after on site RMM: 1E-3% Local release rate: 7.86E-5 kg/day Explanation: Treatment of air emissions by filters, electrostatic precipitation and/or wet scrubbers. (SpERC for 'Formulation of metal compounds') Release factor after on-site treatment: 10 g/T (10% of SpERC RF for air)
Non agricultural soil	Pd dissolved	Estimated release factor	Release factor after on site RMM: 0% Explanation: No direct emissions to soil.

9.3.1.3. 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 9.28. Exposure concentrations and risks for the environment and man via the environment

Protection target	Assessment entity	Exposure concentration	Risk quantification
Fresh water	Pd dissolved	Local PEC: 2.03E-5 mg/L RCR = 0.452	Final RCR = 0.452
Sediment (freshwater)	Pd dissolved	Local PEC: 0.05 mg/kg dw RCR = 0.182	Final RCR = 0.182
Sewage Treatment Plant	Pd dissolved	Local PEC: 2.09E-4 mg/L RCR = 3.97E-4	Final RCR < 0.01
Agricultural soil	Pd dissolved	Local PEC: 1.86E-3 mg/kg dw RCR = 0.094	Final RCR = 0.094

9.3.2. Worker CS 2: Handling of solid material (PROC 26)

Assessment entity group used for the assessment of this contributing scenario: Palladium dichloride for OCC assessment

9.3.2.1. Conditions of use

	Method
Product (article) characteristics	



	Method
• Physical form of substance: Solid, powder / dust	MEASE 1
• Content in preparation: Not restricted [Effectiveness Inhalation: 0%, Dermal: 0%]	MEASE 1
• Maximum emission potential of the substance: Medium	MEASE 1
Amount used (or contained in articles), frequency and duration of use/exposure	
• Maximum duration of exposure: > 240 min (not restricted) [Effectiveness Inhalation: 0%, Dermal: 0%]	MEASE 1
Technical and organisational conditions and measures	
• Contact level: Intermittent	MEASE 1
• Pattern of exposure control: Direct handling	MEASE 1
• Pattern of use: Non-dispersive use	MEASE 1
Conditions and measures related to personal protection, hygiene and health evaluation	
• Respiratory protective equipment (RPE) as precautionary measure: RPE protecting from local effects via inhalation	
• Gloves as precautionary measure: Gloves protecting from local effects to the skin (high hazard)	
• Eye protection: Eye protection to be worn to protect from adverse effects to the eyes	

9.3.2.2. Exposure and risks for workers

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

Table 9.29. Exposure concentrations and risks for workers

Route of exposure and type of effects	Assessment entity	Exposure concentration	Risk quantification
Inhalation, systemic, long term	Palladium dichloride	4E3 µg/m ³ (MEASE 1) RCR = 0.067	Final RCR = 0.067
Dermal, systemic, long term	Palladium dichloride	141.4 µg/kg bw/day (MEASE 1) RCR = 8.4E-3	Final RCR < 0.01
Combined routes, systemic, long-term			Final RCR = 0.076

Remarks on exposure data from external estimation tools:

MEASE 1 for Palladium dichloride:

Explanation: Dermal, systemic, long term

For calculation of systemic exposure, the exposure estimate for total dermal loading as obtained in MEASE (reported in mg/day) is divided by a body weight of 70 kg for workers.

Risk characterisation

Qualitative risk characterisation (Inhalation, local, long term, Inhalation, local, acute, Dermal, local, long term, Dermal, local, acute, Eye, local):

Further information on the risk characterisation for local effects via inhalation, for local dermal effects and local effects to the eyes is given in Section 9.0.2.3.

Additional remarks on risk characterisation: Under the prescribed conditions of use, exposure is well below the DNELs and no local effects are expected. Therefore, risks are adequately controlled.

9.3.3. Worker CS 3: Formulation in batch process (PROC 4)

Assessment entity group used for the assessment of this contributing scenario: Palladium dichloride for OCC assessment

9.3.3.1. Conditions of use



	Method
Product (article) characteristics	
• Physical form of substance: Solid, powder / dust	MEASE 1
• Content in preparation: Not restricted [Effectiveness Inhalation: 0%, Dermal: 0%]	MEASE 1
• Maximum emission potential of the substance: Medium	MEASE 1
Amount used (or contained in articles), frequency and duration of use/exposure	
• Maximum duration of exposure: > 240 min (not restricted) [Effectiveness Inhalation: 0%, Dermal: 0%]	MEASE 1
Technical and organisational conditions and measures	
• Contact level: Intermittent	MEASE 1
• Pattern of exposure control: Non-direct handling	MEASE 1
• Pattern of use: Non-dispersive use	MEASE 1
Conditions and measures related to personal protection, hygiene and health evaluation	
• Respiratory protective equipment (RPE) as precautionary measure: RPE protecting from local effects via inhalation	
• Gloves as precautionary measure: Gloves protecting from local effects to the skin (high hazard)	
• Eye protection: Eye protection to be worn to protect from adverse effects to the eyes	

9.3.3.2. Exposure and risks for workers

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

Table 9.30. Exposure concentrations and risks for workers

Route of exposure and type of effects	Assessment entity	Exposure concentration	Risk quantification
Inhalation, systemic, long term	Palladium dichloride	5E3 µg/m ³ (MEASE 1) RCR = 0.084	Final RCR = 0.084
Dermal, systemic, long term	Palladium dichloride	3.43 µg/kg bw/day (MEASE 1) RCR = 2.04E-4	Final RCR < 0.01
Combined routes, systemic, long-term			Final RCR = 0.084

Remarks on exposure data from external estimation tools:

MEASE 1 for Palladium dichloride:

Explanation: Dermal, systemic, long term

For calculation of systemic exposure, the exposure estimate for total dermal loading as obtained in MEASE (reported in mg/day) is divided by a body weight of 70 kg for workers.

Risk characterisation

Qualitative risk characterisation (Inhalation, local, long term, Inhalation, local, acute, Dermal, local, long term, Dermal, local, acute, Eye, local):

Further information on the risk characterisation for local effects via inhalation, for local dermal effects and local effects to the eyes is given in Section 9.0.2.3.

Additional remarks on risk characterisation: Under the prescribed conditions of use, exposure is well below the DNELs and no local effects are expected. Therefore, risks are adequately controlled.

9.3.4. Worker CS 4: Mixing, blending (PROC 5)

Assessment entity group used for the assessment of this contributing scenario: Palladium dichloride for OCC assessment

9.3.4.1. Conditions of use



	Method
Product (article) characteristics	
• Physical form of substance: Solid, powder / dust	MEASE 1
• Content in preparation: Not restricted [Effectiveness Inhalation: 0%, Dermal: 0%]	MEASE 1
• Maximum emission potential of the substance: Medium	MEASE 1
Amount used (or contained in articles), frequency and duration of use/exposure	
• Maximum duration of exposure: > 240 min (not restricted) [Effectiveness Inhalation: 0%, Dermal: 0%]	MEASE 1
Technical and organisational conditions and measures	
• Contact level: Intermittent	MEASE 1
• Pattern of exposure control: Non-direct handling	MEASE 1
• Pattern of use: Non-dispersive use	MEASE 1
Conditions and measures related to personal protection, hygiene and health evaluation	
• Respiratory protective equipment (RPE) as precautionary measure: RPE protecting from local effects via inhalation	
• Gloves as precautionary measure: Gloves protecting from local effects to the skin (high hazard)	
• Eye protection: Eye protection to be worn to protect from adverse effects to the eyes	

9.3.4.2. Exposure and risks for workers

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

Table 9.31. Exposure concentrations and risks for workers

Route of exposure and type of effects	Assessment entity	Exposure concentration	Risk quantification
Inhalation, systemic, long term	Palladium dichloride	5E3 µg/m ³ (MEASE 1) RCR = 0.084	Final RCR = 0.084
Dermal, systemic, long term	Palladium dichloride	3.43 µg/kg bw/day (MEASE 1) RCR = 2.04E-4	Final RCR < 0.01
Combined routes, systemic, long-term			Final RCR = 0.084

Remarks on exposure data from external estimation tools:

MEASE 1 for Palladium dichloride:

Explanation: Dermal, systemic, long term

For calculation of systemic exposure, the exposure estimate for total dermal loading as obtained in MEASE (reported in mg/day) is divided by a body weight of 70 kg for workers.

Risk characterisation

Qualitative risk characterisation (Inhalation, local, long term, Inhalation, local, acute, Dermal, local, long term, Dermal, local, acute, Eye, local):

Further information on the risk characterisation for local effects via inhalation, for local dermal effects and local effects to the eyes is given in Section 9.0.2.3.

Additional remarks on risk characterisation: Under the prescribed conditions of use, exposure is well below the DNELs and no local effects are expected. Therefore, risks are adequately controlled.

9.3.5. Worker CS 5: Handling of solutions/suspensions (PROC 8b)

Assessment entity group used for the assessment of this contributing scenario: Palladium dichloride for OCC assessment

9.3.5.1. Conditions of use



	Method
Product (article) characteristics	
• Physical form of substance: Solution, suspension	MEASE 1
• Content in preparation: Not restricted [Effectiveness Inhalation: 0%, Dermal: 0%]	MEASE 1
• Maximum emission potential of the substance: Very low	MEASE 1
Amount used (or contained in articles), frequency and duration of use/exposure	
• Maximum duration of exposure: > 240 min (not restricted) [Effectiveness Inhalation: 0%, Dermal: 0%]	MEASE 1
Technical and organisational conditions and measures	
• Contact level: Intermittent	MEASE 1
• Pattern of exposure control: Non-direct handling	MEASE 1
• Pattern of use: Non-dispersive use	MEASE 1
Conditions and measures related to personal protection, hygiene and health evaluation	
• Respiratory protective equipment (RPE) as precautionary measure: RPE protecting from local effects via inhalation	
• Gloves as precautionary measure: Gloves protecting from local effects to the skin (high hazard)	
• Eye protection: Eye protection to be worn to protect from adverse effects to the eyes	

9.3.5.2. Exposure and risks for workers

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

Table 9.32. Exposure concentrations and risks for workers

Route of exposure and type of effects	Assessment entity	Exposure concentration	Risk quantification
Inhalation, systemic, long term	Palladium dichloride	10 µg/m ³ (MEASE 1) RCR = 1.68E-4	Final RCR < 0.01
Dermal, systemic, long term	Palladium dichloride	3.43 µg/kg bw/day (MEASE 1) RCR = 2.04E-4	Final RCR < 0.01
Combined routes, systemic, long-term			Final RCR < 0.01

Remarks on exposure data from external estimation tools:

MEASE 1 for Palladium dichloride:

Explanation: Dermal, systemic, long term

For calculation of systemic exposure, the exposure estimate for total dermal loading as obtained in MEASE (reported in mg/day) is divided by a body weight of 70 kg for workers.

Risk characterisation

Qualitative risk characterisation (Inhalation, local, long term, Inhalation, local, acute, Dermal, local, long term, Dermal, local, acute, Eye, local):

Further information on the risk characterisation for local effects via inhalation, for local dermal effects and local effects to the eyes is given in Section 9.0.2.3.

Additional remarks on risk characterisation: Under the prescribed conditions of use, exposure is well below the DNELs and no local effects are expected. Therefore, risks are adequately controlled.

9.3.6. Worker CS 6: Wet cleaning (PROC 8a)

Assessment entity group used for the assessment of this contributing scenario: Palladium dichloride for OCC assessment

9.3.6.1. Conditions of use



	Method
Product (article) characteristics	
• Physical form of substance: Solution, suspension	MEASE 1
• Content in preparation: Not restricted [Effectiveness Inhalation: 0%, Dermal: 0%]	MEASE 1
• Maximum emission potential of the substance: Very low	MEASE 1
Amount used (or contained in articles), frequency and duration of use/exposure	
• Maximum duration of exposure: > 240 min (not restricted) [Effectiveness Inhalation: 0%, Dermal: 0%]	MEASE 1
Technical and organisational conditions and measures	
• Contact level: Extensive	MEASE 1
• Pattern of exposure control: Direct handling	MEASE 1
• Pattern of use: Non-dispersive use	MEASE 1
Conditions and measures related to personal protection, hygiene and health evaluation	
• Respiratory protective equipment (RPE) as precautionary measure: RPE protecting from local effects via inhalation	
• Gloves as precautionary measure: Gloves protecting from local effects to the skin (high hazard)	
• Eye protection: Eye protection to be worn to protect from adverse effects to the eyes	

9.3.6.2. Exposure and risks for workers

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

Table 9.33. Exposure concentrations and risks for workers

Route of exposure and type of effects	Assessment entity	Exposure concentration	Risk quantification
Inhalation, systemic, long term	Palladium dichloride	50 µg/m ³ (MEASE 1) RCR = 8.42E-4	Final RCR < 0.01
Dermal, systemic, long term	Palladium dichloride	342.8 µg/kg bw/day (MEASE 1) RCR = 0.02	Final RCR = 0.02
Combined routes, systemic, long-term			Final RCR = 0.021

Remarks on exposure data from external estimation tools:

MEASE 1 for Palladium dichloride:

Explanation: Dermal, systemic, long term

For calculation of systemic exposure, the exposure estimate for total dermal loading as obtained in MEASE (reported in mg/day) is divided by a body weight of 70 kg for workers.

Risk characterisation

Qualitative risk characterisation (Inhalation, local, long term, Inhalation, local, acute, Dermal, local, long term, Dermal, local, acute, Eye, local):

Further information on the risk characterisation for local effects via inhalation, for local dermal effects and local effects to the eyes is given in Section 9.0.2.3.

Additional remarks on risk characterisation: Under the prescribed conditions of use, exposure is well below the DNELs and no local effects are expected. Therefore, risks are adequately controlled.

9.3.7. Worker CS 7: Vacuum cleaning (PROC 26)

Assessment entity group used for the assessment of this contributing scenario: Palladium dichloride for OCC assessment

9.3.7.1. Conditions of use



	Method
Product (article) characteristics	
• Physical form of substance: Solid, powder / dust	MEASE 1
• Content in preparation: Not restricted [Effectiveness Inhalation: 0%, Dermal: 0%]	MEASE 1
• Maximum emission potential of the substance: High	MEASE 1
Amount used (or contained in articles), frequency and duration of use/exposure	
• Maximum duration of exposure: > 240 min (not restricted) [Effectiveness Inhalation: 0%, Dermal: 0%]	MEASE 1
Technical and organisational conditions and measures	
• Contact level: Extensive	MEASE 1
• Integrated local exhaust ventilation: Lower confidence limit (industrial use) [Effectiveness Inhalation: 84%] <i>Surrogate exposure determinant used to reflect the efficiency of a vacuum cleaner.</i> Inhalation explanation: <i>Efficiency for industrial use</i>	MEASE 1
• Pattern of exposure control: Non-direct handling	MEASE 1
• Pattern of use: Non-dispersive use	MEASE 1
• Additional operational conditions for cleaning: No direct manual removal of dust.	MEASE 1
Conditions and measures related to personal protection, hygiene and health evaluation	
• Respiratory protective equipment (RPE) as precautionary measure: RPE protecting from local effects via inhalation	
• Gloves as precautionary measure: Gloves protecting from local effects to the skin (high hazard)	
• Eye protection: Eye protection to be worn to protect from adverse effects to the eyes	

9.3.7.2. Exposure and risks for workers

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

Table 9.34. Exposure concentrations and risks for workers

Route of exposure and type of effects	Assessment entity	Exposure concentration	Risk quantification
Inhalation, systemic, long term	Palladium dichloride	1.6E3 µg/m ³ (MEASE 1) RCR = 0.027	Final RCR = 0.027
Dermal, systemic, long term	Palladium dichloride	14.14 µg/kg bw/day (MEASE 1) RCR = 8.4E-4	Final RCR < 0.01
Combined routes, systemic, long-term			Final RCR = 0.028

Remarks on exposure data from external estimation tools:

MEASE 1 for Palladium dichloride:

Explanation: Dermal, systemic, long term

For calculation of systemic exposure, the exposure estimate for total dermal loading as obtained in MEASE (reported in mg/day) is divided by a body weight of 70 kg for workers.

Risk characterisation

Qualitative risk characterisation (Inhalation, local, long term, Inhalation, local, acute, Dermal, local, long term, Dermal, local, acute, Eye, local):

Further information on the risk characterisation for local effects via inhalation, for local dermal effects and local effects to the eyes is given in Section 9.0.2.3.

Additional remarks on risk characterisation: Under the prescribed conditions of use, exposure is well below the DNELs and no local effects are expected. Therefore, risks are adequately controlled.