



9.2. Exposure scenario 2: Manufacture - Manufacture of the substance in the catalyst industry

Environment contributing scenario(s):		
CS 1	Manufacture of the substance in the catalyst industry	ERC 1
Worker contributing scenario(s):		
CS 2	Closed batch process	PROC 3
CS 3	Fully contained process	PROC 1
CS 4	Laboratory analyses	PROC 15
CS 5	Wet cleaning	PROC 8a
CS 6	Vacuum cleaning	PROC 26

Further description of the use:

Palladium dichloride may be manufactured via: - Dissolving Palladium metal in aqua regia; - Dissolving Palladium metal in hydrochloric acid in the presence of chlorine; - Evaporation of a Disodium tetrachloropalladate solution to let the Palladium dichloride precipitate; or, - Heating of Palladium sponge in the presence of chlorine gas up to 500 °C.

Explanation on the approach taken for the ES:

It is noted that this exposure scenario focusses on exposure to the substance to be registered. Please refer to information on safe use for the handling of the individual raw materials for process steps preceding the chemical transformation step.

9.2.1. Env CS 1: Manufacture of the substance in the catalyst industry (ERC 1)

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

9.2.1.1. Conditions of use

Amount used, frequency and duration of use (or from service life)
• Annual use amount at site: ≤ 6.5 tonnes/year <i>10.8 tonnes palladium dichloride (6.50 tonnes Pd equivalent)</i>
• Daily use amount at site: ≤ 0.023 tonnes/day <i>Based on 280 days per year (SpERC)</i>
Conditions and measures related to biological sewage treatment plant
• Biological STP: Site specific [Effectiveness Water: 73.4%]
• Discharge rate of STP: $\geq 2E3$ m ³ /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)
• 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. The sludge from the on-site treatment plant is processed for metal reclamation (recycling).</i>
Other conditions affecting environmental exposure
• Receiving surface water flow rate: $\geq 1.8E4$ m ³ /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.

9.2.1.2. 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 9.20. Local releases to the environment

Release	Assessment entity	Release estimation method	Explanations
Water	Pd dissolved	Estimated release factor	<p>Release factor before on site RMM: 6.7E-3%</p> <p>Release factor after on site RMM: 6.7E-3%</p> <p>Local release rate: 1.55E-3 kg/day</p> <p>Explanation: On-site wastewater treatment by chemical precipitation, sedimentation, electrolysis, reverse osmosis, ion exchange and/or filtration. Efficiency >99% (typical values reported in SpERC for 'Manufacture of metal-containing catalysts') Release factor after on-site treatment: 67 g/T (10% of SpERC RF for wastewater)</p>
Air	Pd dissolved	Estimated release factor	<p>Release factor before on site RMM: 2.5E-3%</p> <p>Release factor after on site RMM: 2.5E-3%</p> <p>Local release rate: 5.8E-4 kg/day</p> <p>Explanation: Treatment of air emissions by cyclones, filters (e.g. fabric, bag, HEPA or ceramic), electrostatic precipitators and/or wet scrubbers. Efficiency 95 to >99% (typical values reported in SpERC for 'Manufacture of metal-containing catalysts') Release factor after on-site treatment: 25 g/T (10% of SpERC RF for air)</p>
Non agricultural soil	Pd dissolved	Estimated release factor	<p>Release factor after on site RMM: 0%</p> <p>Explanation: No direct emissions to soil.</p>

9.2.1.3. 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 9.21. 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: 2.01E-5 mg/L RCR = 0.447	Final RCR = 0.447
Sediment	Pd dissolved	Local PEC: 0.049 mg/kg dw	Final RCR = 0.18



Protection target	Assessment entity	Exposure concentration	Risk quantification
(freshwater)		RCR = 0.18	
Sewage Treatment Plant	Pd dissolved	Local PEC: 2.07E-4 mg/L RCR = 3.93E-4	Final RCR < 0.01
Agricultural soil	Pd dissolved	Local PEC: 1.9E-3 mg/kg dw RCR = 0.097	Final RCR = 0.097

9.2.2. Worker CS 2: Closed batch process (PROC 3)

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

9.2.2.1. 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: Intermittent	MEASE 1
• Level of containment: Closed process	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	

9.2.2.2. Exposure and risks for workers

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

Table 9.22. 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	1E3 µg/m ³ (MEASE 1) RCR = 0.017	Final RCR = 0.017
Dermal, systemic, long term	Palladium dichloride	1.71 µg/kg bw/day (MEASE 1) RCR = 1.02E-4	Final RCR < 0.01
Combined routes, systemic, long-term			Final RCR = 0.017

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.

9.2.3. Worker CS 3: Fully contained process (PROC 1)

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

9.2.3.1. 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: 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: None	MEASE 1
• Level of containment: Closed process	MEASE 1
• Pattern of exposure control: Non-direct handling	MEASE 1
• Pattern of use: Closed system without breaches	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	

9.2.3.2. Exposure and risks for workers

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

Table 9.23. 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	1.71 µg/kg bw/day (MEASE 1) RCR = 1.02E-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.

9.2.4. Worker CS 4: Laboratory analyses (PROC 15)

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

9.2.4.1. Conditions of use

	Method
Product (article) characteristics	
• Content in preparation: Not restricted [Effectiveness Inhalation: 0%, Dermal: 0%]	MEASE 1
• Maximum emission potential of the substance: High	MEASE 1
• Physical form of substance: Solid, powder / dust	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	

9.2.4.2. Exposure and risks for workers

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

Table 9.24. 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	17.14 µg/kg bw/day (MEASE 1) RCR = 1.02E-3	Final RCR < 0.01
Combined routes, systemic, long-term			Final RCR = 0.085

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.

9.2.5. Worker CS 5: Wet cleaning (PROC 8a)

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

9.2.5.1. 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: 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: Protective gloves according to EN 374 have to be worn. Gloves have to be changed according to manufacturer's information or when damaged, whatever is the earlier. [Effectiveness Dermal: 90%]	MEASE 1
• Eye protection: Eye protection to be worn to protect from adverse effects to the eyes	

9.2.5.2. Exposure and risks for workers

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

Table 9.25. 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	34.29 µg/kg bw/day (MEASE 1) RCR = 2.04E-3	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.

9.2.6. Worker CS 6: Vacuum cleaning (PROC 26)

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

9.2.6.1. 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): RPE with minimum APF = 20 [Effectiveness Inhalation: 95%]	MEASE 1
• Gloves: Protective gloves according to EN 374 have to be worn. Gloves have to be changed according to manufacturer's information or when damaged, whatever is the earlier. [Effectiveness Dermal: 90%]	MEASE 1
• Eye protection: Eye protection to be worn to protect from adverse effects to the eyes	

9.2.6.2. 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	Palladium dichloride	80 µg/m ³ (MEASE 1) RCR = 1.35E-3	Final RCR < 0.01
Dermal, systemic,	Palladium dichloride	1.41 µg/kg bw/day (MEASE 1)	Final RCR < 0.01



Route of exposure and type of effects	Assessment entity	Exposure concentration	Risk quantification
long term		RCR = 8.37E-5	
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.