ZINCO CLORURO SELECTRA

Scheda di dati di sicurezza

conforme al Regolamento (CE) n. 453/2010

Data di pubblicazione: 05/10/2010 Data di revisione: 01/07/2014 Sostituisce la scheda: 31/03/2011 Versione: 4.0

SEZIONE 1: Identificazione della sostanza o della miscela e della società/impresa

1.1. Identificatore del prodotto

Forma del prodotto	:	Sostanza
Nome della sostanza	:	ZINCO CLORURO SELECTRA
Denominazione chimica	:	cloruro di zinco
Numero indice EU	:	030-003-00-2
Numero CE	:	231-592-0
Numero CAS	:	7646-85-7
No. di registro REACH	:	01-2119472431-44
Formula	:	Cl2Zn

1.2. Usi pertinenti identificati della sostanza o miscela e usi sconsigliati

1.2.1. Usi pertinenti identificati

Categoria d'uso principale	:	Uso industriale
Uso della sostanza/ della miscela	:	Vedi allegato. (Scenario di esposizione)

1.2.2. Usi sconsigliati

Nessuna ulteriore informazione disponibile

1.3. Informazioni sul fornitore della scheda di dati di sicurezza

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1.4. Numero telefonico di emergenza

Numero di emergenza	:	Numeri telefonici dei principali Centri Antiveleni italiani (attivi 24/24 ore) 1. Centro Antiveleni di Pavia 0382 24444 (CAV IRCCS Fondazione Maugeri - Pavia) 2. Centro Antiveleni di Milano 02 66101029 (CAV Ospedale Niguarda Ca' Granda - Milano) 3. Centro Antiveleni di Bergamo 800 883300 (CAV Ospedali Riuniti - Bergamo) 4. Centro Antiveleni di Firenze 055 7947819 (CAV Ospedale Careggi - Firenze) 5. Centro Antiveleni di Roma 06 3054343 (CAV Policlinico Gemelli - Roma) 6. Centro Antiveleni di Roma 06 49978000 (CAV Policlinico Umberto I - Roma) 7. Centro Antiveleni di Napoli 081 7472870 (CAV Ospedale Cardarelli - Napoli)

SEZIONE 2: Identificazione dei pericoli

2.1. Classificazione della sostanza o della miscela

Classificazione secondo il regolamento (CE) n. 1272/2008 [CLP]

Acute Tox. 4 (Oral)	H302
Skin Corr. 1B	H314
Aquatic Acute 1	H400
Aquatic Chronic 1	H410

Testo integrale delle frasi H: vedere la sezione 16

Limiti di concentrazione specifici:

(C >= 5)	STOT SE 3, H335

Classificazione secondo le direttive 67/548/CEE [DSD] o 1999/45/CE [DPD]

C; R34

Xn; R22

N; R50/53

Testo integrale delle frasi R: vedere la sezione 16

Limiti di concentrazione specifici:

(5 =< C < 10)	Xi;R36/37/38
(C >= 10)	C;R34

Effetti avversi fisicochimici, per la salute umana e per l’ambiente

Nessuna ulteriore informazione disponibile

2.2. Elementi dell’etichetta

Etichettatura secondo la regolamento CE n. 1272/2008 [CLP]

Pittogrammi di pericoli (CLP) :

GHS05 GHS07 GHS09

Avvertenza (CLP)	:	Pericolo
Indicazioni di pericolo (CLP)	:	H302 - Nocivo se ingerito H314 - Provoca gravi ustioni cutanee e gravi lesioni oculari H410 - Molto tossico per gli organismi acquatici con effetti di lunga durata
Consigli di prudenza (CLP)	:	P260 - Non respirare i vapori P280 - Indossare guanti, indumenti protettivi, protezione per gli occhi, protezione per il viso P303+P361+P353 - IN CASO DI CONTATTO CON LA PELLE (o con i capelli): togliersi di dosso immediatamente tutti gli indumenti contaminati. Sciacquare la pelle/fare una doccia P304+P340 - IN CASO DI INALAZIONE: trasportare l'infortunato all’aria aperta e mantenerlo a riposo in posizione che favorisca la respirazione P305+P351+P338 - IN CASO DI CONTATTO CON GLI OCCHI: sciacquare accuratamente per parecchi minuti. Togliere le eventuali lenti a contatto se è agevole farlo. Continuare a sciacquare P310 - Contattare immediatamente un CENTRO ANTIVELENI o un medico

2.3. Altri pericoli

Nessuna ulteriore informazione disponibile

SEZIONE 3: Composizione/informazioni sugli ingredienti

3.1. Sostanza

Nome	:	ZINCO CLORURO SELECTRA
Numero CAS	:	7646-85-7
Numero CE	:	231-592-0
Numero indice EU	:	030-003-00-2

Nome	Identificatore del prodotto	%	Classificazione secondo la direttiva 67/548/CEE
Cloruro di zinco	(Numero CAS) 7646-85-7 (Numero CE) 231-592-0 (Numero indice EU) 030-003-00-2 (no. REACH) 01-2119472431-44	94 - 100	C; R34 Xn; R22 N; R50/53

Nome	Identificatore del prodotto	Limiti di concentrazione specifici
Cloruro di zinco	(Numero CAS) 7646-85-7 (Numero CE) 231-592-0 (Numero indice EU) 030-003-00-2 (no. REACH) 01-2119472431-44	(5 =< C < 10) Xi;R36/37/38 (C >= 10) C;R34

Nome	Identificatore del prodotto	%	Classificazione secondo il regolamento (CE) n. 1272/2008 [CLP]
Cloruro di zinco	(Numero CAS) 7646-85-7 (Numero CE) 231-592-0 (Numero indice EU) 030-003-00-2 (no. REACH) 01-2119472431-44	94 - 100	Acute Tox. 4 (Oral), H302 Skin Corr. 1B, H314 Aquatic Acute 1, H400 Aquatic Chronic 1, H410

Nome	Identificatore del prodotto	Limiti di concentrazione specifici
Cloruro di zinco	(Numero CAS) 7646-85-7 (Numero CE) 231-592-0 (Numero indice EU) 030-003-00-2 (no. REACH) 01-2119472431-44	(C >= 5) STOT SE 3, H335

Testo integrale delle frasi R e H : vedere la sezione 16

3.2. Miscela

Non applicabile

SEZIONE 4: Misure di primo soccorso

4.1. Descrizione delle misure di primo soccorso

Misure di primo soccorso generale	:	Controllare le funzioni vitali. Vittima incosciente: mantenere libere le vie respiratorie. Arresto respiratorio: respirazione artificiale o ossigeno. Arresto cardiaco: rianimare la vittima. Tenere la vittima a riposo in posizione semi-eretta. Choc: a preferenza stare supino, con le gambe in alto. Vomito: evitare soffocazione/polmonite chimica. Tenere la vittima al caldo (no riscaldamento). Tenere la vittima sotto sorveglianza. Prestare aiuto psicologico. Tenere tranquilla la vittima, evitare gli sforzi. Dipendente dallo stato della vittima: medico/ospedale.
Misure di primo soccorso in caso di inalazione	:	Trasportare l'infortunato all'aria aperta e mantenerlo a riposo in posizione che favorisca la respirazione. Difficoltà respiratorie: consultare un medico.
Misure di primo soccorso in caso di contatto cutaneo	:	Sciacquare immediatamente e abbondantemente con acqua per 15-20 minuti. Sciacquare la pelle/fare una doccia. Togliersi di dosso immediatamente tutti gli indumenti contaminati. Se gli abiti restano attaccati alla pelle: non toglierli. Coprire le ferite con bende sterili. Consultare un medico. Superficie bruciata> 10%: ammissione all'ospedale.
Misure di primo soccorso in caso di contatto con gli occhi	:	Sciacquare immediatamente e abbondantemente con acqua per 15 minuti. Contattare immediatamente un oculista. Non applicare un mezzo di neutralizzazione (chimico).
Misure di primo soccorso in caso di ingestione	:	Sciacquare la bocca con acqua. Subito dopo l'ingestione: far bere molta acqua. NON provocare il vomito. Medico: non somministrare un antidoto chimico (+. carbone attivo). Consultare immediatamente un medico.

4.2. Principali sintomi ed effetti, sia acuti che ritardati

Sintomi/lesioni in caso di inalazione	:	Polvere : Tosse., Irritazione della gola e delle vie respiratorie, Irritazione della mucosa nasale. In caso d'esposizione a forti concentrazioni di polveri : Corrosivo per le vie respiratorie, Rischio di edema polmonare, Rischio di polmonite. Fumi : L'inalazione dei fumi puo' provocare febbre da fumi metallici. Debolezza. Aumento della temperatura corporea. Emicrania. nausea, vomito. Gusto di metallo. Dolori muscolari. Respirazione accelerata. Difficoltà respiratoria. Rischio di edema delle vie aeree superiori. Arresto respiratorio.
Sintomi/lesioni in caso di contatto con la pelle	:	Bruciature/corrosione.
Sintomi/lesioni in caso di contatto con gli occhi	:	Corrosione del tessuto oculare. Lesioni oculari permanenti.
Sintomi/lesioni in caso di ingestione	:	Bruciature delle mucose gastrointestinali. Possibile perforazione dell'esofago. Nausea. Vomito. Diarrea. I sintomi possono insorgere in ritardo. : Sangue nelle feci. Riduzione della pressione sanguigna. Choc.

4.3. Indicazione dell'eventuale necessità di consultare immediatamente un medico oppure di trattamenti speciali

Nessuna ulteriore informazione disponibile

SEZIONE 5: Misure antincendio

5.1. Mezzi di estinzione

Mezzi di estinzione idonei	:	Per circoscrivere l'incendio dei materiali circostanti, usare mezzi adeguati allo scopo.
Mezzi di estinzione non idoneii	:	Nessuno noto.

5.2. Pericoli speciali derivanti dalla sostanza o dalla miscela

Prodotti di combustione pericolosi in caso di incendio	:	Sviluppo di vapori tossici e corrosivi. (acido cloridrico). I vapori. (Composti metallici).

5.3. Raccomandazioni per gli addetti all'estinzione degli incendi

Istruzioni per l'estinzione	:	Rarefare gas tossici spruzzando acqua. Tener conto dell'acqua di estinzione tossica. Moderare l'uso di acqua, se possibile raccoglierla/contenerla.
Protezione durante la lotta antincendio	:	Guanti di protezione. Visiera protettiva. Indumenti resistenti alla corrosione. Polvere : Respiratore ad aria compressa/ossigeno. Incendio/riscald.:respiratore di aria compressa/di ossigeno.

SEZIONE 6: Misure in caso di rilascio accidentale

6.1. Precauzioni personali, dispositivi di protezione e procedure in caso di emergenza

Misure di carattere generale	:	Mantenere l'ambiente pulito al fine di evitare di sollevare polvere. Nessuna fiamma libera. Non fumare.

6.1.1. Per chi non interviene direttamente

Mezzi di protezione	:	Per maggiori informazioni, vedere la sezione 8 : "Controllo dell'esposizione-protezione individuale".

6.1.2. Per chi interviene direttamente

Mezzi di protezione	:	Guanti di protezione. Visiera protettiva. Indumenti resistenti alla corrosione. Polvere : Respiratore ad aria compressa/ossigeno. (vedere sezione(i) : 8).

6.2. Precauzioni ambientali

Raccogliere/pompare il prodotto disperso in contenitori adatti. Tappare la falla/interrompere l'afflusso. Arginare il solido disperso. Abbattere/diluire la nuvola di polvere con acqua nebulizzata. Tener conto dell'acqua di precipitazione tossica/corrosiva. Evitare l'inquinamento del terreno/dell'acqua. Evitare l'immissione nelle fognature o corsi d'acqua.

6.3. Metodi e materiali per il contenimento e per la bonifica

Metodi di pulizia : Evitare la dispersione coprendo con sabbia/terra secca. Raccogliere il solido fuoriuscito in contenitori coperti. Raccogl. accuratamente la sostanza fuoriusc./quel che resta. Lavare le superfici sporcate con molta acqua. Pulire le attrezzature e l'abbigliamento dopo il lavoro. Raccogliere in recipienti adeguati e eliminare i materiali impregnati in un centro autorizzato.

6.4. Riferimento ad altre sezioni

Per maggiori informazioni, vedere la sezione 13.

SEZIONE 7: Manipolazione e immagazzinamento

7.1. Precauzioni per la manipolazione sicura

Precauzioni per la manipolazione sicura : Mantenere l'ambiente pulito al fine di evitare di sollevare polvere. Conservare lontano da fiamme libere/dal calore. Osservare una stretta igiene. Conservare il recipiente ben chiuso. Togliersi di dosso immediatamente gli indumenti contaminati/Togliersi immediatamente gli indumenti contaminati. NON scaricare nelle fognature.

Misure di igiene : Osservare una stretta igiene. Mantenere il recipiente ben chiuso. Non mangiare, né bere, né fumare durante l'impiego.

7.2. Condizioni per l’immagazzinamento sicuro, comprese eventuali incompatibilità

Condizioni per lo stoccaggio : Temperatura di stoccaggio : 2 - 40 °C. Conservare in luogo asciutto. Conservare in luogo ben ventilato. Può essere conservato sotto argo. Conservare a temperatura ambiente.

Prodotti incompatibili : Agente ossidante. Acidi forti. Alcali forti. Acqua. Umidità. Metalli di prima trasformazione e leghe.

Calore e sorgenti di ignizione : Tenere lontano da ogni sorgente di ignizione.

Materiali di imballagio : Materiale sintetico. Polietilene. Plastica. Vetro. terraglie/porcellana. Cartone. Non usare : Acciaio, alluminio.

7.3. Usi finali specifici

Scenario di esposizione : Vedi allegato.

SEZIONE 8: Controllo dell’esposizione/protezione individuale

8.1. Parametri di controllo

Cloruro di zinco (7646-85-7)		
Repubblica Ceca	Nome locale	Chlorid zine natý
Repubblica Ceca	Expoziční limity (PEL) (mg/m³)	1 mg/m³
Repubblica Ceca	Expoziční limity (NPK-P) (mg/m³)	2 mg/m³
Francia	Nome locale	Zinc (chlorure de,fumées)
Francia	VME (mg/m³)	1 mg/m³
Germania	TRGS 900 Valori limiti per l'esposizione professionale (mg/m³)	5 mg/m³
Olanda	Grenswaarde TGG 8H (mg/m³)	5 mg/m³
Polonia	Nome locale	Dichlorek cynku (chlorek cynku) dymy
Polonia	NDS (mg/m³)	1 mg/m³
Polonia	NDSCh (mg/m³)	2 mg/m³
Portogallo	Nome locale	Cloreto de zinco, fumos
Portogallo	OEL TWA (mg/m³)	1 mg/m³
Portogallo	OEL STEL (mg/m³)	2 mg/m³
Spagna	VLA-ED (mg/m³)	1 mg/m³ (fumo)
Spagna	VLA-EC (mg/m³)	2 mg/m³ (fumo)
Svezia	Nome locale	Zink chloride respirable dust
Svezia	nivågränsvärde (NVG) (mg/m³)	1 mg/m³
Regno Unito	Nome locale	Zinc chloride, fume
Regno Unito	WEL TWA (mg/m³)	1 mg/m³
Regno Unito	WEL STEL (mg/m³)	2 mg/m³
USA - ACGIH	ACGIH TWA (mg/m³)	5 mg/m³
USA - ACGIH	ACGIH STEL (mg/m³)	10 mg/m³

ZINCO CLORURO SELECTRA (7646-85-7)	
DNEL/DMEL (Lavoratori)	
A lungo termine - effetti sistemici, cutanea	8,3 mg/kg di peso corporeo/giorno
A lungo termine - effetti sistemici, inalazione	1 mg/m³
DNEL/DMEL (Popolazione generale)	
A lungo termine - effetti sistemici,orale	0,83 mg/kg di peso corporeo/giorno

ZINCO CLORURO SELECTRA (7646-85-7)	
A lungo termine - effetti sistemici, cutanea	8,3 mg/kg di peso corporeo/giorno
A lungo termine - effetti locali, inalazione	1,3 mg/m³
PNEC (Acqua)	
PNEC aqua (acqua dolce)	20,6 µg/L
PNEC aqua (acqua marina)	6,1 µg/L
PNEC (Sedimento)	
PNEC sedimento (acqua dolce)	117,8 mg/kg dwt
PNEC sedimento (acqua marina)	56,5 mg/kg dwt
PNEC (Suolo)	
PNEC suolo	35,6 mg/kg dwt
PNEC (STP)	
PNEC Impianto di trattamento acque reflue	100 µg/L

8.2. Controlli dell'esposizione

Controlli tecnici idonei : Evitare la formazione di polvere. Conservare lontano da fiamme libere/dal calore. Misurazione di concentrazione nell'atmosfera. Lavorare all'aria aperta/usare l'aspirazione localizzata/ventilazione o protezione respiratoria.

Indumenti protettivi - scelta del materiale : Indumenti resistenti alla corrosione. In caso di formazione di polvere : Protezione della testa/del collo

Protezione delle mani : Guanti. Utilizzare guanti di gomma. Plastica. Guanti di gomma butilica. Gomma di cloroprene. Polietilene clorosolfonica. Neoprene. Viton

Protezione degli occhi : Visiera protettiva. In caso di formazione di polvere : Occhiali di protezione a mascherina

Protezione respiratoria : Polvere : Respiratore per particelle/aerosol con filtro tipo P3. Riscaldamento: Maschera antigas con filtro di tipo E. In caso di esposizione a concentrazioni elevate di polveri o vapori: Apparecchio autorespiratorio

Controlli dell'esposizione ambientale : (vedere sezione(i) : 6 - 13).

SEZIONE 9: Proprietà fisiche e chimiche

9.1. Informazioni sulle proprietà fisiche e chimiche fondamentali

Stato fisico : Solido
Aspetto : Polvere. Granuli.
Massa molecolare : 136,27 g/mol
Colore : bianco.
Odore : inodore.
Soglia olfattiva : Non applicabile
pH : 4.6 - 6 (10%) - 3.5 (50%)
Velocità d'evaporazione relativa (acetato butilico=1) : Dati non disponibili
Punto di fusione : 287 - 313 °C 1 atm - Metodo A.1 (UE)
Punto di congelamento : Dati non disponibili
Punto di ebolizione : 732 °C
Punto di infiammabilità : Non applicabile
Temperatura di autoaccensione : Dati non disponibili
Temperatura di decomposizione : 360 °C
Infiammabilità (solidi, gas) : Non infiammabile
Tensione di vapore : Non applicabile
Pressione critica : Non applicabile
Densità relativa di vapore a 20 °C : Dati non disponibili
Densità relativa : 2,93 (22 °C - Metodo A.3 - UE)
Densità : 2930 kg/m³ (22 °C)
Solubilità : Acqua: 432 g/100 ml (25 °C) - OCDE 105 : 85.1 g/100 ml (20 °C)
Etanolo: 76 g/100 ml
Log Pow : Dati non disponibili
Viscosità cinematica : Dati non disponibili
Viscosità dinamica : 100-200 mPa.s (400 °C) - 300 mPa.s (346 °C) - 500 mPa.s (326 °C) - 900 mPa.s (306 °C) - 1300 mPa.s (294 °C)
Proprietà esplosive : Dati non disponibili
Proprietà ossidanti : Dati non disponibili

Limiti d'esplosività	: Non applicabile

9.2. Altre informazioni

Percentuale di COV	: 0 %
Misura	: 288-561 µm

SEZIONE 10: Stabilità e reattività

10.1. Reattività

Reazione acida.

10.2. Stabilità chimica

Stabile nelle normali condizioni d'uso.

10.3. Possibilità di reazioni pericolose

Reagisce violentemente con : Acidi forti., Alcali forti.

10.4. Condizioni da evitare

Impedire o limitare la formazione e la dispersione di polveri.

10.5. Materiali incompatibili

Agente ossidante. Alcali forti. Acidi forti. metalli. Acqua. Umidità. Acciaio. Alluminio.

10.6. Prodotti di decomposizione pericolosi

Sviluppo di vapori tossici e corrosivi. (acido cloridrico). I vapori. (Composti metallici).

SEZIONE 11: Informazioni tossicologiche

11.1. Informazioni sugli effetti tossicologici

Tossicità acuta	: Orale: Nocivo se ingerito.

Cloruro di zinco (7646-85-7)	
DL50 orale ratto	1100 mg/kg (OCDE 401) - Esperienza pratica
CL50 inalazione ratto (mg/l)	2000 mg/m³ (gli aerosol - 10 min - femmina) - Esperienza pratica

Corrosione/irritazione cutanea	: Provoca gravi ustioni cutanee e gravi lesioni oculari. Molto irritante per la pelle (1% - 5d - su coniglio) - Esperienza pratica pH: 4.6 - 6 (10%) - 3.5 (50%)
Lesioni oculari gravi/irritazioni oculari gravi	: Gravi lesioni oculari/irritazione oculare, categoria 2, implicita pH: 4.6 - 6 (10%) - 3.5 (50%)
Sensibilizzazione respiratoria o cutanea	: Non classificato Non sono noti effetti sensibilizzanti (OCDE 429 - ratto - femmina) - read-across.
Mutagenicità delle cellule germinali	: Non classificato I test di mutagenesi sono risultati negativi (in vitro - OCDE 473) Esperienze umane I test di mutagenesi sono risultati positivi (in vivo) ratto maschio Esperienza pratica
Cancerogenicità	: Non classificato Dati non disponibili
Tossicità riproduttiva	: Non classificato Tossicità sviluppata NOAEL - OCDE 416 - 30 mg/kg bw/d - read-across ratto femmina Fertilità NOAEL - OCDE 416 - 7.5 mg/kg bw/d ratto Esperienza pratica
Tossicità specifica per organi bersaglio (esposizione singola)	: Non classificato
Tossicità specifica per organi bersaglio (esposizione ripetuta)	: Non classificato per via orale - OCDE 408 - 3000 ppm - read-across 13 settimane ratto maschio femmina

Pericolo in caso di aspirazione	:	Non classificato

SEZIONE 12: Informazioni ecologiche

12.1. Tossicità

Cloruro di zinco (7646-85-7)	
CL50 pesci 1	0,169 mg/l Oncorhynchus mykiss
CE50 Daphnia 1	0,147 mg/l Ceriodaphnia dubia
NOEC (cronico)	0,019 mg/l Pseudokirchnerie lla subcapitata
NOEC cronica pesce	0.044 - 0.530 mg/l
NOEC cronica crostaceo	0.037 - 0.400 mg/l
IC50, acute	0.136 mg/l

12.2. Persistenza e degradabilità

Cloruro di zinco (7646-85-7)	
Persistenza e degradabilità	Non applicabile.

12.3. Potenziale di bioaccumulo

Cloruro di zinco (7646-85-7)	
BCF pesci 1	58 - 457 Cyprinus carpio
Log Kow	Non applicabile
Potenziale di bioaccumulo	Non applicabile.

12.4. Mobilità nel suolo

Nessuna ulteriore informazione disponibile

12.5. Risultati della valutazione PBT e vPvB

Componente	
Cloruro di zinco (7646-85-7)	Questa sostanza/miscela non soddisfa i criteri PBT della Regolamento REACH, allegato XIII Questa sostanza/miscela non soddisfa i criteri vPvB della Regolamento REACH, allegato XIII

12.6. Altri effetti avversi

Altri effetti avversi	:	Potenziale di riscaldamento globale (GWP) : Non elencato. Pericoloso per l'ozonosfera : Non classificato. Rischio di inquinamento dell'acqua potabile (acqua freatica).

SEZIONE 13: Considerazioni sullo smaltimento

13.1. Metodi di trattamento dei rifiuti

Metodi di trattamento dei rifiuti	:	Riciclare o smaltire conformemente alle disposizioni legislative vigenti. Può essere trasportato in discarica,in conformità alle normative locali in vigore. Smaltimento in conformità con le disposizioni legali vigenti. Non mescolare con altri rifiuti. Non scaricare nelle fogne e nei fiumi.
Codice dell'elenco europeo dei rifiuti	:	15 01 10* - imballaggi contenenti residui di sostanze pericolose o contaminati da tali sostanze

SEZIONE 14: Informazioni sul trasporto

Secondo i requisiti di ADR / RID / IMDG / IATA / ADN

14.1. Numero ONU

Numero ONU (ADR)	:	2331
Numero ONU (IMDG)	:	2331
Numero ONU (IATA)	:	2331
Numero ONU (ADN)	:	2331
Numero ONU (RID)	:	2331

14.2. Nome di spedizione dell'ONU

Designazione ufficiale di trasporto (ADR)	:	CLORURO DI ZINCO ANIDRO
Designazione ufficiale di trasporto (IMDG)	:	ZINC CHLORIDE, ANHYDROUS
Designazione ufficiale di trasporto (IATA)	:	Zinc chloride, anhydrous
Designazione ufficiale di trasporto (ADN)	:	CLORURO DI ZINCO ANIDRO
Designazione ufficiale di trasporto (RID)	:	CLORURO DI ZINCO ANIDRO
Descrizione del documento di trasporto (ADR)	:	UN 2331 CLORURO DI ZINCO ANIDRO, 8, III, (E), PERICOLOSO PER L'AMBIENTE
Descrizione del documento di trasporto (IMDG)	:	UN 2331 ZINC CHLORIDE, ANHYDROUS, 8, III, INQUINANTE MARINO/PERICOLOSO PER L'AMBIENTE

14.3. Classi di pericolo connesso al trasporto

ADR

Classi di pericolo connesso al trasporto (ADR)	:	8

Etichette di pericolo (ADR)	:	8
	:	

IMDG

Classi di pericolo connesso al trasporto (IMDG)	:	8
Etichette di pericolo (IMDG)	:	8
	:	

IATA

Classi di pericolo connesso al trasporto (IATA)	:	8
Etichette di pericolo (IATA)	:	8
	:	

ADN

Classi di pericolo connesso al trasporto (ADN)	:	8
Etichette di pericolo (ADN)	:	8
	:	

RID

Classi di pericolo connesso al trasporto (RID)	:	8
Etichette di pericolo (RID)	:	8
	:	

14.4. Gruppo d’imballaggio

Gruppo di imballaggio (ADR)	:	III
Gruppo di imballaggio (IMDG)	:	III
Gruppo di imballaggio (IATA)	:	III
Gruppo di imballaggio (ADN)	:	III
Gruppo di imballaggio (RID)	:	III

14.5. Pericoli per l'ambiente

Pericoloso per l'ambiente	:	Si
Inquinante marino	:	Si
Altre informazioni	:	Nessuna ulteriore informazione disponibile

14.6. Precauzioni speciali per gli utilizzatori

14.6.1. Trasporto via terra

Codice di classificazione (ADR)	:	C2
Quantità limitate (ADR)	:	5kg
Quantità esenti (ADR)	:	E1
Istruzioni di imballaggio (ADR)	:	P002, IBC08, LP02, R001
Disposizioni speciali di imballaggio (ADR)	:	B3
Disposizioni concernenti l'imballaggio in comune (RID)	:	MP10
Istruzioni di trasporto in cisterne mobili e container per il trasporto alla rinfusa (ADR)	:	T1
Disposizioni speciali cisterne mobili e contenitori per il trasporto alla rinfusa (ADR)	:	TP33
Codice cisterna (ADR)	:	SGAV
Veicolo per il trasporto in cisterna	:	AT
Categoria di trasporto (ADR)	:	3
Disposizioni speciali di trasporto - Rinfusa (ADR)	:	VV9
N° pericolo (n°. Kemler)	:	80
Pannello arancione	:	
Codice restrizione galleria (ADR)	:	E
Codice EAC	:	2X

14.6.2. Trasporto via mare

Quantità limitate (IMDG)	:	5 kg
Quantità esenti (IMDG)	:	E1
Packing instructions (IMDG)	:	P002, LP02
IBC packing instructions (IMDG)	:	IBC08
IBC special provisions (IMDG)	:	B3
Tank instructions (IMDG)	:	T1
Disposizioni speciali cisterna (IMDG)	:	TP33
EmS-No. (Fire)	:	F-A
EmS-No. (Spillage)	:	S-B
Stowage category (IMDG)	:	A

14.6.3. Trasporto aereo

Quantità esenti aereo passeggeri e cargo (IATA)	:	E1
Quantità limitate aereo passeggeri e cargo (IATA)	:	Y845
Quantità nette max. di quantità limitate aereo passeggeri e cargo (IATA)	:	5kg
Istruzioni di imballaggio aereo passeggeri e cargo (IATA)	:	860
Quantità nette max. per aereo passeggeri e cargo (IATA)	:	25kg
Istruzioni di imballaggio aereo cargo (IATA)	:	864
Quantità max. netta aereo cargo (IATA)	:	100kg
Codice ERG (IATA)	:	8L

14.6.4. Trasporto fluviale

Codice di classificazione (ADN)	:	C2
Quantità limitate (ADN)	:	5 kg
Quantità esenti (ADN)	:	E1
Atrezzatura richiesta (ADN)	:	PP, EP
Numero di coni/semafori blu (ADN)	:	0
Non soggetto all'ADN	:	No

14.6.5. Trasporto per ferrovia

Codice di classificazione (RID)	:	C2
Quantità limitate (RID)	:	5kg
Quantità esenti (RID)	:	E1
Istruzioni di imballaggio (RID)	:	P002, IBC08, LP02, R001
Disposizioni speciali di imballaggio (RID)	:	B3
Disposizioni concernenti l'imballaggio in comune (RID)	:	MP10
Istruzioni di trasporto in cisterne mobili e container per il trasporto alla rinfusa (RID)	:	T1
Disposizioni speciali cisterne mobili e contenitori per il trasporto alla rinfusa (RID)	:	TP33
Tank codes for RID tanks (RID)	:	SGAV
Categoria di trasporto (RID)	:	3
Disposizioni speciali di trasporto - Rinfusa (RID)	:	VW9
Colis express (express parcels) (RID)	:	CE11
Numero di identificazione del pericolo (RID)	:	80
Trasporto proibito (RID)	:	No

14.7. Trasporto di rinfuse secondo l'allegato II di Marpol 73/78 e il codice IBC

Non applicabile

SEZIONE 15: Informazioni sulla regolamentazione

15.1. Norme e legislazione su salute, sicurezza e ambiente specifiche per la sostanza o la miscela

15.1.1. Normative UE

Nessuna restrizione ai sensi dell'allegato XVII del regolamento REACH

ZINCO CLORURO SELECTRA non è nell'elenco di sostanze candidate REACH

Non contiene sostanze candidate REACH

ZINCO CLORURO SELECTRA non é elencata all'allegato XIV del REACH

Non contiene nessuna sostanza elencata all'allegato XIV del REACH

Percentuale di COV	:	0 %
Ulteriori norme, limitazioni e prescrizioni legali	:	Cloruri : 250 mg/l.

15.1.2. Norme nazionali

Germania

Classe di pericolo per le acque (WGK)	:	3 - estremamente inquinante per l'acqua

Olanda

Waterbezwaarlijkheid	:	4 - Altamente tossico per gli organismi acquatici, può provocare a lungo termine effetti negativi per l'ambiente acquatico

15.2. Valutazione della sicurezza chimica

E' stata eseguita una valutazione della sicurezza chimica

SEZIONE 16: Altre informazioni

Indicazioni di modifiche:
Revisione totale in base alla normativa REACH.

Testo delle frasi R, H e EUH:

Acute Tox. 4 (Oral)	Tossicità acuta (per via orale), categoria 4
Aquatic Acute 1	Pericoloso per l'ambiente acquatico — Pericolo acuto, categoria 1
Aquatic Chronic 1	Pericoloso per l'ambiente acquatico — Pericolo cronico, categoria 1
Skin Corr. 1B	Corrosione/irritazione cutanea, categoria 1B
H302	Nocivo se ingerito
H314	Provoca gravi ustioni cutanee e gravi lesioni oculari
H400	Molto tossico per gli organismi acquatici
H410	Molto tossico per gli organismi acquatici con effetti di lunga durata
R22	Nocivo per ingestione

R34	Provoca ustioni
R50/53	Altamente tossico per gli organismi acquatici, può provocare a lungo termine effetti negativi per l'ambiente acquatico
C	Corrosivo
N	Pericoloso per l'ambiente
Xn	Nocivo

SDS UE (Allegato II REACH)

AVVISO DI NON RESPONSABILITÀ

Le informazioni contenute in questa scheda provengono da fonti affidabili. Sono stabilite sulla base delle nostre conoscenze alla data degli aggiornamenti indicati. Hanno come scopo di aiutare l'utente e non devono essere considerate come una garanzia.
Le condizioni o metodi di carico, stoccaggio, utilizzazione o eliminazione del prodotto non sono sotto il nostro controllo e decliniamo ogni responsabilità in caso di perdita, danno o spese occasionate da tali condizioni o legate ad esse.
Tutte le sostanze o miscele possono presentare dei pericoli sconosciuti e devono essere utilizzati con prudenza. Non possiamo garantire l'esaustività delle descrizioni riguardanti tali pericoli.
Questa scheda è stata redatta e deve essere utilizzata unicamente per questo prodotto. Se il prodotto è impiegato come componente di un altro prodotto, le informazioni in questione possono non essere applicabili.
Questa scheda non libera, in nessun caso, l'utente del prodotto dal rispetto dell'insieme dei testi legislativi, regolamentari e amministrativi relativi al prodotto stesso, alla sicurezza, all'igiene e alla protezione della salute umana e ambientale.
Questa versione non è una traduzione ufficiale del documento originale. Questa traduzione è fornita esclusivamente a titolo informativo.

EXPOSURE ASSESSMENT (with local risk characterisation)

Introduction

In the EU risk assessment on zinc metal and 5 zinc compounds (ZnO, ZnCl2, ZnSO4, Zn3(PO4)2, Zn-distearate), made in the framework of the Regulation 793/93/EEC, an extensive analysis was made for the local and regional exposures to man and environment. This extensive analysis is used as a starting basis for the present assessments, too.

However, some extensions and updates were made in the present analysis, where appropriate. These are shortly discussed below.

Local assessments for workers and environment.

For assessment of exposures at local scale, several generic exposure scenarios (GES) were developed for each zinc substance. This was necessary because of the significant number of uses that was identified for each substance. The multitude of identified uses was assigned to the respective GES based on similarity of process, and , consequently, similarity in exposure and risk management measures. So, GES are relevant for the different identified uses that they group at the same time.

Structure of the local assessments

Because they are so numerous, and for reasons of clarity and consistency, the local exposure scenarios, the local exposure assessments and the local risk characterisations related to each of the GES are presented together under chapter 9.

Approaches for local exposure assessment

For the local exposure assessments, the data reported in the EU risk assessment are used as the starting point. Where appropriate (data gaps, scenarios showing risk), the exposure data from the RA were completed and updated, to better reflect the local situations today. The detail of the data reported by the companies is available for consultation at IZA. In general, measured data are used by preference for the exposure assessment. For a number of the scenarios, no measured exposure data are available; in that case exposure was modelled with established exposure models.

- Assessment of workers exposure is related to the place /process the worker is involved in. The GES group different processes; exposure assessment is done using the worst case approach by considering full shift exposure at the workplace with highest potential for exposure. Risk management measures are specified accordingly.
- Environmental emissions (notably to water) are usually integrating the totality of emissions from a given site, and cannot be distinguished for each process. Therefore assessments in the GES are done for the site as a whole.

Consumer assessment.

Conform to the approach followed in the EU risk assessment, consumer exposure has been assessed in an integrated way, by combining the exposures following from the use/consumption of different articles containing zinc from different zinc substances all together. This approach is reflecting reality. Since the consumption pattern of zinc containing articles has not significantly changed since the closure of the risk assessment, the analysis made in the RA is used for the present scenario, too. Because of the integrated approach, the consumer scenario is relevant for all zinc substances.

Indirect exposure via the environment

Conform to the approach followed in the RA, a substance-specific assessment is presented for general and local indirect exposure via the environment. Considering that industrial emissions have further decreased since the closure of the RA, the analysis of the RA is used as a realistic worst case for this scenario.

Regional scenario

Conform to the RA, a regional assessment of environmental exposure as a result of the use/consumption of zinc containing articles has been made. Since the emissions related to the use of the different substances all combine in the environment, no substance-specific assessment was made, but an overall assessment, combining all emissions from zinc containing products at the same time in one assessment. This approach was also followed in the EU RA. The environmental release factors for the different zinc articles were extensively discussed in the RA, and serve as a basis for the present analysis. The exposure assessment was however extended from the EU-15 to the EU-27. As compared to the RA database, some important updates of emissions and, notably, of the environmental monitoring data were made. Like for consumers, this regional assessment is relevant for all zinc substances.

9.1. Local scenarios

In table below, the generic exposure scenarios (GES) developed for $ZnCl_2$ are summarised.

Table 1. Generic exposure scenarios for zinc chloride

Number	Sector	Uses	Code
0	Zinc Chloride production	Manufacture Substance	GES_{ZnCl2} 0
1	Formulation step	Forrmulation general	GES_{ZnCl2} 1
2	First tier applications	Manufacturing of other zinc compounds	GES_{ZnCl2} 2
3		Laboratory reagent	GES_{ZnCl2} 3
4		As component for solid blends & matrices	GES_{ZnCl2} 4
5		As component for production of dispersions, pastes and other viscous matrices	GES_{ZnCl2} 5
6	Second tier applications	DU of ZnCl2-containing solid preparations	GES_{ZnCl2} 6
7		DU of ZnCl2-containing liquid & pasty preparations	GES_{ZnCl2} 7

Numerous uses were identified for $ZnCl_2$. These are listed in table below, with the indication of the Generic Exposure Scenario (GES) that is relevant to these identified uses.

Table 2. Identified uses for ZnCl2 and corresponding Generic Exposure Scenario (GES)

IU number	Identified Use (IU) name	GES code
1	Zinc chloride recovery	GESZnCl2 0
2	Zinc chloride production and refining	GESZnCl2 0
6	Production of inorganic zinc compounds	GESZnCl2 2
7	Electrogalvanising	GESZnCl2 2
8	Electroplating	GESZnCl2 2
9	Zinc production by electrowinning	GESZnCl2 2
10	Production of Zinc chloride based fluxing agents	GESZnCl2 2
11	steel surface treatment prior to hot-dip galvanizing	GESZnCl2 4, GESZnCl2 5
12	Use of zinc chloride based fluxing agents before welding/soldering processes	GESZnCl2 6, Generic consumer/environment*
13	Laboratory reagent	GESZnCl2 3
14	Catalytic agent	GESZnCl2 2, GESZnCl2 3
15	Zinc production by pyrometallurgy	GESZnCl 2
16	Production of organic zinc compounds	GESZnCl2 2
17	Production of organic pigments	GESZnCl2 1, GESZnCl2 4
18	Production of coatings, paints, inks, enamels, varnishes	GESZnCl2 1, GESZnCl2 4
19	Formulation of abrasive material for tools	GESZnCl2 1, GESZnCl2 4
20	Component for paper coating or treatment for paper products	GESZnCl2 1, GESZnCl2 5
21	Use of ZnCl2 containing paper coatings	GESZnCl2 6
22	Textile and leather coating treatment	GESZnCl2 1, GESZnCl2 5
23	Use of ZnCl2 containing coatings for textile and leather	GESZnCl2 6
24	Additive in the manufacturing of electric-electronic components	GESZnCl2 1, GESZnCl2 4
25	Batteries /fuel cells	GESZnCl2 1, GESZnCl2 4, GESZnCl2 5

26	Component for production of rubber, resins and related preparations	GESZnCl2 1, GESZnCl2 5
27	Production of polymer-matrices, plastics and related preparations	GESZnCl2 1, GESZnCl2 5
28	Additive / component for the production of Sealants / Adhesives / Mastics	GESZnCl2 1, GESZnCl2 5
29	Use of ZnCl2-containing Sealants / Adhesives / Mastics	GESZnCl2 7, Generic consumer/environment
30	Additive / component for the production of Lubricants / Grease / Metal working fluids	GESZnCl2 1, GESZnCl2 5
31	Use of ZnCl2-containing Lubricants / Grease / Metal working fluids	GESZnCl2 7, Generic consumer/environment
32	Additive / component for the production of Polishes / wax blends	GESZnCl2 1, GESZnCl2 5
33	Use of ZnCl2-containing Polishes / wax blends	GESZnCl2 7, Generic consumer/environment
34	Use of ZnCl2-containing catalysts	GESZnCl2 1, GESZnCl2 5
35	Additive component for production of de-icing products	GESZnCl2 1, GESZnCl2 5
36	Use of ZnCl2-containing de-icing products	GESZnCl2 7, Generic consumer/environment
37	Additive for the formulation of animal feedstuffs	GESZnCl2 1, GESZnCl2 4, GESZnCl2 5
38	Additive for the formulation of biocidal products	GESZnCl2 1, GESZnCl2 4, GESZnCl2 5
39	Additive for the formulation of cleaning products	GESZnCl2 1, GESZnCl2 4, GESZnCl2 5
40	Use of ZnCl2-containing cleaning products	GESZnCl2 6, GESZnCl2 7, Generic consumer/environment
41	Additive for the formulation of fertilizers	GESZnCl2 1, GESZnCl2 4, GESZnCl2 5
42	Use of ZnCl2-containing fertilizer's formulations	Generic consumer/environment
43	Additive in the formulation of cosmetics	GESZnCl2 1, GESZnCl2 4, GESZnCl2 5
44	Use of cosmetics	GESZnCl2 6, GESZnCl2 7, Generic consumer/environment
45	Additive in the formulation of pharma / veterinary products	GESZnCl2 1, GESZnCl2 4, GESZnCl2 5
46	Use of of Pharma / veterinary products	GESZnCl2 6, GESZnCl2 7, Generic consumer/environment

* corresponds to “GES 8” in IUCLID

9.1.1. GES $ZnCl_2$-0: Industrial use of primary or secondary zinc bearing material in the manufacture of $ZnCl_2$ in several process steps, collection of the substance produced and packaging.

Table 3. GES $ZnCl_2$-0

Exposure Scenario Format (1) addressing uses carried out by workers
9.1.1. Title of Exposure Scenario number GES $ZnCl_2$-0: Industrial use of primary or secondary zinc bearing material in the manufacture of $ZnCl_2$ in several process steps, collection of the substance produced and packaging.
List of all use descriptors related to the life cycle stage and all the uses under it; include market sector (by PC), if relevant; SU: 3, 8, 9 PROC: 2, 3, 8b, 9, 26 PC: 19, 20, 21 AC: not applicable ERC: 1
9.1.1 Exposure Scenario

9.1.1.1 Contributing scenario (1) controlling environmental exposure for the Industrial use of primary or secondary zinc bearing material in the manufacture of $ZnCl_2$ in several process steps, collection of the substance produced and packaging.

The manufacturing process includes:

- Reception of zinc-bearing materials, if applicable, and transfer to the reaction tank (chloride media)
- Reception of the Intermediate Zinc chloride solution in the reaction tank, if applicable
- Sequential addition of reagents for purification steps and filtration on press filter, when needed. Ventilation is adapted.
- Concentration by water evaporation, under exhaust hood.
- Pouring on a cooling belt
- Discharge and packaging of produced zinc chloride crystals. Workers have to place and adjust the bag or drum under the discharge pipe and to set the process in motion. Filled bags or drums are subsequently closed and carried to the storage area.
- Exposure to dust can occur during packing of the powder. Solutions are packed in intermediate bulk containers (ca. 1 m^3 capacity); solids are packed in bags or drums.
- Maintenance activities
-

Product characteristics

Product related conditions:

- ZnCl2 is produced in minimum 80¨purity; higher grades (>95%) are usual.

Amounts used

Daily and annual amount per site:

- maximum 12500 T/y;

Frequency and duration of use

- Continuous production

Environment factors not influenced by risk management

Flow rate of receiving surface water:

- Default is used unless specified otherwise

Other given operational conditions affecting environmental exposure

Other given operational conditions: e.g. technology or process techniques determining the initial release of substance from process (via air and waste water); dry or water based processes; conditions related to temperature and pressure; indoor or outdoor use of products; work in confined area or open air;

- Most of the operations are in wet phase.
- Even when no process waters some non-process water can be generated containing zinc (e.g. from cleaning)
- All processes are performed indoor in a confined area. All residues containing zinc are recycled.

Technical conditions and measures at process level (source) to prevent release

Process design aiming to prevent releases and hence exposure to the environment; this includes in particular conditions ensuring rigorous containment; performance of the containment to be specified (e.g. by quantification of a release factor in section 9.x.2 of the CSR);

- Process enclosures and closed circuits where relevant and possible.
- Local exhaust ventilation on work areas with potential dust generation, dust capturing and removal techniques
- Containment of liquid volumes in sumps to collect/prevent accidental spillage, acid solutions are treated with alkali.
- Higher temperatures (~= 100°C) in the surroundings of the drying units are possible.

Technical onsite conditions and measures to reduce or limit discharges, air emissions and releases to soil

Technical measures, e.g. on-site waste water and waste treatment techniques, scrubbers, filters and other technical measures aiming at reducing releases to air, sewage system, surface water or soil; this includes strictly controlled conditions (procedural and control technology) to minimise emissions; specify effectiveness of measures;
specify the size of industrial sewage treatment plant (m3/d), degradation effectiveness and sludge treatment (if applicable);

- On-site waste water treatment techniques can be applied to prevent releases to water (if applicable) e.g.: chemical precipitation, sedimentation and filtration (efficiency 90-99.98%).

1. Careful use of chlorhydric acid and corrosive chloride solutions

- Containment of liquid volumes in sumps to collect/prevent accidental spillage
- Air emissions are controlled by use of bag-house filters and/or other air emission abatement devices e.g. fabric (or bag) filters (up to 99% efficiency), wet scrubbers (50-99% efficiency). This may create a general negative pressure in the building.

Organizational measures to prevent/limit release from site

Specific organisational measures or measures needed to support the functioning of particular technical measures. Those measures need to be reported in particular for demonstrating strictly controlled conditions.

- In general emissions are controlled and prevented by implementing an integrated management system e.g. ISO 9000, ISO 1400X series, or alike, and, when applicable, by being IPPC-compliant.
  - Such management system should include general industrial hygiene practice e.g.:
    - information and training of workers,
    - regular cleaning of equipment and floors,
    - procedures for process control and maintenance,...
- Treatment and monitoring of releases to outside air, and exhaust gas streams (process & hygiene), according to national regulation.
- SEVESO 2 compliance, if applicable

Conditions and measures related to municipal sewage treatment plant

Size of municipal sewage system/treatment plant (m3/d); specify degradation effectiveness; sludge treatment technique (disposal or recovery); measures to limit air emissions from sewage treatment (if applicable); please note*: the default size of the municipal STP (2000 m_3/d) will be rarely changeable for downstream uses.*

- In cases where applicable: default size, unless specified otherwise.

Conditions and measures related to external treatment of waste for disposal

Fraction of used amount transferred to external waste treatment for disposal; type of suitable treatment for waste generated by work-ers uses, e.g. hazardous waste incineration, chemical-physical treatment for emulsions, chemical oxidation of aqueous waste; specify effectiveness of treatment;

- If any, all hazardous wastes are treated by certified contractors according to EU and national legislation.

Conditions and measures related to external recovery of waste

Fraction of used amount transferred to external waste treatment for recovery: specify type of suitable recovery operations for waste generated by workers uses, e.g. re-distillation of solvents, refinery process for lubricant waste, recovery of slags, heat recovery out-side waste incinerators; specify effectiveness of measure;

- All residues from the wet process are recycled.
- By-products (ashes) from the dry process that are formed in the reactor, are recovered and either recycled in the system or handled further according the waste legislation.
- Users of Zn and Zn-compounds have to favour the recycling channels of the end-of-life products
- Users of Zn and Zn-compounds have to minimize Zn-containing waste, promote recycling routes and, for the remaining, dispose the waste streams according the Waste regulation.

9.1.1.2 Contributing scenario (2) controlling worker exposure for the industrial use of primary or secondary zinc bearing material in the manufacture of $ZnCl_2$ in several process steps, collection of the substance produced and packaging.

Product characteristic

Product related conditions, e.g. the concentration of the substance in a mixture, the physical state of that mixture (solid, liquid; if solid: level of dustiness), package design affecting exposure)

Zinc chloride is hygroscopic in nature and is produced in a dust-free crystalline form (5 mm).

The dustiness of zinc chloride is very low. Total dustiness was measured by the modified Heubach Dust meter to be 1.14 mg/g, with 99.66% of the particles larger than 15.8 µm (Deutsche Montan Technologie, 2000) (RA 2008).

Amounts used

Amounts used at a workplace (per task or per shift); note: sometimes this information is not needed for assessment of worker's expo-sure Maximum 96 T/day, 32T/shift
Frequency and duration of use/exposure
Duration per task/activity (e.g. hours per shift) and frequency (e.g. single events or repeated) of exposure 8hrs shift
Human factors not influenced by risk management
Particular conditions of use, e.g. body parts potentially exposed as a result of the nature of the activity Uncovered body parts: (potentially) face
Other given operational conditions affecting workers exposure
Other given operational conditions: e.g. technology or process techniques determining the initial release of substance from process into workers environment; room volume, whether the work is carried out outdoors/indoors, process conditions related to temperature and pressure. • All processes are carried out indoor in confined areas.
Technical conditions and measures at process level (source) to prevent release
Process design aiming to prevent releases and hence exposure of workers; this in particular includes conditions ensuring rigorous containment; performance of containment to be specified (e.g. by quantification of residual losses or exposure) • Local exhaust ventilation on furnaces and other work areas with potential dust generation, dust capturing and removal techniques • Process enclosures closed circuits or semi-enclosures where appropriate. 2. Careful use of chlorhydric acid and corrosive chloride solutions • Containment of liquid volumes in sumps to collect/prevent accidental spillage • Local exhaust ventilation on furnaces and other work areas with potential dust and fumes generation, dust capturing and removal techniques.
Technical conditions and measures to control dispersion from source towards the worker
Engineering controls, e.g. exhaust ventilation, general ventilation; specify effectiveness of measure • Local exhaust ventilation systems (generic LEC (84%) as worst case; higher efficiencies (90-95%) are usual • Cyclones/filters (for minimizing dust emissions) : efficiency: 70-90% (cyclones), 50-80% (dust filters), 85-95% (double stage, cassette filters) • Process enclosure, especially in potentially dusty units • Dust control: dust and Zn in dust needs to be measured in the workplace air (static or individual) according to national regulations. • Special care for the general establishment and maintenance of a clean working environment by e.g.:   • Cleaning of process equipment and workshop • Storage of packaged Zn product in dedicated zones
Organisational measures to prevent /limit releases, dispersion and exposure
Specific organisational measures or measures needed to support the functioning of particular technical measures (e.g. training and supervision). Those measures need to be reported in particular for demonstrating strictly controlled conditions (to justify exposure based waiving). In general integrated management systems are implemented at the workplace e.g. ISO 9000, ISO-ICS 13100, or alike, and are, when appropriate, IPPC-compliant.

Such management system would include general industrial hygiene practice e.g.:
- information and training of workers on prevention of exposure/accidents,
- procedures for control of personal exposure (hygiene measures)
- regular cleaning of equipment and floors, extended workers instruction-manuals
- procedures for process control and maintenance,...
- personal protection measures (see below)

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

Personal protection, e.g. wearing of gloves, face protection, full body dermal protection, goggles, respirator; specify effectiveness of measure; specify the suitable material for the PPE (where relevant) and advise how long the protective equipment can be used before replacement (if relevant)

Wearing of gloves and protective clothing is compulsory (efficiency >=90%).

With normal handling, no respiratory personal protection (breathing apparatus) is necessary. If risk for exceedance of OEL/DNEL, use e.g.:

-dust filter-half mask P1 (efficiency 75%)

-dust filter-half mask P2 (efficiency 90%)

-dust filter-half mask P3 (efficiency 95%)

-dust filter-full mask P1 (efficiency 75%)

-dust filter-full mask P2 (efficiency 90 %)

-dust filter-full mask P3 (efficiency 97.5%)

Eyes: safety glasses are optional

Exposure estimation and risk characterisation

1. Environment

The risk assessment (RA) on $ZnCl_2$ (ECB 2008) assessed the risks manufacture of $ZnCl_2$ based on reported data that are summarised in table below. The dataset was updated with more recent data, that are also included.

Table 4. Environmental risk characterisation for the manufacture of $ZnCl_2$

Data from the EU RA	tonnage	Cadd*/PNEC** water	Cadd/PNEC** sediment	PEC/PNEC soil	PEC/PNEC STP
ZnCl2 manufacture (RA: 5 companies, cfr table 3.4.10)					
1***	6100	2.2	20 (8.3)	0.02	Not applicable
2	5700	0.001	0.002	0.02	1.1
3	3700	0.14	2.6 (1)	0.02	3.8
4	12500	0.02	0.3	0.02	0.02
5	588	0.56	10 (4.2)	0.02	2.6
*Recent data**** *		PEC/PNEC water	PEC/PNEC sediment		
Company A	6500				
WWTP		0.18	0.3	0.39	NA
cooling		0.62	4.5*****	0.39	NA
Company B	15000	0.17	0.23	0.39	NA

*In the RAs, “Cadd” the “added concentration by the emissions at a given site was used for the risk characterisation. As such, the risks related to the local emissions at the site were assessed only, without the added exposure from the regional background.

**the risk ratios are those cited in the RA, i.e. with the PNECs derived in the RA; between brackets: risk ratio with updated PNEC.

*** no on site WWTP or STP

**** for the recent data, the regional exposure was taken into account (PEC/PNEC).

*****internal recycling of cooling waters followed by WWTP treatment is planned.

Table 5. Exposure assessment for the industrial manufacture ZnCl2 , recently reported data

$ZnCl_2$ manufacture	PEC water (µg Zn/l)	PEC sediment mg Zn/kgDW)	PEC soil (mg Zn/kgDW)	PEC STP (mg Zn/l)
Company A				
WWTP	3.6	70	42	NA
Cooling	12.7	1053	42	NA
Company B	3.5	54.4	41	NA

Conclusion: based on the available data from the risk assessment and recently measured data, the risk ratios demonstrate no risk for the water and soil, but risk for the sediment in a few cases. In the sediment, the bioavailability of zinc will be determined by the content of acid volatile sulphide (AVS). It has been documented that there is covariance between zinc in sediment and AVS. In cases where AVS and sediment-Zn were measured near industrial sites, there was indeed a surplus on AVS observed, rendering the zinc present at that site non-bioavailable. Whether or not this phenomenon is also present at the sites mentioned in table above, can only be confirmed by local measurements.

In any case, the data show that there are production sites for $ZnCl_2$ for which no risk for the environment is calculated. It is concluded that, when the risk management measures described in this scenario are applied, no risk is predicted for environment, (including sediment) for the manufacture of $ZnCl_2$ (e.g., it is noted that at site A reporting recent data, the emission from cooling waters will be replaced by internal recycling of these waters, with connection to the on-site WWTP. The emissions from the latter process don't result in risk).

Calculation of local exposure- Bioavailability correction

The local exposure at a given site can be calculated specifically using the excel sheet prepared by Arche (see "tools" on http://www.reach-zinc.eu/)

In addition, bioavailability corrections can be integrated in the exposure assessment, if the environmental parameters that are needed for the calculations, are documented.

- For water assessment, bioavailability model correction can be applied when the following water parameters are documented for the receiving water: Dissolved organic carbon (DOC), pH, hardness or Ca-concentration. For the calculations, the "zinc BLM-calculator" excel tool is used to this end (see "tools" on http://www.reach-zinc.eu/). When the local values of these parameters are unknown, regional data can be used as an alternative. Use of regional instead of local values should always be handled with caution.
- For sediment, a generic bioavailability factor of 2 is already integrated in the PNEC, based on AVS/SEM levels and according to the risk assessment (ECB 2008). A further refinement of local bioavailability can be made when local AVS/SEM concentrations are documented. The bioavailable fraction of zinc is given by subtracting local AVS from local SEM-Zn (SEM-Zn - AVS).
- For soil, a worst case bioavailability correction (corresponding to sandy soils) is already integrated. Further refinement for zinc bioavailability in other soil types is possible, when the local soil type is documented, together with pH, CEC (see "tools" on http://www.reach-zinc.eu/)

2. Workers

Occupational exposure to zinc chloride is possible due to emissions from parts of the process when solid, dusty zinc chloride is already formed. The packaging and repackaging of the produced zinc chloride in bags, big bags or bulk tankers may lead to contamination of the facility and to exposure (direct or indirect) of workers, by inhalation and dermal contact.

Pulmonary absorption may occur but most of the material that is deposited in the head and the tracheobronchial region is rapidly translocated to the GI tract and part of it will be absorbed in the GI tract.

The particle size of $ZnCl_2$ is however rather large (99.66% larger than 15.8 µm).

In the RA on $ZnCl_2$, an exposure assessment was made based on reported data from 3 companies. The general conclusion was that no risks were observed (see table below)

Table 6. Occupational exposure data and risk characterisation for manufacture of zinc compounds

RA data (RA ZnCl2, table 4.1.3.2A)	Zn in workplace air (mg/m3) total inhalable	Risk ratio inhalation***	Systemic inhalation exposure (mg/d)*	Risk ratio systemic inhalation	Systemic dermal **(mg/d)	Risk ratio systemic total
3 companies	0.2	0.2	0.8	0.2	0.4	0.12

* assuming a respiratory absorption of 40% for ZnCl2/ZnSO4 and 20% for ZnO and other zinc compounds, and an inhalation volume of 10m3

** assuming a dermal absorption of 0.2% for dust, no wearing of gloves assumed

***DNEL inhalation for ZnCl2 is 1.0 mg/m3

Conclusion: based on the data from the risk assessment, and in accordance to the conclusion drawn in the RA, there is no risk predicted for workers for this scenario if the risk management measures as described in the scenario are applied.

9.1.2. GES $ZnCl_2$-1: Industrial use of $ZnCl_2$ in the formulation of preparations by mixing thoroughly, dry or in a solvent, the starting materials with potentially pressing, pelletising, sintering, possibly followed by packing

Table 7. GES $ZnCl_2$-1

Exposure Scenario Format (1) addressing uses carried out by workers
9.1.2. Title of Exposure Scenario number $ZnCl_2$ GES-1: Industrial use of $ZnCl_2$ in the formulation of preparations by mixing thoroughly, dry or in a solvent, the starting materials with potentially pressing, pelletising, sintering, possibly followed by packing .
List of all use descriptors related to the life cycle stage and all the uses under it; include market sector (by PC), if relevant; ***SU: 3,10*** ***PROC: 1,2,3,4,5, 8b,9,13, 14, 15, 22*** ***PC: Not applicable*** ***AC: not applicable*** ***ERC: 1,2***
Further explanations (if needed) $ZnCl_2$ is used in the manufacture of preparations by mixing thoroughly the starting materials, followed by direct use of packaging of the preparation. Many different industrial uses are characterised by this process. Therefore these industrial uses are all covered by this generic exposure scenario.
9.1.2 Exposure Scenario
9.1.2.1. Contributing scenario (1) controlling environmental exposure for the Industrial use of $ZnCl_2$ in the formulation of preparations by mixing thoroughly, dry or in a solvent, the starting materials with potentially pressing, pelletising, sintering, possibly followed by packing .
Further specification: In the described process, the zinc chloride is: • Removed from the packaging and stored in silos after delivery. • Extracted from the silo, dosed and fed with the other reagents to the mixing tank. Mixing occurs batch-wise or continuously, according the process receipt. The mixing occurs in a closed tank/chamber. • The preparation (dry or wet (solvent/paste) matrix) is further used as such or packed for further treatment/use.
Product characteristics
Product related conditions: $ZnCl_2$ is used in minimum 80% purity; higher grades (>95%) are usual
Amounts used
Daily and annual amount per site: maximum 5000 T/y;
Frequency and duration of use
Continuous production is assumed as a worst case. It is possible that use is not continuous; this has to be considered when estimating exposure.

Environment factors not influenced by risk management
Flow rate of receiving surface water: default for generic scenario: 18,000 m3/d, unless specified otherwise
Other given operational conditions affecting environmental exposure
Other given operational conditions: e.g. technology or process techniques determining the initial release of substance from process (via air and waste water); dry or water based processes; conditions related to temperature and pressure; indoor or outdoor use of products; work in confined area or open air; • All processes are performed indoor in a confined area. All residues containing zinc are recycled. • Even when no process waters (e.g. when dry process throughout), some non-process water can be generated containing zinc(e.g. from cleaning)
Technical conditions and measures at process level (source) to prevent release
Process design aiming to prevent releases and hence exposure to the environment; this includes in particular conditions ensuring rigorous containment; performance of the containment to be specified (e.g. by quantification of a release factor in section 9.x.2 of the CSR); • Process enclosures and closed circuits where relevant and possible. • Dust capturing and removal techniques are applied on local exhaust ventilation on furnaces and other work areas with potential dust generation. • Containment of liquid volumes in sumps to collect/prevent accidental spillage
Technical onsite conditions and measures to reduce or limit discharges, air emissions and releases to soil
Technical measures, e.g. on-site waste water and waste treatment techniques, scrubbers, filters and other technical measures aiming at reducing releases to air, sewage system, surface water or soil; this includes strictly controlled conditions (procedural and control technology) to minimise emissions; specify effectiveness of measures; *specify the size of industrial sewage treatment plant (m3/d), degradation effectiveness and sludge treatment (if applicable);* • On-site waste water treatment techniques can be applied to prevent releases to water (if applicable) e.g.: chemical precipitation, sedimentation and filtration (efficiency 90-99.98%). • Air emissions are controlled by use of bag-house filters and/or other air emission abatement devices e.g. fabric (or bag) filters (up to 99% efficiency), wet scrubbers (50-99% efficiency). This may create a general negative pressure in the building.
Organizational measures to prevent/limit release from site

Specific organisational measures or measures needed to support the functioning of particular technical measures. Those measures need to be reported in particular for demonstrating strictly controlled conditions.
 	
• In general emissions are controlled and prevented by implementing an integrated management system e.g. ISO 9000, ISO 1400X series, or alike, and, when applicable, by being IPPC-compliant.
    o Such management system should include general industrial hygiene practice e.g.:
        ▪ information and training of workers,
        ▪ regular cleaning of equipment and floors,
        ▪ procedures for process control and maintenance,...
• Treatment and monitoring of releases to outside air, and exhaust gas streams (process & hygiene), according to national regulation.
• SEVESO 2 compliance, if applicable

Conditions and measures related to municipal sewage treatment plant
Size of municipal sewage system/treatment plant (m3/d); specify degradation effectiveness; sludge treatment technique (disposal or recovery); measures to limit air emissions from sewage treatment (if applicable); please note*: the default size of the municipal STP (2000 m3/d) will be rarely changeable for downstream uses.* • In cases where applicable: default size, unless specified otherwise.
Conditions and measures related to external treatment of waste for disposal
Fraction of used amount transferred to external waste treatment for disposal; type of suitable treatment for waste generated by work-ers uses, e.g. hazardous waste incineration, chemical-physical treatment for emulsions, chemical oxidation of aqueous waste; specify effectiveness of treatment; • If any, all hazardous wastes are treated by certified contractors according to EU and national legislation. • Users of Zn and Zn-compounds have to favour the recycling channels of the end-of-life products

- Users of Zn and Zn-compounds have to minimize Zn-containing waste, promote recycling routes and, for the remaining, dispose the waste streams according the Waste regulation.

Conditions and measures related to external recovery of waste

Fraction of used amount transferred to external waste treatment for recovery: specify type of suitable recovery operations for waste generated by workers uses, e.g. re-distillation of solvents, refinery process for lubricant waste, recovery of slags, heat recovery out-side waste incinerators; specify effectiveness of measure;

- All residues are recycled or handled and conveyed according to waste legislation. .

9.1.2.2. Contributing scenario (2) controlling worker exposure for the Industrial use of $ZnCl_2$ in the formulation of preparations by mixing thoroughly, dry or in a solvent, the starting materials with potentially pressing, pelletising, sintering, possibly followed by packing .

Further specification

$ZnCl_2$ is used in the manufacture of preparations by mixing thoroughly the starting materials, followed by direct use of packaging of the preparation. Many different industrial uses are characterised by this process. Therefore these industrial uses are all covered by this generic exposure scenario.

Product characteristic

Product related conditions, e.g. the concentration of the substance in a mixture, the physical state of that mixture (solid, liquid; if solid: level of dustiness), package design affecting exposure)

- The concentration of $ZnCl_2$ in the mixtures can cover a broad range (<= 5% up to >25%) depending on the application.
- The preparation can be solid or liquid.
- When the preparation is in solid state, it can be in a) powdery, b) glassy or c) pelletized form. In the powder form, it can be characterised by high dustiness in a worst case situation.

Amounts used

Amounts used at a workplace (per task or per shift); note: sometimes this information is not needed for assessment of worker's expo-sure

Max 5000T/y = 14T/d = 5T/shift depending on the application.

Frequency and duration of use/exposure

Duration per task/activity (e.g. hours per shift) and frequency (e.g. single events or repeated) of exposure

8 hour shifts (default worst case) are assumed as starting point; it is emphasised that the real duration of exposure could be less. This has to be considered when estimating exposure.

Human factors not influenced by risk management

Particular conditions of use, e.g. body parts potentially exposed as a result of the nature of the activity

Uncovered body parts: (potentially) face

Other given operational conditions affecting workers exposure

Other given operational conditions: e.g. technology or process techniques determining the initial release of substance from process into workers environment; room volume, whether the work is carried out outdoors/indoors, process conditions related to temperature and pressure.

- elevated temperature steps (~=100°C) can occur
- all indoor processes in confined area.

Technical conditions and measures at process level (source) to prevent release

Process design aiming to prevent releases and hence exposure of workers; this in particular includes conditions ensuring rigorous containment; performance of containment to be specified (e.g. by quantification of residual losses or exposure)

- Process enclosures and closed circuits where relevant and possible.
- Local exhaust ventilation on furnaces and other work areas with potential dust generation, dust capturing and removal

techniques.

- Containment of liquid volumes in sumps to collect/prevent accidental spillage

Technical conditions and measures to control dispersion from source towards the worker

Engineering controls, e.g. exhaust ventilation, general ventilation; specify effectiveness of measure

- Local exhaust ventilation systems (high efficiency 90-95%)
- Cyclones/filters (for minimizing dust emissions) : efficiency: 70-90% (cyclones), 50-80% (dust filters), 85-95% (double stage, cassette filters)
- Process enclosure, especially in the drying /calcination / packaging (potentially dusty) units
- Dust control: dust and Zn in dust needs to be measured in the workplace air (static or individual) according to national regulations.
- Special care for the general establishment and maintenance of a clean working environment by e.g.:
    - Cleaning of process equipment and workshop
- Storage of packaged Zn product in dedicated zones

Organisational measures to prevent /limit releases, dispersion and exposure

In general integrated management systems are implemented at the workplace e.g. ISO 9000, ISO-ICS 13100, or alike, and are, when appropriate, IPPC-compliant.

Such management system would include general industrial hygiene practice e.g.:
- information and training of workers on prevention of exposure/accidents,
- procedures for control of personal exposure (hygiene measures)
- regular cleaning of equipment and floors, extended workers instruction-manuals
- procedures for process control and maintenance,...
- personal protection measures (see below)

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

Personal protection, e.g. wearing of gloves, face protection, full body dermal protection, goggles, respirator; specify effectiveness of measure; specify the suitable material for the PPE (where relevant) and advise how long the protective equipment can be used before replacement (if relevant)

Wearing of gloves and protective clothing is compulsory (efficiency >=90%).
With normal handling, no respiratory personal protection (breathing apparatus) is necessary. If risk for exceedance of OEL/DNEL, use e.g.:
-dust filter-half mask P1 (efficiency 75%)
-dust filter-half mask P2 (efficiency 90%)
-dust filter-half mask P3 (efficiency 95%)
-dust filter-full mask P1 (efficiency 75%)
-dust filter-full mask P2 (efficiency 90 %)
-dust filter-full mask P3 (efficiency 97.5%)

Eyes: safety glasses are optional

Exposure estimation and risk characterisation

1. <u>Environment</u>

The processes involved in this scenario can be dry or wet. Even when no process waters are involved, occasional non-process-waters can occur having some zinc content, due to e.g. dust cleaning. Therefore, all formulation processes with $ZnCl_2$ and other zinc compounds should have some form of water treatment, on site or off-site, according to national legislation and permits.

The risk assessments on zinc and zinc compounds reported measured exposure data on a number of sectors falling under this scenario. In most cases, a) the formulation of the substance into the dry or wet preparation/mixture and b) the further industrial use of the preparation/mixture are integrated at the same industrial site. For this reason, environmental emissions data are integrating both process steps, and encompass the GES-1 and GES-4/GES-5. Exposure related to the formulation of the pure $ZnCl_2$ is considered to be the most critical, because the substance is used in its pure state.

The risk assessments (RAs) on several zinc compounds (ECB 2008) assessed the risks related to the industrial use of $ZnCl_2$ (and other zinc compounds) for the formulation of $ZnCl_{2-}$ (Zn-compound) containing preparations, based on reported data. The resulting risk characterisations are summarized in table below. Distinction is being made between assessments based on measured data, and assessments based on modelling, using default release factors.
Table below also summarizes the risk characterisation based on more recent data on manufacture of other compounds. The exposure estimates based on these more recent data are summarized in the second table below.

Table 8. Environmental risk characterisation for the Industrial use of ZnCl2 as component for the manufacture of preparations for further downstream use.

assessments from the EU RA by sector of use*	PEC/PNEC water	PEC/PNEC sediment (**)	PEC/PNEC soil	PEC/PNEC STP
ZnCl2 (table3.4.10., RA ZnCl2, ECB 2008)				
Assessment based on measured data				
Agrochemical industry processing (1 single EU production site)	0.03	0.51	0.02	0.39
Battery industry (1 company)	0	0	0.02	0
Assessments based on modelling				
Chemical industry: processing	0.19	1.7 (0.7)	19	47
Battery industry: processing	0.16	1.4 (0.6)	0.2	0.15
Dyes and inks industry: formulation	5.3	48 (20)	2.0	4.9
Dyes and inks industry: formulation	150	1343 (560)	56	138
Additional recent data* **				
Fertiliser manufacture				
Company A	0.16	0.19	0.39	0

*PNECs from the RA are applied, integrating for sediment the generic bioavailability factor 0.5 and for soil the generic bioavailability factor 0.33 (RA, ECB 2008); Risk ratios for water and sediment are Cadd/PNEC; for STP and soil risk ratios are PEC/PNEC.

**PEC/PNEC ratios for sediment between brackets apply the updated PNEC and generic bioavailability factor of the RA

***all risk ratios are PEC/PNECs

Table 9. Exposure assessment for the industrial use of ZnCl2 for the manufacture of wet or dry preparations, based on recently reported exposure data.

	PEC water (µg Zn/l)	PEC sediment mg Zn/kgDW)	PEC soil (mg Zn/kgDW)	PEC STP (mg Zn/l)
Fertiliser manufacture				
Company A	3.4	45	41	0

Conclusion

When local risks are assessed using measured emissions data, no risk for the environment is generally described for the formulation processes using $ZnCl_2$. Also recent data on fertiliser manufacture show no risk. Only when default release factors are applied (assessment based on modelling), risks are calculated. The measured data however overrule these modelled results, so it is concluded based on the measured data that there is no risk for the environment from this scenario, when risk management measures, as described, are applied.

The "no risk" conclusion on the environmental assessment of formulation of $ZnCl_2$ is confirmed by data on formulation with other zinc substances, see table below.

Table 10. Environmental risk characterisation for the industrial use of Zn compounds as component for the manufacture of preparations for further downstream use.

assessments from the EU RA by sector of use*	PEC/PNEC water	PEC/PNEC sediment (**)	PEC/PNEC soil	PEC/PNEC STP
ZnS04 (table3.4.10., RA ZnSO4, ECB 2008)				
Assessment based on measured data				
Agricultural feed industry	**0**	0	0.02	0
Assessments based on modelling				
Agricultural pesticide industry	0.11	1	11	26
Agricultural fertiliser industry	19	175	7.3	18
Agricultural feed industry	1.0	9	0.4	0.94
Chemical industry: processing	0.19	1.7	19	47
ZnO (table3.4.33. RA ZnO, ECB 2008)				
Assessment based on measured data				
Tyre industry: processing	0	0	0.15	0
General rubber industry: processing	0	0	0.08	0
Ceramic industry processing typical plant average	0	0	0.14	0
Ceramic industry processing typical plant range	0	0	0.06-0.38	0
Ferrites industry (average of 4 (out of 5) plants	0.27	2.5 (1.0)	0.4	0.25
Varistors (average of 2 (out of 4) plants***	0.06	1.2 (0.5)	0.09	0.06
Catalysts processing****	<4.9	<45	0.02	<4.5
Feedstuff additive: formulation (site specific)	0	0	0.02	0
Feedstuff additive: formulation (generic average use)	0	0	0.03	0
Feedstuff additive: formulation (generic largest use use)	0	0	0.05	0
Paints: formulation	0	0	0.02	0
Paints: processing (industry data)	0	0	0.02	0
Assessments based on modelling				
Glass industry: processing (average use)	2.5	23	0.93	2.3
Glass industry: processing (largest use)	6.3	57	2.4	5.8
Lubricants: formulation (average use)	7.5	67	2.7	6.9
Lubricants: formulation (largest use)	13	118	5	12
Paints/ processing: generic data	1.6	14	0.6	1.5
Cosmetics pharmaceuticals: formulation (average use)	2.5	23	0.93	2.3
Cosmetics pharmaceuticals: formulation (largest use)	21	188	8	19
Zn phosphate (table3.4.9., RA Zn phosphate, ECB 2008)				
Assessment based on measured data				
Paint industry (average from 3 of 5 sites reported)*****	0.19	1.7 (0.35)	Not calculated	0.35
Assessments based on modelling				
Paint industry: formulation	8.3	75	3.1	7.7
Paint industry: processing, solvent borne	0.23	2.1	0.28	0.21
Paint industry: processing, water borne	1.2	11	0.43	1.1

*PNECs from the RA are applied, integrating for sediment the generic bioavailability factor 0.5 and for soil the generic bioavailability factor 0.33 (RA, ECB 2008); Risk ratios for water and sediment are Cadd/PNEC; for STP and soil risk ratios are PEC/PNEC.

**PEC/PNEC ratios for sediment between brackets apply the updated PNEC and generic bioavailability factor of the RA

***data from site 3 (showing as only risk ratios>1), not considered, because it was explicitly mentioned that no WWTP or STP was present (RA ZnO).

****calculations from concentration in waste water reported as "<1mg Zn/l" (value of 1mg/l taken as maximum) For the one case with risk based on measured data observed in the RA, the catalysts producing sector, extensive additional data were generated; they demonstrate the absence of risks (see GES 1 ZnO).

*****Only reliable data are used, where the truly measured emission and/or effluent concentration was reported

Calculation of local exposure- Bioavailability correction

The local exposure at a given site can be calculated specifically using the excel sheet prepared by Arche (see "tools" on http://www.reach-zinc.eu/)

In addition, bioavailability corrections can be integrated in the exposure assessment, if the environmental parameters that are needed for the calculations, are documented.

- For water assessment, bioavailability model correction can be applied when the following water parameters are documented for the receiving water: Dissolved organic carbon (DOC), pH, hardness or Ca-concentration. For the calculations, the "zinc BLM-calculator" excel tool is used to this end (see "tools" on http://www.reach-zinc.eu/). When the local values of these parameters are unknown, regional data can be used as an alternative. Use of regional instead of local values should always be handled with caution.
- For sediment, a generic bioavailability factor of 2 is already integrated in the PNEC, based on AVS/SEM levels and according to the risk assessment (ECB 2008). A further refinement of local bioavailability can be made when local AVS/SEM concentrations are documented. The bioavailable fraction of zinc is given by subtracting local AVS from local SEM-Zn (SEM-Zn - AVS).
- For soil, a worst case bioavailability correction (corresponding to sandy soils) is already integrated. Further refinement for zinc bioavailability in other soil types is possible, when the local soil type is documented, together with pH, CEC (see "tools" on http://www.reach-zinc.eu/)

2. Workers

When blending/mixing $ZnCl_2$ or other zinc compounds in a wet or dry preparation, occupational exposure is possible due to dust generation at several steps of the process. The highest potential for dust generation/exposure is at the unpacking of the dry $ZnCl_2$-powder and its mixing into the preparation matrix. At this stage mainly, dusts may lead to contamination of the facility and to exposure (direct or indirect) of workers, by inhalation and dermal contact.

Pulmonary absorption may occur but most of the material that is deposited in the head and the tracheobronchial region is rapidly translocated to the GI tract and part of it will be absorbed in the GI tract. $ZnCl_2$ has however not so small particle size (99.66% of the particles larger than 15.8 µm).The size of the dry preparations is dependent on the application.

For assessing of worker exposure to zinc in formulation processes, exposure to high dustiness pure $ZnCl_2$ at the unpacking stage is assumed as a worst case.

The RA ZnSO4 (ECB 2008) mentions some measured data on ZnO related to this specific activity. These data can be used as worst case scenario for the coarser, hygroscopic $ZnCl_2$, and are given below. In addition, the workers exposure during $ZnCl_2$ production ($ZnCl_2$ GES-0) is also given as worst case similar scenario (second table below). Dermal exposure is modelled, assuming high dustiness as a worst case, but implementing the wearing of gloves.

Table 11. Occupational exposure data and risk characterisation for the Industrial formulation of dry or wet preparations/mixtures by mixing thoroughly ZnCl2 or other zinc compound with the other starting materials, with possible pressing, pelletising, sintering and packaging of the preparations/mixtures.

Data from ZnSO4 RA:Sector	activity	8-hrs Inhalation exposure (mg Zn/m3)	Risk ratio inhalation**	Inhalation exposure systemic (mg Zn/d)	Dermal exposure (modelled) systemic (mg/d)	Risk ratio systemic
Paint industry*	Emptying of ZnO from big bags into dispensers	0.17-0.28	0.03-0.06	0.34-0.56	0.2	0.05-0.07
	Loading powders from 25kg big bags into dispensers	0.1-0.5 Average: 0.29	0.02-0.1 Average: 0.06	0.2-1.0 0.58	0.2	0.04-0.12 0.08
	Loading powders from big bags into dispensers	0.01-1.34 Average 0.27	0.002-0.3 Average 0.0.05	0.02-2.68 0.54	0.2	0.02-0.3 0.07
Ceramics (1 company)	ZnO loaded from bulk transport to bulk storage	0.1-0.98	0.02-0.2	0.2-2.0	0.2	0.04-0.2
ZnO production, dry	Manufacture: contributing scenario 1 (ref ZnO GES-0)	50P: 0.33 90P: 2.0	50P: 0.06 90P: 0.4	50P: 0.66 90P: 4.0	0.05	50P: 0.07 90P: 0.4
Recent data: sector						
Catalyst production	Emptying of containers	Mean: 0.37 Range: <0.001-1.07	Mean: 0.07 Range: <0.0002-0.2	0.74	0.2	0.09

*values are for total dust; exposure to dust for short duration; data extrapolated to 8hrs exposure

**DNEL inhalation for ZnCl2/ZnSO4 and other soluble zinc substances is 1.0 mg/m3; for ZnO and other slightly soluble/ insoluble zinc substances: 5mg/m3

Table 12. Occupational exposure data and risk characterisation for the scenario “the industrial use of ZnO for the manufacture of $ZnCl_2$” ($ZnCl_2$ GES-0)

RA data (RA ZnCl2, table 4.1.3.2A)	Zn in workplace air (mg/m3) total inhalable	Risk ratio inhalation***	Systemic inhalation exposure (mg/d)*	Risk ratio inhalation systemic	Systemic dermal **(mg/d)	Risk ratio systemic total
3 companies	0.2	0.2	0.8	0.08	0.4	0.12

* assuming a respiratory absorption of 40% for ZnCl2/ZnSO4 and 20% for ZnO and other zinc compounds, and an inhalation volume of 10m3

** assuming a dermal absorption of 0.2% for dust, no wearing of gloves assumed

***DNEL inhalation for ZnCl2/ZnSO4 and other soluble zinc substances is 1.0 mg/m3; for ZnO and other slightly soluble/ insoluble zinc substances: 5mg/m3

Conclusion: based on measured data from the RA, data from similar worst case scenario (dry ZnO manufacture), and additional recent measured data, no risk is demonstrated/predicted following the risk management measures indicated.

9.1.3. GES $ZnCl_2$-2: industrial use of zinc chloride or $ZnCl_2$-formulations in the manufacturing of other inorganic or organic zinc substances in a solvent-based matrix with potentially filtering and packaging.

Table 13. GES $ZnCl_2$-2

Exposure Scenario Format (1) addressing uses carried out by workers
9.1.3. Title of Exposure Scenario number GES $ZnCl_2$-2: industrial use of zinc chloride or $ZnCl_2$-formulations in the manufacturing of other inorganic or organic zinc substances in a solvent-based matrix with potentially filtering and packaging.
List of all use descriptors related to the life cycle stage and all the uses under it; include market sector (by PC), if relevant; • SU: 3, 8, 9, 10, 14, 15, 17, 0 (Nace C24.4.3., E38.3, C25.6.1.) • PROC: 1, 2, 3, 5, 8b, 9, 13, 15, 21, 22, 23, 26 • PC : 7, 14, 19, 20, 21, 24, 29, 39 • AC : 2, 7, 12 • ERC : 1, 2, 5, 6a
Further explanations (if needed) $ZnCl_2$ is used as a starting material for the manufacturing of several other inorganic and organic zinc compounds. All the manufacturing processes are covered by the present scenario.
9.1.3. Exposure Scenario
9.1.3.1. Contributing scenario (1) controlling environmental exposure for the industrial use of zinc chloride or $ZnCl_2$-formulations in the manufacturing of other inorganic or organic zinc substances in a solvent-based matrix with potentially filtering and packaging.
Further specification Description of activities/process(es) covered in the Exposure Scenario • Reception of the $ZnCl_2$ or $ZnCl_2$-containing formulation, or $ZnCl_2$-bearing raw material in the reaction tank • Sequential addition of reagents for purification steps and filtration on press filter, when needed (ventilation is adapted). • Concentration by water evaporation, under exhaust hood, is optional. • Possible pouring on a cooling belt, is optional as well • Discharge and packaging of produced zinc compounds. Workers have to place and adjust the bag or drum under the discharge pipe and to set the process in motion. Filled bags or drums are subsequently closed and carried to the storage area. • Exposure to dust can occur during packing of the powder. Solutions are packed in intermediate bulk containers (ca. 1 m^3 capacity), solid products are packed in bags or drums. • Maintenance activities
Product characteristics
Product related conditions, e.g. the concentration of the substance in a mixture; viscosity of product; package design affecting expo-sure Zn-compounds are produced in their pure form e.g.: >99%, or in solution.
Amounts used

Daily and annual amount per site (for uses in industrial setting) or daily and annual amount for wide disperse uses; Up to 75 T/d of $ZnCl_2$ is transformed to equivalent Zn compound
Frequency and duration of use
Intermittent (used < 12 times per year for not more than 24 h) or continuous use/release Continuous production is assumed as a worst case. It is possible that use is not continuous; this has to be considered when estimating exposure.
Environment factors not influenced by risk management
Flow rate of receiving surface water (m3/d, usually 18,000 m3/d for the standard town by default; please note*: the default flow rate will be rarely changeable for downstream uses.* Default for generic scenario: 18,000 m3/d, unless specified otherwise
Other given operational conditions affecting environmental exposure
Other given operational conditions: e.g. technology or process techniques determining the initial release of substance from process (via air and waste water); dry or water based processes; conditions related to temperature and pressure; indoor or outdoor use of products; work in confined area or open air; • Wet processes (leaching, filtering, purification) followed by drying (possible grinding), and packaging; • All indoor processes, in confined area.
Technical conditions and measures at process level (source) to prevent release
Process design aiming to prevent releases and hence exposure to the environment; this includes in particular conditions ensuring rigorous containment; performance of the containment to be specified (e.g. by quantification of a release factor in section 9.x.2 of the CSR); • Careful use of acids and corrosive solutions, if used • Sump containment is provided under the tanks and the filters i.o. to collect any accidental spillage • When applicable, process waters need to be specifically treated before release • Dosing and packaging operations occur under a special ventilation hood • Process air is filtered before release outside the building
Technical onsite conditions and measures to reduce or limit discharges, air emissions and releases to soil
Technical measures, e.g. on-site waste water and waste treatment techniques, scrubbers, filters and other technical measures aiming at reducing releases to air, sewage system, surface water or soil; this includes strictly controlled conditions (procedural and control technology) to minimise emissions; specify effectiveness of measures; *specify the size of industrial sewage treatment plant (m3/d), degradation effectiveness and sludge treatment (if applicable);* • On-site waste water treatment techniques are (if applicable) e.g.: chemical precipitation, sedimentation, filtration (efficiency 90-99.98%). • Containment of liquid volumes in sumps to collect/prevent accidental spillage • Air emissions are controlled by use of bag-house filters and/or other air emission abatement devices e.g. fabric (or bag) filters (up to 99% efficiency), wet scrubbers (50-99% efficiency). This may create a general negative pressure in the building. Air emissions are continuously monitored.
Organizational measures to prevent/limit release from site

Specific organisational measures or measures needed to support the functioning of particular technical measures. Those measures need to be reported in particular for demonstrating strictly controlled conditions.
 	
• In general emissions are controlled and prevented by implementing an integrated management system e.g. ISO 9000, ISO 1400X series, or alike, and, when applicable, by being IPPC-compliant.
    o Such management system should include general industrial hygiene practice e.g.:
        ▪ information and training of workers,
        ▪ regular cleaning of equipment and floors,
        ▪ procedures for process control and maintenance,...
• Treatment and monitoring of releases to outside air, and exhaust gas streams (process & hygiene), according to national regulation.
• SEVESO 2 compliance, if applicable

Conditions and measures related to municipal sewage treatment plant

Size of municipal sewage system/treatment plant (m3/d); specify degradation effectiveness; sludge treatment technique (disposal or recovery); measures to limit air emissions from sewage treatment (if applicable); please note*: the default size of the municipal STP (2000 m3/d) will be rarely changeable for downstream uses.*

- In cases where applicable: default size, unless specified otherwise.

Conditions and measures related to external treatment of waste for disposal

Fraction of used amount transferred to external waste treatment for disposal; type of suitable treatment for waste generated by work-ers uses, e.g. hazardous waste incineration, chemical-physical treatment for emulsions, chemical oxidation of aqueous waste; specify effectiveness of treatment;

- If any, all hazardous wastes are treated by certified contractors according to EU and national legislation.
- Users of Zn and Zn-compounds have to favour the recycling channels of the end-of-life products
- Users of Zn and Zn-compounds have to minimize Zn-containing waste, promote recycling routes and, for the remaining, dispose the waste streams according the Waste regulation.

Conditions and measures related to external recovery of waste

Fraction of used amount transferred to external waste treatment for recovery: specify type of suitable recovery operations for waste generated by workers uses, e.g. re-destillation of solvents, refinery process for lubricant waste, recovery of slags, heat recovery out-side waste incinerators; specify effectiveness of measure;

By-products formed during the process are either recycled, internally or externally, or handled further as waste , according the waste legislation

9.1.3.2. Contributing scenario (2) controlling worker exposure for the industrial use of zinc chloride or $ZnCl_2$-formulations in the manufacturing of other inorganic or organic zinc substances in a solvent-based matrix with potentially filtering and packaging.

Product characteristic

Product related conditions, e.g. the concentration of the substance in a mixture, the physical state of that mixture (solid, liquid; if solid: level of dustiness), package design affecting exposure)

- Zinc chloride is transformed to equivalent pure zinc compound.
- The formed zinc compound can be produced as a powder with varying particle size (worst case scenario) or can be in solution.

Amounts used

Amounts used at a workplace (per task or per shift); note: sometimes this information is not needed for assessment of worker's exposure

Up to maximum 25T/shift

Frequency and duration of use/exposure

Duration per task/activity (e.g. hours per shift) and frequency (e.g. single events or repeated) of exposure

8hrs shift (worst case)

Human factors not influenced by risk management

Particular conditions of use, e.g. body parts potentially exposed as a result of the nature of the activity

Uncovered body parts: (potentially) face

Other given operational conditions affecting workers exposure

Other given operational conditions: e.g. technology or process techniques determining the initial release of substance from process into workers environment; room volume, whether the work is carried out outdoors/indoors, process conditions related to temperature and pressure.

All processes are carried out indoor in confined areas.

Technical conditions and measures at process level (source) to prevent release
Process design aiming to prevent releases and hence exposure of workers; this in particular includes conditions ensuring rigorous containment; performance of containment to be specified (e.g. by quantification of residual losses or exposure) • Process enclosures or semi-enclosures where appropriate. • Local exhaust ventilation work areas with potential dust and fumes generation, dust capturing and removal techniques • Containment of liquid volumes in sumps to collect/prevent accidental spillage
Technical conditions and measures to control dispersion from source towards the worker
Engineering controls, e.g. exhaust ventilation, general ventilation; specify effectiveness of measure • Local exhaust ventilation systems (high efficiency 90-95%) • Cyclones/filters (for minimizing dust emissions) : efficiency: 70-90% (cyclones), 50-80% (dust filters), 85-95% (double stage, cassette filters) • Process enclosure, especially in the drying /calcination / packaging (potentially dusty) units • Dust control: dust and Zn in dust needs to be measured in the workplace air (static or individual) according to national regulations. • Special care for the general establishment and maintenance of a clean working environment by e.g.:   • Cleaning of process equipment and workshop • Storage of packaged Zn product in dedicated zones
Organisational measures to prevent /limit releases, dispersion and exposure
Specific organisational measures or measures needed to support the functioning of particular technical measures (e.g. training and supervision). Those measures need to be reported in particular for demonstrating strictly controlled conditions (to justify exposure based waiving). In general integrated management systems are implemented at the workplace e.g. ISO 9000, ISO-ICS 13100, or alike, and are, when appropriate, IPPC-compliant. Such management system would include general industrial hygiene practice e.g.: o information and training of workers on prevention of exposure/accidents, o procedures for control of personal exposure (hygiene measures) o regular cleaning of equipment and floors, extended workers instruction-manuals o procedures for process control and maintenance,... o personal protection measures (see below)
Conditions and measures related to personal protection, hygiene and health evaluation
Personal protection, e.g. wearing of gloves, face protection, full body dermal protection, goggles, respirator; specify effectiveness of measure; specify the suitable material for the PPE (where relevant) and advise how long the protective equipment can be used before replacement (if relevant) Wearing of gloves and protective clothing is compulsory (efficiency >=90%). With normal handling, no respiratory personal protection (breathing apparatus) is necessary. If risk for exceedance of OEL/DNEL, use e.g.: -dust filter-half mask P1 (efficiency 75%) -dust filter-half mask P2 (efficiency 90%) -dust filter-half mask P3 (efficiency 95%) -dust filter-full mask P1 (efficiency 75%) -dust filter-full mask P2 (efficiency 90 %) -dust filter-full mask P3 (efficiency 97.5%) Eyes: safety glasses are optional

Exposure estimation and risk characterisation

1. Environment

Zinc chloride is used for the manufacture of zinc compounds e.g.:, $Zn_3(PO4)_2$, $Zn(OH)CO_3$, ZnS... The risk assessments (RAs) (ECB 2008) assessed the risks related to this process for e.g. $Zn_3(PO4)_2$ based on reported data. The resulting risk characterisation is summarised in table below. Table below also summarises the risk characterisation based on more recent data on manufacture of other compounds. The exposure estimates based on these more recent data are summarise in the subsequent table below.

Table 14. Environmental risk characterisation for the scenario "industrial use of ZnCl2 for the manufacture of other zinc compounds"

Data from the EU RA	Tonnage (T/y)	Cadd*/PNEC water	Cadd**/PNEC sediment	Cadd/PNEC soil	PEC/PNEC STP
Manufacture of $Zn_3(PO4)_2$ (RA: 5 companies; cfr table 3.4.10 of RA)					
A	6000	0.06	0.5***	0.03	NA
B	6000	0.01	0.3	0.02	NA
C	3000	0.02	0.4	0.02	0.02
D	6000	0.05	0.4***	0.02	NA
E	<1000	0.001	0.01	0.02	0.001
Recent data ***					
$Zn_3(PO4)_2$ manufacture					
Company F (recent data)	8000	(PEC/PNEC)	(PEC/PNEC)	(PEC/PNEC)	(PEC/PNEC)
2005		0.18	0.32	0.39	NA
2006		0.18	0.37	0.39	NA
2007		0.18	0.38	0.39	NA
2008		0.18	0.31	0.39	NA
2009		0.18	0.31	0.39	NA
$Zn(OH)CO_3$ manufacture					
Company A (direct)(2009)	5000	0.32	1.6	0.39	NA
(indirect)		0.26	1.0	0.39	0.92
$ZnBr_2$ manufacture					
Company A	72	0.17	0.19	0.39	0

*In the RAs, "Cadd" the "added concentration by the emissions at a given site was used for the risk characterisation. As such, the risks related to the local emissions at the site were assessed only, without the added exposure from the regional background. The risk ratios are those cited in the RA, i.e. with the PNECs derived in the RA;

**after application of generic bioavailability factor 0.5 (RA 2008).

***for the recent data, the regional exposure was taken into account (PEC/PNEC).

Table 15. Exposure assessment for the industrial use of ZnCl2 for the manufacture of other zinc compounds, based on recently reported exposure data.

$Zn_3(PO4)_2$ manufacture	PEC water (µg Zn/l)	PEC sediment mg Zn/kgDW)	PEC soil (mg Zn/kgDW)	PEC STP (mg Zn/l)
Company F				
2005	3.7	75	42	NA
2006	3.8	86	42	NA
2007	3.8	88	42	NA
2008	3.7	72	42	NA
2009	3.7	72	42	NA

$Zn(OH)CO_3$ manufacture				
Company A *(direct)(2009)*	6.5	382	42	NA
(indirect)	5.2	242	42	48
$ZnBr_2$ manufacture				
Company A	0	0	42	0

Conclusion: based on the information of the risk assessment, there is no environmental risk at the sites covered by this scenario, when e.g. on site treatment of waste waters is present.

The general absence of risk is confirmed by recently measured data covering also manufacture of other zinc compounds except for 1 company, where risk for sediment is predicted. It is noted that for this company a very small dilution (1.4) was reported. In the sediment, the bioavailability of zinc will be determined by the content of acid volatile sulphide (AVS). It has been documented that there is covariance between zinc in sediment and AVS. In cases where AVS and sediment-Zn were measured near industrial sites, there was indeed a surplus on AVS observed, rendering the zinc present at that site non-bioavailable. Whether or not this phenomenon is also present at the sites mentioned in table above, can only be confirmed by local measurements.

It can be concluded that there is no risk for the environment from the manufacture of zinc compounds from $ZnCl_2$, if risk management measures as described in this scenario are applied.

Calculation of local exposure- Bioavailability correction

The local exposure at a given site can be calculated specifically using the excel sheet prepared by Arche (see "tools" on http://www.reach-zinc.eu/)

In addition, bioavailability corrections can be integrated in the exposure assessment, if the environmental parameters that are needed for the calculations, are documented.

- For water assessment, bioavailability model correction can be applied when the following water parameters are documented for the receiving water: Dissolved organic carbon (DOC), pH, hardness or Ca-concentration. For the calculations, the "zinc BLM-calculator" excel tool is used to this end (see "tools" on http://www.reach-zinc.eu/). When the local values of these parameters are unknown, regional data can be used as an alternative. Use of regional instead of local values should always be handled with caution.
- For sediment, a generic bioavailability factor of 2 is already integrated in the PNEC, based on AVS/SEM levels and according to the risk assessment (ECB 2008). A further refinement of local bioavailability can be made when local AVS/SEM concentrations are documented. The bioavailable fraction of zinc is given by subtracting local AVS from local SEM-Zn (SEM-Zn - AVS).
- For soil, a worst case bioavailability correction (corresponding to sandy soils) is already integrated. Further refinement for zinc bioavailability in other soil types is possible, when the local soil type is documented, together with pH, CEC (see "tools" on http://www.reach-zinc.eu/)

2. Workers

- Occupational exposure (inhalation and dermal) to zinc chloride and the manufactured zinc compounds is possible due to manipulation of powdery materials, and from parts of the process when the zinc compound is already formed. The packaging and repackaging of the produced zinc compound in bags, big bags or bulk tankers may lead to contamination of the facility and to exposure (direct or indirect) of workers.
- Pulmonary absorption may occur but most of the material that is deposited in the head and the tracheobronchial region is rapidly translocated to the GI tract and part of it will be absorbed in the GI tract.
- $ZnCl_2$ has however rather coarse particle size (99.66% of the particles larger than 15.8 µm).
- Dermal contact with hands is prevented by mandatory wearing of gloves.
- With normal handling, no respiratory personal protection (breathing apparatus) is necessary. Dust filter can be used (e.g. P2, efficiency 90%) if there is risk for exceedance of OEL/NOAEL.

Data reported on exposure in the risk assessment and more recently are summarised together with the risk characterisation in table below.

Table 16. Workplace exposure data and risk characterisation for the scenario "industrial use of ZnCl2 for the manufacture of other zinc compounds".

RA data	Zn in workplace air (mg/m3) total inhalable	Risk ratio inhalation****	Systemic inhalation exposure (mg/d)*	Risk ratio systemic inhalation	Systemic dermal** (mg/d)	Risk ratio systemic dermal
$Zn_3(PO4)_2$	Rwc: 0.7	0.14	Rwc: 2.8	0.3	0.8	0.08

Recent data						
$Zn_3(PO4)_2$ (2007) *Data reported by 1 company, at "most contaminated area"*	0.5-1	0.1-0.2	1-2	0.1-0.2	No data, assumed as modelled: 0.5***	0.05
$Zn(OH)CO_3$ production (1 company)	0.83	0.2	1.6	0.2	No data, assumed as modelled: 0.5***	0.05

* assuming a respiratory absorption of 40% for ZnCl2 and 20% for ZnO, and an inhalation volume of 10m3.

**dermal absorption of 0.2% for dust; no wearing of gloves assumed in RA

***24mg/d (MEASE) *0.2 (dermal absorption factor for dust) ; wearing of gloves obligatory; (PROC 4-5-8b; dispersive)

**** DNEL inhalation for ZnCl2/ZnSO4 and other soluble zinc substances is 1.0 mg/m3; for ZnO and other slightly soluble/ insoluble zinc substances: 5mg/m3

Conclusion: based on the measured data reported in the EU risk assessment, and confirmed by some more recent data, there is no risk for workers for this scenario.

9.1.4. GES $ZnCl_2$-3: Industrial and professional use of $ZnCl_2$ as active laboratory reagent in aqueous or organic media, for analysis or synthesis.

Table 17. GES- $ZnCl_2$-3

Exposure Scenario Format (1) addressing uses carried out by workers
9.1.4. Title of Exposure Scenario number $ZnCl_2$ GES-3: Industrial and professional use of $ZnCl_2$ as active laboratory reagent in aqeous or organic media, for analysis or synthesis.
List of all use descriptors related to the life cycle stage and all the uses under it; include market sector (by PC), if relevant; ***SU: 3,10, 22, 24*** ***PROC: 1,2,3,4,5, 8b,9, 15*** ***PC: 19, 21, 28, 39*** ***AC: not applicable*** ***ERC: 1,2, 4, 6a, 6b, 8a, 8d***
9.1.4. Exposure Scenario
9.1.4.1. Contributing scenario (1) controlling environmental exposure for the Industrial and professional use of $ZnCl_2$ as active laboratory reagent in aqeous or organic media, for analysis or synthesis.
Further specification: The zinc chloride is used for • Analysis: sample (solid or liquid) treatment or preparation: the substance is in the sample or in the reagens • or synthesis: manipulations are usually under ventilation (e.g. laminar flow, ventilation hood) • The substance is used o at the industrial scale, in industrial installations for air control and water treatment o at the professional scale by laboratories
Product characteristics

Product related conditions:

$ZnCl_2$ is used in minimum 80% purity; higher grades (>95%) are usual

Amounts used

Daily and annual amount per site:

maximum 5 T/y (industrial scale)
maximum 0.5 T/y (professional scale)

Frequency and duration of use

Use is usually intermittent but continuous use is assumed as a worst case. It is possible that use is not continuous; this has to be considered when estimating exposure.

Environment factors not influenced by risk management

Flow rate of receiving surface water:

If applicable: default for generic scenario: 18,000 m3/d, unless specified otherwise

Other given operational conditions affecting environmental exposure

Other given operational conditions: e.g. technology or process techniques determining the initial release of substance from process (via air and waste water); dry or water based processes; conditions related to temperature and pressure; indoor or outdoor use of products; work in confined area or open air;

- All processes are performed indoor in a confined area, with dedicated laboratory equipment. All solid residues containing zinc are recovered for recycling.

Technical conditions and measures at process level (source) to prevent release

Process design aiming to prevent releases and hence exposure to the environment; this includes in particular conditions ensuring rigorous containment; performance of the containment to be specified (e.g. by quantification of a release factor in section 9.x.2 of the CSR);

- Process enclosures and closed circuits where relevant.
- If relevant, dust capturing and removal techniques are applied on local exhaust ventilation (centralised treatment, scrubbers, filters,...)
- Containment of liquid volumes to collect waste streams

Technical onsite conditions and measures to reduce or limit discharges, air emissions and releases to soil

Technical measures, e.g. on-site waste water and waste treatment techniques, scrubbers, filters and other technical measures aiming at reducing releases to air, sewage system, surface water or soil; this includes strictly controlled conditions (procedural and control technology) to minimise emissions; specify effectiveness of measures;
specify the size of industrial sewage treatment plant (m3/d), degradation effectiveness and sludge treatment (if applicable);

- At industrial scale, the waste waters will be treated in the on-site waste water treatment techniques that can be applied to prevent releases to water (if applicable) e.g.: chemical precipitation, sedimentation and filtration (efficiency 90-99.98%).
- At professional scale, the emissions are treated usually by STP. Professional services will be used for treating waste streams e.g. for the recovery of metallic solids (for recycling), and for the recovery of e.g. acid solutions containing the substance.
- Air emissions are controlled by use filters and/or other air emission abatement devices e.g. fabric (or bag) filters (up to 99% efficiency), wet scrubbers (50-99% efficiency). This may create a general negative pressure in the laboratory.

Organizational measures to prevent/limit release from site

Specific organisational measures or measures needed to support the functioning of particular technical measures. Those measures need to be reported in particular for demonstrating strictly controlled conditions.

- In general emissions are controlled and prevented by implementing an integrated management system e.g. ISO 9000/9001, ISO 1400X series, or alike, and, when applicable, by being IPPC-compliant.
  - Such management system should include general industrial hygiene practice e.g.:
    - information and training of laboratory personnel,
    - regular cleaning of equipment and floors,
    - procedures for process control and maintenance,...

- Treatment and monitoring of releases to outside air, and exhaust gas streams according to national regulation.

Conditions and measures related to municipal sewage treatment plant

Size of municipal sewage system/treatment plant (m3/d); specify degradation effectiveness; sludge treatment technique (disposal or recovery); measures to limit air emissions from sewage treatment (if applicable); please note*: the default size of the municipal STP (2000 m3/d) will be rarely changeable for downstream uses.*

- In cases where applicable: default size, unless specified otherwise.

Conditions and measures related to external treatment of waste for disposal

Fraction of used amount transferred to external waste treatment for disposal; type of suitable treatment for waste generated by work-ers uses, e.g. hazardous waste incineration, chemical-physical treatment for emulsions, chemical oxidation of aqueous waste; specify effectiveness of treatment;

- If any, all hazardous wastes are treated by certified contractors according to EU and national legislation.
- Users of Zn and Zn-compounds have to favour the recycling channels of the end-of-life products
- Users of Zn and Zn-compounds have to minimize Zn-containing waste, promote recycling routes and, for the remaining, dispose the waste streams according the Waste regulation.

Conditions and measures related to external recovery of waste

Fraction of used amount transferred to external waste treatment for recovery: specify type of suitable recovery operations for waste generated by workers uses, e.g. re-distillation of solvents, refinery process for lubricant waste, recovery of slags, heat recovery out-side waste incinerators; specify effectiveness of measure;

- All residues are recycled or handled and conveyed according to waste legislation. .

9.1.4.2. Contributing scenario (2) controlling worker exposure for the Industrial use of $ZnCl_2$ as active laboratory reagent in aqeous or organic media, for analysis or synthesis.

Product characteristic

Product related conditions, e.g. the concentration of the substance in a mixture, the physical state of that mixture (solid, liquid; if solid: level of dustiness), package design affecting exposure)

- $ZnCl_2$ is used in minimum 80% purity; higher grades (>95%) are usual
- The sample can be solid or liquid.
- When the preparation is in solid state, it can be in a) powdery, b) glassy or c) pelletized form. In the powder form, it can be characterised by high dustiness in a worst case situation.

Amounts used

Amounts used at a workplace (per task or per shift); note: sometimes this information is not needed for assessment of worker's expo-sure

maximum 5 T/y (industrial scale)
maximum 0.5 T/y (professional scale)
.

Frequency and duration of use/exposure

Duration per task/activity (e.g. hours per shift) and frequency (e.g. single events or repeated) of exposure

Use is usually intermittent but continuous use is assumed as a worst case. It is possible that use is not continuous; this has to be considered when estimating exposure.

Human factors not influenced by risk management

Particular conditions of use, e.g. body parts potentially exposed as a result of the nature of the activity

Uncovered body parts: (potentially) face

Other given operational conditions affecting workers exposure

Other given operational conditions: e.g. technology or process techniques determining the initial release of substance from process into workers environment; room volume, whether the work is carried out outdoors/indoors, process conditions related to temperature and pressure.

- high temperature steps can occur in protected zones (fume cupboards);

- all indoor processes in confined area, including hazardous substances cabinets.

Technical conditions and measures at process level (source) to prevent release

Process design aiming to prevent releases and hence exposure of workers; this in particular includes conditions ensuring rigorous containment; performance of containment to be specified (e.g. by quantification of residual losses or exposure)

- Process enclosures and closed circuits where relevant and possible.
- Local exhaust ventilation on work areas with potential generation of dust or fumes, dust capturing and removal techniques (fume cupboards).
- Containment of liquid volumes and collection in special circuits

Technical conditions and measures to control dispersion from source towards the worker

Engineering controls, e.g. exhaust ventilation, general ventilation; specify effectiveness of measure

- Local exhaust ventilation systems are provided where needed on the benches and in the fume cupboards.
- Process enclosures if relevant
- Dust control: dust to be measured in the workplace air according to national regulations.
- Special care for the general establishment and maintenance of a clean working environment by e.g.:
    - Cleaning of process equipment and laboratory
- Storage of Zn products in dedicated zones, e.g.: hazardous substances cabinets

Organisational measures to prevent /limit releases, dispersion and exposure

In general integrated management systems are implemented at the workplace e.g. ISO 9000/9001, ISO-ICS 13100, or alike, and are, when appropriate, IPPC-compliant.

Such management system would include general industrial hygiene practice e.g.:
- o information and training of personnel on prevention of exposure/accidents,
- o procedures for control of personal exposure (hygiene measures)
- o regular cleaning of equipment and floors, extended workers instruction-manuals
- o procedures for process control and maintenance,...
- o personal protection measures (see below)

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

Personal protection, e.g. wearing of gloves, face protection, full body dermal protection, goggles, respirator; specify effectiveness of measure; specify the suitable material for the PPE (where relevant) and advise how long the protective equipment can be used before replacement (if relevant)

Wearing of protective clothing is compulsory (efficiency >=90%).

Gloves can be used occasionally if risk for direct contact with the substance

With normal handling, no respiratory personal protection (breathing apparatus) is necessary. If risk for exceedance of OEL/DNEL, use e.g.:

-dust filter-half mask P1 (efficiency 75%)

-dust filter-half mask P2 (efficiency 90%)

-dust filter-half mask P3 (efficiency 95%)

-dust filter-full mask P1 (efficiency 75%)

-dust filter-full mask P2 (efficiency 90 %)

-dust filter-full mask P3 (efficiency 97.5%)

Eyes: safety glasses are optional but usually taken as “normal laboratory practice”

Exposure estimation and risk characterisation

1. <u>Environment</u>

In laboratory use of the substance, 2 situations can be distinguished related to environmental management/exposure:

- At industrial scale, the waste waters from the laboratory will be connected to the on-site waste water treatment system and will be treated like the industrial process and other waters. The techniques that can be applied to prevent releases to water (if applicable) are thus the same as for the industrial waste waters e.g.: chemical precipitation, sedimentation and filtration (efficiency 90-99.98%).
- At professional scale, the emissions to water are treated usually by STP. Still, professional services will be used for treating waste streams e.g. for the recovery of metallic solids (for recycling), and for the recovery of acid solutions containing the substance. These controlled waste streams will contain the bulk of the emissions.
- Air emissions in general are controlled by use of filters and/or other air emission abatement devices e.g. fabric (or bag) filters (up to 99% efficiency), wet scrubbers (50-99% efficiency). This may create a general negative pressure in the laboratory

For estimating the industrial laboratory emissions, the release factors are used, because they can be considered a worst case situation, because the zinc compounds are in their pure form, and the laboratories will be connected to the waste water treatment system. The release factors are summarised in table below:

Table 18. Environmental release factors for the manufacture of different zinc compounds, to be used for industrial laboratories using zinc compounds.

Zn compound manufacture	Release factor to air	Release factor to water (g/g)
Zinc Carbonate (1 company)	0.00012	0.000009
Zinc chloride (with WWTP) (1 company)	/	0.0000063
Zinc oxide(1 company)	0.00046	0.000006
(1 company)	0.000012	0.0000044
(3 companies)	0.000017-0.00009	0
Zinc phosphate (1 company)	0.00003-**0.0005**	**0.000016**-0.00001

For the industrial use of zinc compounds, the highest of the measured release factors are used: 0.0005 for release to air, and 0.000016 for release to water.

The exposure estimates and risk characterisation based on the modeling of emissions with these release factors are summarized in the table below.

For professional laboratory, the STP treatment is applied. The Eurometaux SPERC for “use of metal compounds” is 0.1% for air, 3% for water. The exposure estimates and risk characterisation based on the modeling of emissions with these release factors are also summarized in the table below.

Table 19. Exposure assessment and risk characterisation for the industrial and professional use of $ZnCl_2$ in laboratory.

	Maximum tonnage used (T/y)	PEC water (µg/l)	PEC/PNEC water*	PEC sediment mg/kgDW)	PEC/PNEC sediment*	PEC soil (mg/kgDW)	PEC/PNEC soil*	PEC STP (mg/l)	PEC/PNEC STP
Industrial	5	3.4	0.17	46	0.2	41	0.39	0.2	0
Professional	0.5	4.7	0.23	184	0.79	41	0.39	0.034	0.66

*PECs include the regional PEC

Conclusion: The risk ratios for the industrial uses of zinc compounds in laboratory are very low. For the professional uses, even when the very conservative release factor to water (Eurometaux SPERC) is applied, still PEC/PNECs < 1 are predicted. In conclusion, the use of zinc compounds in industrial and professional laboratory does not lead to a risk for the environment, when the risk management measures as described in this scenario are applied.

Calculation of local exposure- Bioavailability correction

The local exposure at a given site can be calculated specifically using the excel sheet prepared by Arche (see "tools" on http://www.reach-zinc.eu/)

In addition, bioavailability corrections can be integrated in the exposure assessment, if the environmental parameters that are needed for the calculations, are documented.

- For water assessment, bioavailability model correction can be applied when the following water parameters are documented for the receiving water: Dissolved organic carbon (DOC), pH, hardness or Ca-concentration. For the calculations, the "zinc BLM-calculator" excel tool is used to this end (see "tools" on http://www.reach-zinc.eu/). When the local values of these parameters are unknown, regional data can be used as an alternative. Use of regional instead of local values should always be handled with caution.
- For sediment, a generic bioavailability factor of 2 is already integrated in the PNEC, based on AVS/SEM levels and according to the risk assessment (ECB 2008). A further refinement of local bioavailability can be made when local AVS/SEM concentrations are documented. The bioavailable fraction of zinc is given by subtracting local AVS from local SEM-Zn (SEM-Zn - AVS).
- For soil, a worst case bioavailability correction (corresponding to sandy soils) is already integrated. Further refinement for zinc bioavailability in other soil types is possible, when the local soil type is documented, together with pH, CEC (see "tools" on http://www.reach-zinc.eu/)

2) Workers

Laboratory personnel applies general risk management measures to prevent exposure to zinc fumes/dust. Given the small quantities that are used in industrial, as well as in professional use, the human exposure is very limited.

Table below summarises the MEASE predictions of human exposure.

Table 20. Occupational exposure data and risk characterisation for the Industrial and professional use of $ZnCl_2$ and other zinc compounds in the laboratory.

Laboratory use	8-hrs Inhalation exposure (mg Zn/m3)	Risk ratio inhalation****	Inhalation exposure systemic (mg Zn/d)**	Dermal exposure (modelled) systemic (mg/d) ***	Risk ratio systemic
Industrial/professional PROC 1, 2, 3, 4, 5, 8b, 9, 15*	≤0.023	≤0.023	0.04	0.005	0.004

*MEASE parameters:

Aqueous solution

>25% content

Professional use

Wide dispersive use

Direct handling

Intermittent exposure

LEV generic

No RPE

gloves

**assuming a respiratory absorption of 40% for ZnCl2/ZnSO4 as a worst case for all zinc compounds (20% for ZnO and other zinc compounds), and an inhalation volume of 10m3

*** assuming a dermal absorption of 0.2% for dust, wearing of gloves assumed

****DNEL inhalation for ZnCl2/ZnSO4 and other soluble zinc substances is 1.0 mg/m3; for ZnO and other slightly soluble/ insoluble zinc substances: 5mg/m3

<u>Conclusion:</u> based on modelling of exposure with MEASE, no risk is predicted for workers in the laboratory using $ZnCl_2$ and other zinc compounds, following the risk management measures as described.

9.1.5. GES $ZnCl_2$-4 : Industrial use of $ZnCl_2$ or $ZnCl_2$-formulations as component for the manufacture of solid blends and matrices for further downstream use.

Table 21.GES $ZnCl_2$-4

Exposure Scenario Format (1) addressing uses carried out by workers
9.1.5. Title of Exposure Scenario number GES $ZnCl_2$ - 4 : Industrial use of $ZnCl_2$ or $ZnCl_2$-formulations as component for the manufacture of solid blends and matrices for further downstream use.
List of all use descriptors related to the life cycle stage and all the uses under it; include market sector (by PC), if relevant; ***SU: 1, 3, 4, 5, 8, 9, 10, 11, 12, 13, 14, 15, 16, 18, 19, 20, 0 (Nace C21.1., 23.9.9., 26.1.1.,27.2.)*** ***PROC: 1, 2, 3, 4, 5 ,8b, 9,13, 14, 15, 22,25,26*** ***PC: 1, 8, 9a,9b,9c,14,15,18,19, 20, 21, 26,28, 29, 32,35, 37, 38*** ***AC:2,3, 4 -*** ***ERC: 1, 2, 3, 4, 5, 7, 8a, 8b, 8d, 10a, 10b, 11a***
Further explanations (if needed) $ZnCl_2$ or $ZnCl_2$-containing preparations are used in the manufacture of dry preparations by mixing thoroughly the starting materials, possibly followed by pressing or pelletizing, and finally packaging of the preparation.
9.1.5. Exposure Scenario
9.1.5.1. Contributing scenario (1) controlling environmental exposure for the Industrial use of $ZnCl_2$ or $ZnCl_2$-formulations as component for the manufacture of solid blends and matrices for further downstream use.
Further specification: In the described process, the $ZnCl_2$ (or Zn compound) containing preparation/mixture is optionally: • Pressed at high temperature (>1000°C), grinded and re-pressed or fritted at high temperature • Molten at high temperature (>500°C) and further cast as glassy material • Pressed and pelletized at low temperature And subsequently packed, or used as such, in further treatment/use
Product characteristics
Product related conditions: $ZnCl_2$ (or Zn compound) in the preparation can be > 25%, usually <5%
Amounts used
Daily and annual amount per site: maximum 5000 T/y;
Frequency and duration of use
Continuous production is assumed as a worst case. It is possible that use is not continuous; this has to be considered when estimating exposure.
Environment factors not influenced by risk management
Flow rate of receiving surface water: default for generic scenario: 18,000 m3/d, unless specified otherwise
Other given operational conditions affecting environmental exposure

Other given operational conditions: e.g. technology or process techniques determining the initial release of substance from process (via air and waste water); dry or water based processes; conditions related to temperature and pressure; indoor or outdoor use of products; work in confined area or open air;

- All dry processes throughout, no process waters. Even when no process waters occur (with dry process throughout), some non-process water can be generated containing zinc (e.g. from cleaning)
- High temperature steps are possible.
- All processes are performed indoor in a confined area. All residues containing zinc are recycled.

Technical conditions and measures at process level (source) to prevent release

Process design aiming to prevent releases and hence exposure to the environment; this includes in particular conditions ensuring rigorous containment; performance of the containment to be specified (e.g. by quantification of a release factor in section 9.x.2 of the CSR);

- Local exhaust ventilation on furnaces and other work areas with potential dust generation.
- Dust capturing and removal techniques are applied.
- Process enclosures where relevant and possible.

Technical onsite conditions and measures to reduce or limit discharges, air emissions and releases to soil

Technical measures, e.g. on-site waste water and waste treatment techniques, scrubbers, filters and other technical measures aiming at reducing releases to air, sewage system, surface water or soil; this includes strictly controlled conditions (procedural and control technology) to minimise emissions; specify effectiveness of measures;
specify the size of industrial sewage treatment plant (m3/d), degradation effectiveness and sludge treatment (if applicable);

- No process waters, so possible emissions to water are limited and non-process related.
- On-site waste water treatment techniques can be applied to prevent releases to water (if applicable) e.g.: chemical precipitation, sedimentation and filtration (efficiency 90-99.98%).
- Air emissions are controlled by use of bag-house filters and/or other air emission abatement devices e.g. fabric or bag filters, wet scrubbers. This may create a general negative pressure in the building.

Organizational measures to prevent/limit release from site

Specific organisational measures or measures needed to support the functioning of particular technical measures. Those measures need to be reported in particular for demonstrating strictly controlled conditions.

In general emissions are controlled and prevented by implementing an integrated management system e.g. ISO 9000, ISO 1400X series, or alike, and, when appropriate, by being IPPC-compliant.

  - information and training of workers,
  - regular cleaning of equipment and floors,
  - procedures for process control and maintenance,...

- Treatment and monitoring of releases to outside air, and exhaust gas streams (process & hygiene), according to national regulation.
- SEVESO 2 compliance, if applicable.

Conditions and measures related to municipal sewage treatment plant

Size of municipal sewage system/treatment plant (m3/d); specify degradation effectiveness; sludge treatment technique (disposal or recovery); measures to limit air emissions from sewage treatment (if applicable); please note*: the default size of the municipal STP (2000 m3/d) will be rarely changeable for downstream uses.*

In cases where applicable: default size, unless specified otherwise.

Conditions and measures related to external treatment of waste for disposal

Fraction of used amount transferred to external waste treatment for disposal; type of suitable treatment for waste generated by work-ers uses, e.g. hazardous waste incineration, chemical-physical treatment for emulsions, chemical oxidation of aqueous waste; specify effectiveness of treatment;

- If any, all hazardous wastes are treated by certified contractors according to EU and national legislation.
- Users of Zn and Zn-compounds have to favour the recycling channels of the end-of-life products
- Users of Zn and Zn-compounds have to minimize Zn-containing waste, promote recycling routes and, for the remaining, dispose the waste streams according the Waste regulation.

Conditions and measures related to external recovery of waste

Fraction of used amount transferred to external waste treatment for recovery: specify type of suitable recovery operations for waste generated by workers uses, e.g. re-distillation of solvents, refinery process for lubricant waste, recovery of slags, heat recovery out-side waste incinerators; specify effectiveness of measure;

- All residues are recycled or handled and conveyed according to waste legislation. .

9.1.5.2. Contributing scenario (2) controlling worker exposure for the Industrial use of $ZnCl_2$ or $ZnCl_2$-formulations as component for the manufacture of solid blends and matrices for further downstream use.

Name of contributing scenario 2:

Industrial formulation of dry preparations/mixtures by mixing thoroughly the $ZnCl_2$ (or other zinc compounds) with the other starting materials, with possible pressing, pelletising, sintering and packaging of the preparations/mixtures

Product characteristic

Product related conditions, e.g. the concentration of the substance in a mixture, the physical state of that mixture (solid, liquid; if solid: level of dustiness), package design affecting exposure)

- The concentration of $ZnCl_2$ in the mixtures can be up to >25% but is usually of the order of <= 5%, depending on the application.
- The preparation is in the solid state, usually with a low level of dustiness; however, powder forms can occur, the high dustiness is therefore applied as a worst case.
- $ZnCl_2$ particles are coarser then e.g. ZnO; 99.66% of the particles is larger than 15.8 µm

Amounts used

Amounts used at a workplace (per task or per shift); note: sometimes this information is not needed for assessment of worker's expo-sure

Max 5000T/y = 15T/d = 5T/shift depending of application.

Frequency and duration of use/exposure

Duration per task/activity (e.g. hours per shift) and frequency (e.g. single events or repeated) of exposure

8 hour shifts (default worst case) are assumed as starting point; it is emphasised that the real duration of exposure could be less. This has to be considered when estimating exposure.

Human factors not influenced by risk management

Particular conditions of use, e.g. body parts potentially exposed as a result of the nature of the activity

Uncovered body parts: (potentially) face

Other given operational conditions affecting workers exposure

Other given operational conditions: e.g. technology or process techniques determining the initial release of substance from process into workers environment; room volume, whether the work is carried out outdoors/indoors, process conditions related to temperature and pressure.

- Dry processes: dry operational conditions throughout the process; no process waters;
- high temperature steps can occur;
- indoor processes in confined area.

Technical conditions and measures at process level (source) to prevent release

Process design aiming to prevent releases and hence exposure of workers; this in particular includes conditions ensuring rigorous containment; performance of containment to be specified (e.g. by quantification of residual losses or exposure)

- Local exhaust ventilation on furnaces and other work areas with potential dust generation, dust capturing and removal techniques
- Process enclosures where appropriate

Technical conditions and measures to control dispersion from source towards the worker

Engineering controls, e.g. exhaust ventilation, general ventilation; specify effectiveness of measure • Local exhaust ventilation systems and process enclosures are generally applied • Cyclones/filters (for minimizing dust emissions): efficiency 70%-90% (cyclones); dust filters (50-80%) • LEV in work area: efficiency 84% (generic LEV)
Organisational measures to prevent /limit releases, dispersion and exposure
Specific organisational measures or measures needed to support the functioning of particular technical measures (e.g. training and supervision). Those measures need to be reported in particular for demonstrating strictly controlled conditions (to justify exposure based waiving). In general integrated management systems are implemented at the workplace e.g. ISO 9000, ISO-ICS 13100, or alike, and are, when appropriate, IPPC-compliant. Such management system would include general industrial hygiene practice e.g.: o information and training of workers on prevention of exposure/accidents, o procedures for control of personal exposure (hygiene measures) o regular cleaning of equipment and floors, extended workers instruction-manuals o procedures for process control and maintenance,... o personal protection measures (see below)
Conditions and measures related to personal protection, hygiene and health evaluation
Personal protection, e.g. wearing of gloves, face protection, full body dermal protection, goggles, respirator; specify effectiveness of measure; specify the suitable material for the PPE (where relevant) and advise how long the protective equipment can be used before replacement (if relevant) Wearing of gloves and protective clothing is compulsory (efficiency >=90%). With normal handling, no respiratory personal protection (breathing apparatus) is necessary. If risk for exceedance of OEL/DNEL, use e.g.: -dust filter-half mask P1 (efficiency 75%) -dust filter-half mask P2 (efficiency 90%) -dust filter-half mask P3 (efficiency 95%) -dust filter-full mask P1 (efficiency 75%) -dust filter-full mask P2 (efficiency 90 %) -dust filter-full mask P3 (efficiency 97.5%) Eyes: safety glasses are optional

Exposure estimation and risk characterisation

1. <u>Environment</u>

The processes involved in this scenario are all dry, so there are no process waters. Even when no process waters are involved, occasional non-process-waters can occur having some zinc content, due to e.g. from dust cleaning. Therefore, all formulation processes with $ZnCl_2$ and other zinc compounds should have some form of water treatment, on site or off-site, according to national legislation and permits.

The physical form of the preparations is usually solid; the dustiness is then much lower than with the original substance $ZnCl_2$. However, since powder forms can occur, high dustiness (cfr ZnO) is applied as worst case.

The risk assessments on zinc and zinc compounds reported measured exposure data on a number of sectors falling under this scenario. In most cases, two sequential process steps are integrated at the same industrial site:

a) the formulation of the substance into the dry preparation/mixture and

b) the further industrial use of the preparation/mixture.

For this reason, environmental emissions data are in most cases integrating both process steps, and encompass both the generic scenarios GES-1 (formulation of $ZnCl_2$/Zn compound into mixture) and GES-4. In the integrated process, exposure related to the formulation of the pure $ZnCl_2$ is considered to be the most critical, because the substance is used in powdery form in its pure state. Therefore the data reported in the risk assessments for the formulation of $ZnCl_2$/Zn compounds in mixtures (cfr GES 1) are used as worst case for the present scenario.

The resulting risk characterisations are summarized in table below. Distinction is being made between assessments based on measured data, and assessments based on modelling, using default release factors. Preference is given to the measured data.

Table below also summarizes the risk characterisation based on more recent data on manufacture of other compounds. The exposure estimates based on these more recent data are summarized in the second table below.

Table 22. Environmental risk characterisation for the Industrial use of $ZnCl_2$ as component for the manufacture of solid blends and matrices for further downstream use.

assessments from the EU RA by sector of use*	PEC/PNEC water	PEC/PNEC sediment (**)	PEC/PNEC soil	PEC/PNEC STP
$ZnCl_2$ (table3.4.10., RA **$ZnCl_2$**, ECB 2008)				
Assessment based on measured data				
Agrochemical industry processing (1 single EU production site)	0.03	0.51	0.02	0.39
Assessments based on modelling				
Chemical industry: processing	0.19	1.7 (0.71)	19	47
Additional recent data*****				
Fertiliser manufacture				
Company A	0.16	0.19	0.39	0

*PNECs from the RA are applied, integrating for sediment the generic bioavailability factor 0.5 and for soil the generic bioavailability factor 0.33 (RA, ECB 2008); Risk ratios for water and sediment are Cadd/PNEC; for STP and soil risk ratios are PEC/PNEC.

**PEC/PNEC ratios for sediment between brackets apply the updated PNEC and generic bioavailability factor of the RA

***all risk ratios are PEC/PNECs

Table 23. Exposure assessment for the_industrial use of $ZnCl_2$ as component for the manufacture of solid blends and matrices for further downstream use.

	PEC water (µg Zn/l)	PEC sediment mg Zn/kgDW)	PEC soil (mg Zn/kgDW)	PEC STP (mg Zn/l)
Fertiliser manufacture				
Company A	3.4	45	41	0

Conclusion

When local risks are assessed using measured emissions data, no risk is described for the formulation processes using $ZnCl_2$. Also recent data on an additional sector (fertiliser) show no risk. Only when default release factors are applied (assessment based on modelling), risks are calculated. The measured data however overrule these modelled results, so it is concluded based on th measured data that there is no risk for the environment from this scenario, when risk management measures, as described, are applied.

The conclusion on the environmental assessment on the use of $ZnCl_2$ for the manufacture of solid blends and matrices for further downstream use is confirmed by data on formulation with other zinc substances, see table below.

Table 24. Environmental risk characterisation for the Industrial use of Zn compounds as component for the manufacture of solid blends and matrices for further downstream use.

assessments from the EU RA by sector of use*	PEC/PNEC water	PEC/PNEC sediment (**)	PEC/PNEC soil	PEC/PNEC STP
ZnS04 (table3.4.10., RA ZnSO4, ECB 2008)				
Assessment based on measured data				
Agricultural feed industry	**0**	0	0.02	0
Assessments based on modelling				
Agricultural pesticide industry	0.11	1	11	26
Agricultural fertiliser industry	19	175	7.3	18
Agricultural feed industry	1.0	9	0.4	0.94
Chemical industry: processing	0.19	1.7	19	47
RA ZnO (table 3.4.33., ECB 2008)				
Assessment based on measured data				
Ceramic industry processing typical plant average	0	0	0.14	0
Ceramic industry processing typical plant range	0	0	0.06-0.38	0
Ferrites industry (average of 4 (out of 5) plants	0.27	2.5 (1.0)	0.4	0.25
Varistors (average of 2 (out of 4) plants***	0.06	1.2 (0.5)	0.09	0.06
Catalysts processing****	<4.9	<45	0.02	<4.5
Feedstuff additive: formulation (site specific)	0	0	0.02	0
Feedstuff additive: formulation (generic average use)	0	0	0.03	0
Feedstuff additive: formulation (generic largest use use)	0	0	0.05	0
Assessments based on modelling				
Glass industry: processing (average use)	2.5	23	0.93	2.3
Glass industry: processing (largest use)	6.3	57	2.4	5.8

*PNECs from the RA are applied, integrating for sediment the generic bioavailability factor 0.5 and for soil the generic bioavailability factor 0.33 (RA, ECB 2008); Risk ratios for water and sediment are Cadd/PNEC; for STP and soil risk ratios are PEC/PNEC.

**PEC/PNEC ratios for sediment between brackets apply the updated PNEC and generic bioavailability factor of the RA

***data from site 3 (showing as only risk ratios>1), not considered, because it was explicitly mentioned that no WWTP or STP was present (RA ZnO).

****calculations from reported maximum concentration in waste water (<1mg Zn/l); For the one case with risk based on measured data observed in the RA, the catalysts producing sector, extensive additional data were generated; they demonstrate the absence of risks (see GES 1 ZnO).

Calculation of local exposure- Bioavailability correction

The local exposure at a given site can be calculated specifically using the excel sheet prepared by Arche (see "tools" on http://www.reach-zinc.eu/)

In addition, bioavailability corrections can be integrated in the exposure assessment, if the environmental parameters that are needed for the calculations, are documented.

- For water assessment, bioavailability model correction can be applied when the following water parameters are documented for the receiving water: Dissolved organic carbon (DOC), pH, hardness or Ca-concentration. For the calculations, the "zinc BLM-calculator" excel tool is used to this end (see "tools" on http://www.reach-zinc.eu/). When the local values of these parameters are unknown, regional data can be used as an alternative. Use of regional instead of local values should always be handled with caution.
- For sediment, a generic bioavailability factor of 2 is already integrated in the PNEC, based on AVS/SEM levels and according to the risk assessment (ECB 2008). A further refinement of local bioavailability can be made when local

AVS/SEM concentrations are documented. The bioavailable fraction of zinc is given by subtracting local AVS from local SEM-Zn (SEM-Zn - AVS).

- For soil, a worst case bioavailability correction (corresponding to sandy soils) is already integrated. Further refinement for zinc bioavailability in other soil types is possible, when the local soil type is documented, together with pH, CEC (see “tools” on http://www.reach-zinc.eu/)

2. Workers

Occupational exposure to zinc chloride when dry mixing/blending $ZnCl_2$/ $ZnCl_2$-preparations into dry solid matrices for further downstream use is possible due to dust emissions at several steps of the process. These dusts may lead to contamination of the facility and to exposure (direct or indirect) of workers, by inhalation and dermal contact.

However, most of the products formed (pellets, fluxes, ..) are compacted solids, so dustiness is limited. Pulmonary absorption may occur but most of the material that is deposited in the head and the tracheobronchial region is rapidly translocated to the GI tract and part of it will be absorbed in the GI tract. It is noted that $ZnCl_2$ particles are coarser then e.g. ZnO; 99.66% of the particles is larger than 15.8 µm. The particle size distribution of the preparations is dependent on the application.

For assessing worker exposure, different lines of evidence can be used:

- As a worst case, data reported in the risk assessment for the integrated process of mixing of the ZnO/Zn compound into the dry preparation and the subsequent further processing **(table 100** below).
- As a worst case, recent data on this step in e.g. catalyst production, pigment production (**table 100 below).**
- Data for the formulation of pure $ZnCl_2$/Zn compounds can also be applied as a worst case. In this scenario, the main possibility for exposure is at the unpacking step of the pure Zn compound, and its mixing into the other components of the mix. In further processes, the concentration of the Zn compound is lower, and, consequently, exposure is also predicted to be lower. The risk assessments of e.g. ZnSO4 (ECB 2008) mentioned data for this step (**table 101** below).
- the manufacture of $ZnCl_2$ can be considered as an additional worst case (highest concentration, pure $ZnCl_2$) (**table 102**).

Table 25. Occupational exposure data for the Industrial use of $ZnCl_2$ and other Zn compounds as component for the manufacture of solid blends and matrices for further downstream use.

Risk assessment data (RA $ZnCl_2$, ECB 2008) **scenario**	Inhalation exposure (mg Zn/m3) (total inhalable)	Risk ratio inhalation***	Inhalation systemic (mg/d)	Dermal exposure RA systemic (MEASE-modelled) mg/d**	Total systemic exposure (mg/d)	Risk ratio (based on measured data-systemic)
Production of animal feedstuff *	Typical: / Rwc: 0.5	Rwc : 0.5	Rwc : 2*	2.3	4.3	0.43
Production of fertilisers*	Rwc: 0.2	Rwc:0.2	0.8	0.2	1	0.1
Recent data (on ZnO) **Sector: activity**						
Catalyst production: Emptying of containers	Mean: 0.37 Range: <0.001-1.07	Mean: 0.07 Range: <0.0002-0.21	0.74 Up to 2.14	0.2	0.94 Up to 2.34	0.09 Up to 0.2
Catalyst production: drying	Mean: 0.37 Range: 0.07-0.84	Mean: 0.07 Range: 0.01-0.2	0.74 Up to 1.7	(0.2)	0.94 Up to 1.9	0.09 Up to 0.19
Catalyst production: mixing	Mean: 0.19 Range: <0.01-0.44	Mean: 0.04 Range: <0.002-0.09	0.38 Up to 0.88	(0.2)	0.58 Up to 1.1	0.06 Up to 0.1
Catalyst production: forming	Mean: 0.2 Range: 0.004-1.42	Mean: 0.04 Range: 0.0008-0.3	0.4 Up to 2.8	(0.2)	0.6 Up to 3	0.06 Up to 0.3
Catalyst production: precipitation/filtration	Mean: 0.73 Range: 0.06-	Mean: 0.15 Range: 0.012-0.3	1.5 Up to 2.7	(0.2)	1.7 Up to 2.9	0.17 Up to 0.3

	1.37					
Catalyst production: screening	Mean : 0.41 Range: <0.01-1.96	Mean: 0.08 Range: <0.002-0.4	0.82 Up to 3.9	(0.2)	1.0 Up to 4.1	0.1 Up to 0.4
Catalyst production: filling	Mean: 0.61 Range: 0.004-1.66	Mean: 0.12 Range: 0.0008-0.33	1.2 Up to 3.3	(0.2)	1.4 Up to 3.5	0.14 Up to 0.4
Catalyst production: binning off	Mean: 0.52 Range: <0.01-1.32	Mean: 0.1 Range: <0.002-0.03	1.0 Up to 2.6	(0.2)	1.2 Up to 2.8	0.12 Up to 0.28
Catalyst production: maintenance	Mean: 0.37 Range: 0.16-0.59	Mean: 0.07 Range: 0.03-0.12	0.74 Up to 1.2	(0.2)	0.94 Up to 1.4	*0.09* Up to 0.14
Recent data on ZnO and other Zn compounds						
Pigment production: dosing and mixing (2005)	0.83	0.17	1.6	(0.2)	1.8	0.18
Pigment production: dosing and mixing (2006)	0.29	0.06	0.6	(0.2)	0.8	0.08
Pigment production: dosing and mixing (2009)	0.14	0.03	0.3	(0.2)	0.5	0.05
Pigment production: calcinations (charge) (2004)	0.33	0.07	0.66	(0.2)	0.9	0.09
Pigment production: calcinations (charge) (2005)	0.055	0.01	0.11	(0.2)	0.3	0.03
Pigment production: calcinations (charge) (2009)	0.43	0.009	0.9	(0.2)	1.1	0.1
Unspecified (“ZnO 8b”): preparing granulates	0.1	0.02	0.2	(0.2)	0.4	0.04
Unspecified (“ZnO 8b”): pressing measuring 2005	0.1	0.02	0.2	(0.2)	0.4	0.04

*RA ZnSO4. 40% respiratory absorption was assumed for ZnSO4, and 10m3 respiratory volume/d

**It is noted that in the RA, dermal exposures are estimated higher than in the present MEASE modelling, because the use of specialised working gloves is mandatory.

***DNEL inhalation for ZnCl2/ZnSO4 and other soluble zinc substances is 1.0 mg/m3; for ZnO and other slightly soluble/ insoluble zinc substances: 5mg/m3

Table 26. Additional occupational data and risk characterisations also relevant for the industrial use of $ZnCl_2$ and other Zn compounds as component for the manufacture of solid blends and matrices for further downstream use.

Data from ZnSO4 RA by Sector	activity	8-hrs Inhalation exposure (mg Zn/m3)	Risk ratio inhalation**	Inhalation exposure systemic (mg Zn/d)	Dermal exposure (modelled) systemic (mg/d)	Systemic exposure total (mg Zn/d)	Risk ratio systemic
Paint industry*	Emptying of ZnO from big bags into dispensers	0.17-0.28	0.17-0.28	0.34-0.56	0.2	0.54-0.76	0.05-0.08
	Loading powders from 25kg big bags into dispensers	0.1-0.5 Average: 0.29	0.1-0.5 Average: 0.29	0.2-1.0 0.58	0.2	0.4-1.2 0.78	0.04-0.12 0.08
	Loading powders from big bags into dispensers	0.01-1.34 Average 0.27	0.01-1.34 Average 0.27	0.02-2.68 0.54	0.2	0.22-2.88 0.74	0.02-0.3 0.07
Ceramics (1 company)	ZnO loaded from bulk transport to bulk storage	0.1-0.98	0.1-0.98	0.2-2.0	0.2	0.4-2.2	0.04-0.2

*values are for total dust; exposure to dust for short duration; data extrapolated to 8hrs exposure
** DNEL inhalation for ZnCl2/ZnSO4 and other soluble zinc substances is 1.0 mg/m3; for ZnO and other slightly soluble/ insoluble zinc substances: 5mg/m3

Table 27. Occupational exposure data and risk characterisation for the scenario “$ZnCl_2$ manufacture”

RA data (RA ZnCl2, table 4.1.3.2A)	Zn in workplace air (mg/m3) total inhalable	Risk ratio inhalation***	Systemic inhalation exposure (mg/d)*	Risk ratio systemic inhalation	Systemic dermal **(mg/d)	Risk ratio systemic dermal
3 companies	0.2	0.2	0.8	0.08	0.4	0.04

* assuming a respiratory absorption of 40% for ZnCl2/ZnSO4 and 20% for ZnO and other zinc compounds, and an inhalation volume of 10m3
** assuming a dermal absorption of 0.2% for dust, no wearing of gloves assumed
***DNEL inhalation for ZnCl2/ZnSO4 and other soluble zinc substances is 1.0 mg/m3; for ZnO and other slightly soluble/ insoluble zinc substances: 5mg/m3

Conclusion: based on measured data from the risk assessments and data from similar worst case scenarios, no risk is predicted for workers, following the risk management measures indicated in this scenario.

9.1.6. GES $ZnCl_2$-5: Industrial use of $ZnCl_2$ or $ZnCl_2$-formulations as component for the manufacture of dispersions, pastes or other viscous or polymerized matrices.

Table 28. GES $ZnCl_2$-5

Exposure Scenario Format (1) addressing uses carried out by workers
9.1.5. Title of Exposure Scenario number GES $ZnCl_2$ -5 : Industrial use of $ZnCl_2$ or $ZnCl_2$-formulations as component for the manufacture of dispersions, pastes or other viscous or polymerized matrices.
List of all use descriptors related to the life cycle stage and all the uses under it; include market sector (by PC), if relevant; ***SU: 1, 3, 4, 5, 6b, 7, 8, 9, 10, 11, 12, 14, 15,16,18, 19, 20, 0 (Nace C23.2., 23.9.9., 27.2)*** ***PROC: 1, 2,3,4,5,6,7, 8b,9,10, 11, 13, 14, 19, 20, 21, 24, 25*** ***PC: 4, 8, 8, 12, 23, 24, 25, 28, 29, 31, 32, 33, 34, 35, 37, 38,39, 40*** ***AC:1, 2, 3, 5, 6, 7, 10, 11, 13-*** ***ERC:1, 2, 3,5, 6a, 6b,6d, 8a, 8b, 8c, 8d,8f, 9a, 9b, 10a, 10b,11a***
Further explanations (if needed)

9.1.5. Exposure Scenario

9.1.5.1. Contributing scenario (1) controlling environmental exposure for the industrial use of $ZnCl_2$ or $ZnCl_2$-formulations as component for the manufacture of dispersions, pastes or other viscous or polymerized matrices.

Name of contributing scenario

Further specification:

In the described process, the zinc chloride containing preparation/mixture is:

- unpacked and stored in silos
- Extracted from the silo, dosed and fed with the other reagents and/or solvents to the mixing tank, batch-wise or continuously, according the process receipt.
- The resulting zinc salt containing mixture (solution, dispersion, paste) is directly further processed, or packed, for further treatment/use.

Product characteristics

Product related conditions:

$ZnCl_2$ in preparation can be > 25%

Amounts used

Daily and annual amount per site:

maximum 5000 T/y;

Frequency and duration of use

Continuous production is assumed as a worst case. It is possible that use is not continuous; this has to be considered when estimating exposure.

Environment factors not influenced by risk management

Flow rate of receiving surface water:

default for generic scenario: 18,000 m3/d, unless specified otherwise

Other given operational conditions affecting environmental exposure

Other given operational conditions: e.g. technology or process techniques determining the initial release of substance from process (via air and waste water); dry or water based processes; conditions related to temperature and pressure; indoor or outdoor use of products; work in confined area or open air;

- In parallel, non-process water can be generated containing zinc (e.g. from cleaning)
- All processes are performed indoor in a confined area.
- All residues containing zinc are recycled.

Technical conditions and measures at process level (source) to prevent release

Process design aiming to prevent releases and hence exposure to the environment; this includes in particular conditions ensuring rigorous containment; performance of the containment to be specified (e.g. by quantification of a release factor in section 9.x.2 of the CSR);

- Local exhaust ventilation on mixing tanks and other work areas with potential dust generation.
- Dust capturing and removal techniques are applied.
- Process enclosures where relevant and possible.

Technical onsite conditions and measures to reduce or limit discharges, air emissions and releases to soil

Technical measures, e.g. on-site waste water and waste treatment techniques, scrubbers, filters and other technical measures aiming at reducing releases to air, sewage system, surface water or soil; this includes strictly controlled conditions (procedural and control technology) to minimise emissions; specify effectiveness of measures;
specify the size of industrial sewage treatment plant (m3/d), degradation effectiveness and sludge treatment (if applicable);

- Most of the operations imply wet process-steps

- Sump containment is provided under the tanks and the filters i.o. to collect any accidental spillage
- On-site waste water treatment techniques can be applied to prevent releases to water (if applicable) e.g.: chemical precipitation, sedimentation and filtration (efficiency 90-99.98%).
- Air emissions are controlled by use of bag-house filters and/or other air emission abatement devices e.g. fabric or bag filters, wet scrubbers. This may create a general negative pressure in the building.

Organizational measures to prevent/limit release from site

Specific organisational measures or measures needed to support the functioning of particular technical measures. Those measures need to be reported in particular for demonstrating strictly controlled conditions.

- In general emissions are controlled and prevented by implementing an integrated management system e.g. ISO 9000, ISO 1400X series, or alike, and, when applicable, by being IPPC-compliant.
    - Such management system should include general industrial hygiene practice e.g.:
        - information and training of workers,
        - regular cleaning of equipment and floors,
        - procedures for process control and maintenance,...
- Treatment and monitoring of releases to outside air, and exhaust gas streams (process & hygiene), according to national regulation.
- SEVESO 2 compliance, if applicable.

Conditions and measures related to municipal sewage treatment plant

Size of municipal sewage system/treatment plant (m3/d); specify degradation effectiveness; sludge treatment technique (disposal or recovery); measures to limit air emissions from sewage treatment (if applicable); please note*: the default size of the municipal STP (2000 m3/d) will be rarely changeable for downstream uses.*

In cases where applicable: default size, unless specified otherwise.

Conditions and measures related to external treatment of waste for disposal

Fraction of used amount transferred to external waste treatment for disposal; type of suitable treatment for waste generated by work-ers uses, e.g. hazardous waste incineration, chemical-physical treatment for emulsions, chemical oxidation of aqueous waste; specify effectiveness of treatment;

- If any, all hazardous wastes are treated by certified contractors according to EU and national legislation.
- Users of Zn and Zn-compounds have to favour the recycling channels of the end-of-life products
- Users of Zn and Zn-compounds have to minimize Zn-containing waste, promote recycling routes and, for the remaining, dispose the waste streams according the Waste regulation.

Conditions and measures related to external recovery of waste

Fraction of used amount transferred to external waste treatment for recovery: specify type of suitable recovery operations for waste generated by workers uses, e.g. re-distillation of solvents, refinery process for lubricant waste, recovery of slags, heat recovery out-side waste incinerators; specify effectiveness of measure;

All residues are recycled or handled and conveyed according to waste legislation. .

9.1.5.2. Contributing scenario (2) controlling worker exposure for the industrial use of $ZnCl_2$ or $ZnCl_2$-formulations as component for the manufacture of dispersions, pastes or other viscous or polymerized matrices.

Product characteristic

Product related conditions, e.g. the concentration of the substance in a mixture, the physical state of that mixture (solid, liquid; if solid: level of dustiness), package design affecting exposure)

- The concentration of $ZnCl_2$ in the mixtures can be >25%, depending on the application.
- The preparation is in the liquid state, as a paste or dispersion or other viscous or polymerized matrix, with a low level of dustiness; however, powder forms can occur, medium dustiness is therefore applied as a worst case

Amounts used

Amounts used at a workplace (per task or per shift); note: sometimes this information is not needed for assessment of worker's expo-sure

Max 5000T/y = 20 T/d = 7 T/shift depending of application.
Frequency and duration of use/exposure
Duration per task/activity (e.g. hours per shift) and frequency (e.g. single events or repeated) of exposure 8 hour shifts (default worst case) are assumed as starting point; it is emphasised that the real duration of exposure could be less. This has to be considered when estimating exposure.
Human factors not influenced by risk management
Particular conditions of use, e.g. body parts potentially exposed as a result of the nature of the activity Uncovered body parts: (potentially) face
Other given operational conditions affecting workers exposure
Other given operational conditions: e.g. technology or process techniques determining the initial release of substance from process into workers environment; room volume, whether the work is carried out outdoors/indoors, process conditions related to temperature and pressure. • Wet processes • All indoor processes in confined area.
Technical conditions and measures at process level (source) to prevent release
Process design aiming to prevent releases and hence exposure of workers; this in particular includes conditions ensuring rigorous containment; performance of containment to be specified (e.g. by quantification of residual losses or exposure) • Local exhaust ventilation on mixing tanks, furnaces and other work areas with potential dust generation, dust capturing and removal techniques • Process enclosures where appropriate
Technical conditions and measures to control dispersion from source towards the worker
Engineering controls, e.g. exhaust ventilation, general ventilation; specify effectiveness of measure • Local exhaust ventilation systems and process enclosures are generally applied • Cyclones/filters (for minimizing dust emissions): efficiency 70%-90% (cyclones); dust filters (50-80%) • LEV in work area: generic LEV (efficiency 84%) is considered worst case; higher efficiencies are usual.
Organisational measures to prevent /limit releases, dispersion and exposure
Specific organisational measures or measures needed to support the functioning of particular technical measures (e.g. training and supervision). Those measures need to be reported in particular for demonstrating strictly controlled conditions (to justify exposure based waiving). In general integrated management systems are implemented at the workplace e.g. ISO 9000, ISO-ICS 13100, or alike, and are, when appropriate, IPPC-compliant. Such management system would include general industrial hygiene practice e.g.: o information and training of workers on prevention of exposure/accidents, o procedures for control of personal exposure (hygiene measures) o regular cleaning of equipment and floors, extended workers instruction-manuals o procedures for process control and maintenance,... o personal protection measures (see below)
Conditions and measures related to personal protection, hygiene and health evaluation
Personal protection, e.g. wearing of gloves, face protection, full body dermal protection, goggles, respirator; specify effectiveness of measure; specify the suitable material for the PPE (where relevant) and advise how long the protective equipment can be used before replacement (if relevant) Wearing of gloves and protective clothing is compulsory (efficiency >=90%). With normal handling, no respiratory personal protection (breathing apparatus) is necessary. If risk for exceedance of OEL/DNEL, use e.g.:

-dust filter-half mask P1 (efficiency 75%)
-dust filter-half mask P2 (efficiency 90%)
-dust filter-half mask P3 (efficiency 95%)
-dust filter-full mask P1 (efficiency 75%)
-dust filter-full mask P2 (efficiency 90 %)
-dust filter-full mask P3 (efficiency 97.5%)
In particular, when PROC 7, 11, 19 are involved, respiratory protection is recommended
Eyes: safety glasses are optional

Exposure estimation and risk characterisation

1. Environment

The processes involved in this scenario are all wet. Even when no process waters are involved, occasional non-process-waters can occur having some zinc content, due to e.g. dust cleaning. Therefore, all formulation processes with $ZnCl_2$ and other zinc compounds should have some form of water treatment, on site or off-site, according to national legislation and permits.

The physical form of the preparations is a wet matrix, so the dustiness is usually very low than with the original substance $ZnCl_2$. However, since powder forms can occur, medium dustiness is applied as worst case.
The risk assessments on zinc and zinc compounds reported measured exposure data on a number of sectors falling under this scenario. In most cases, two sequential process steps are integrated at the same industrial site:
a) the formulation of the substance into the wet preparation/mixture and
b) the further industrial use of the preparation/mixture.

For this reason, environmental emissions data are in most cases integrating both process steps, and encompass both the generic scenarios GES-1 (formulation of $ZnCl_2$/Zn compound into mixture) and GES-5. In the integrated process, exposure related to the formulation of the pure $ZnCl_2$ is considered to be the most critical, because the substance is used in powdery form in its pure state, which gives highest potential for environmental exposure (even when no process waters, by non-process emissions, e.g. by cleaning). Therefore the data reported in the risk assessments for the formulation of $ZnCl_2$/Zn compounds in mixtures (cfr GES 1) are used as worst case for the present scenario.

The resulting risk characterisations are summarized in table below. Distinction is being made between assessments based on measured data, and assessments based on modelling, using default release factors. Preference is given to the measured data.

Table below also summarizes the risk characterisation based on more recent data on manufacture of other compounds. The exposure estimates based on these more recent data are summarized in the second table below.

Table 29. Environmental risk characterisation for the Industrial use of ZnCl2 as component for the manufacture of liquid blends and matrices for further downstream use.

assessments from the EU RA by sector of use*	PEC/PNEC water	PEC/PNEC sediment (**)	PEC/PNEC soil	PEC/PNEC STP
$ZnCl_2$ (table3.4.10., RA **$ZnCl_2$**, ECB 2008)				
Assessment based on measured data				
Agrochemical industry processing (1 single EU production site)	0.03	0.51	0.02	0.39
Battery industry (1 company)	0	0	0.02	0
Assessments based on modelling				
Chemical industry: processing	0.19	1.7 (0.71)	19	47
Battery industry: processing	0.16	1.4	0.2	0.15
Dyes and inks industry: formulation	5.3	48	2.0	4.9

Dyes and inks industry: formulation	150	1343	56	138
Additional recent data* **				
Fertiliser manufacture				
Company A	0.16	0.19	0.39	0

*PNECs from the RA are applied, integrating for sediment the generic bioavailability factor 0.5 and for soil the generic bioavailability factor 0.33 (RA, ECB 2008); Risk ratios for water and sediment are Cadd/PNEC; for STP and soil risk ratios are PEC/PNEC.

**PEC/PNEC ratios for sediment between brackets apply the updated PNEC and generic bioavailability factor of the RA

***all risk ratios are PEC/PNECs

Table 30. Exposure assessment for the industrial use of Zn0 as component for the manufacture of liquid blends and matrices for further downstream use.

	PEC water (µg Zn/l)	PEC sediment mg Zn/kgDW)	PEC soil (mg Zn/kgDW)	PEC STP (mg Zn/l)
Fertiliser manufacture				
Company A	3.4	45	41	0

Conclusion

When local risks are assessed using measured emissions data, no risk is generally described for the formulation processes using $ZnCl_2$. Recent data on an additional sector (fertiliser) show also no risk. Only when default release factors are applied (assessment based on modelling), risks are calculated. The measured data however overrule these modelled results, so it is concluded based on the measured data that there is no risk for the environment from this scenario, when risk management measures, as described, are applied.

The conclusion on the environmental assessment of formulation of $ZnCl_2$ is confirmed by data on formulation with other zinc substances, most of the RA, with recent data added, see table below.

Table 31. Environmental risk characterisation for the Industrial use of Zn compounds as component for the manufacture of liquid blends and matrices for further downstream use.

assessments from the EU RA by sector of use*	PEC/PNEC water	PEC/PNEC sediment (**)	PEC/PNEC soil	PEC/PNEC STP
ZnS04 (table3.4.10., RA ZnSO4, ECB 2008)				
Assessment based on measured data				
Agricultural feed industry	**0**	0	0.02	0
Assessments based on modelling				
Agricultural pesticide industry	0.11	1	11	26
Agricultural fertiliser industry	19	175	7.3	18
Agricultural feed industry	1.0	9	0.4	0.94
Chemical industry: processing	0.19	1.7	19	47
ZnO (table3.4.33., ECB 2008)				
Assessment based on measured data				
Tyre industry: processing	0	0	0.15	0
General rubber industry: processing	0	0	0.08	0
Feedstuff additive: formulation (site specific)	0	0	0.02	0
Feedstuff additive: formulation (generic average use)	0	0	0.03	0
Feedstuff additive: formulation (generic largest use use)	0	0	0.05	0
Paints: formulation	0	0	0.02	0
Paints: processing (industry data)	0	0	0.02	0
Assessments based on modelling				
Lubricants: formulation (average use)	7.5	67	2.7	6.9
Lubricants: formulation (largest use)	13	118	5	12
Paints/ processing: generic data	1.6	14	0.6	1.5
Cosmetics pharmaceuticals: formulation (average use)	2.5	23	0.93	2.3

Cosmetics pharmaceuticals: formulation (largest use)	21	188	8	19
Zn phosphate (table3.4.9., RA Zn phosphate, ECB 2008)				
Assessment based on measured data				
Paint industry (average from 3 of 5 sites reported)***	0.19	1.7 (0.35)	Not calculated	0.35
Assessments based on modelling				
Paint industry: formulation	8.3	75	3.1	7.7
Paint industry: processing, solvent borne	0.23	2.1	0.28	0.21
Paint industry: processing, water borne	1.2	11	0.43	1.1
Additional recent data** **				
Use of Zn(H3PO4)2 in liquid blend	0.23	0.79	0.39	/

*PNECs from the RA are applied, integrating for sediment the generic bioavailability factor 0.5 and for soil the generic bioavailability factor 0.33 (RA, ECB 2008); Risk ratios for water and sediment are Cadd/PNEC; for STP and soil risk ratios are PEC/PNEC.

**PEC/PNEC ratios for sediment between brackets apply the updated PNEC and generic bioavailability factor of the RA

***Only reliable data are used, where the truly measured emission and/or effluent concentration was reported

**** all risk ratios are PEC/PNECs

Table 32. Exposure assessment for the industrial use of Zn compounds as component for the manufacture of liquid blends and matrices for further downstream use.

Making liquid blends of Zn(H3PO4)2	PEC water (µg Zn/l)	PEC sediment mg Zn/kgDW)	PEC soil (mg Zn/kgDW)	PEC STP (mg Zn/l)
Company A	4.7	187	41	/

A specific use of $ZnCl_2$ in liquid blend is as a flux solution in batch (general) hot dip galvanising. The EU RA assessed in detail the exposure from this use. In the EU RA, exposure from hot dip galvanising (HDG) was extensively analysed (ECB 2008).

For general (batch) HDG, extensive data were available from galvanising plants in FR, UK, DE, NL. Emissions to water, including emissions from run-off of stockpiled galvanised steel articles, were assessed in detail. A complete and detailed measured dataset on 20 NL galvanising plants was used for risk characterisation. The NL dataset was indeed, together with the data on the other countries mentioned, considered to be representative for the EU, *"because the process itself does not result in zinc emissions (holds for EU in general) and the releases from non-process sources are expected not to be significantly different between EU countries"* (EU RA, ECB 2008). These data are summarised in table below.

Table 33. Exposure assessment and risk characterisation for the Industrial use of Zinc, alloyed or not, for metal surface treatment (hot dip galvanising) or for pyrometallurgical extraction processes.

Data reported in the EU risk assessment on zinc*	PEC/PNEC water	PEC/PNEC sediment	PEC/PNEC soil	PEC/PNEC STP
General (batch) hot dip galvanising	0.0018-0.037	0.03-0.66	0	0.0016-0.034

*data from RA zinc, table 3.4.67. Risk ratios with PNECs from RA, and as reported in the RA: for water/sediment: Cadd/PNEC; for STP/soil: PEC/PNEC.

Conclusion: The data from the risk assessment demonstrate that also for general hot dip galvanising, there is no risk for environment.

Calculation of local exposure- Bioavailability correction

The local exposure at a given site can be calculated specifically using the excel sheet prepared by Arche (see "tools" on http://www.reach-zinc.eu/)

In addition, bioavailability corrections can be integrated in the exposure assessment, if the environmental parameters that are needed for the calculations, are documented.

- For water assessment, bioavailability model correction can be applied when the following water parameters are documented for the receiving water: Dissolved organic carbon (DOC), pH, hardness or Ca-concentration. For the calculations, the "zinc BLM-calculator" excel tool is used to this end (see "tools" on http://www.reach-zinc.eu/). When the local values of these parameters are unknown, regional data can be used as an alternative. Use of regional instead of local values should always be handled with caution.
- For sediment, a generic bioavailability factor of 2 is already integrated in the PNEC, based on AVS/SEM levels and according to the risk assessment (ECB 2008). A further refinement of local bioavailability can be made when local

AVS/SEM concentrations are documented. The bioavailable fraction of zinc is given by subtracting local AVS from local SEM-Zn (SEM-Zn - AVS).

- For soil, a worst case bioavailability correction (corresponding to sandy soils) is already integrated. Further refinement for zinc bioavailability in other soil types is possible, when the local soil type is documented, together with pH, CEC (see “tools” on http://www.reach-zinc.eu/)

2. Workers

Occupational exposure to zinc when wet mixing/blending $ZnCl_2$/ $ZnCl_2$ preparations into wet matrices for further downstream use is possible due to dust emissions at the initial step of the process (mixing of the dry $ZnCl_2$ into the other components). These dusts may lead to contamination of the facility and to exposure (direct or indirect) of workers, by inhalation and dermal contact.

However, the mixtures that are formed (pastes, dispersions or other viscous or polymerized matrices) are wet, so dustiness is very limited. Pulmonary absorption may occur but most of the material that is deposited in the head and the tracheobronchial region is rapidly translocated to the GI tract and part of it will be absorbed in the GI tract. It is noted that $ZnCl_2$ particles are coarser then e.g. ZnO; 99.66% of the particles is larger than 15.8 µm.

For assessing worker exposure, different lines of evidence can be used:

- data reported in the risk assessment for the integrated process of mixing of the $ZnCl_2$ or other Zn compounds into the wet preparation and the subsequent further processing. Some data on dry mixing are included here as worst case (**table 109** below).
- recent data on this step in e.g. catalyst production, pigment production (dry formulation: worst case) are also included as worst case (**table 109**).
- Data for the formulation of high dustiness pure ZnO/Zn compounds can also be applied as a worst case. In this scenario, the main possibility for exposure is at the unpacking step of the ZnO/Zn compound, and its mixing into the other components of the mix. The risk assessments of e.g. ZnSO4 (ECB 2008) mentioned data for this step (**table 110** below).
- the manufacture of $ZnCl_2$ can be considered as an additional worst case (high dustiness) (**table 111).**

Table 34. Occupational exposure data for the Industrial use of formulations containing ZnO and/or other zinc compounds as component for the manufacture of mixtures for further downstream use.

Risk assessment data (ECB 2008) **scenario**	Inhalation exposure (mg Zn/m3) (total inhalable)	Risk ratio inhalation*****	Inhalation systemic (mg/d)	Dermal exposure RA systemic (MEASE-modelled) mg/d****	Total systemic exposure (mg/d)	Risk ratio (systemic) total
Production of animal feedstuff * (ZnO)	Typical: / Rwc: 0.5	Rwc : 0.5	Rwc : 2**	2.3	4.3	0.43
Production of fertilisers*	Rwc: 0.2	Rwc:0.2	0.8	0.2	1	0.1
Production of paints containing ZnO**	2		4	4.8 (0.2)	8.8 (4.2)	0.88 (0.42)
Production of rubber products containg ZnO**	2		4	4.4 (0.2)	8.4 (4.2)	0.84 (0.42)
Production of paint***	0.4		0.8	0.9 (0.2)	1.7 (1.0)	0.17 (0.1)
Recent data **Sector: activity**						
Catalyst production : emptying of containers (dry formulation: worst case)	Mean: 0.37 Range: <0.001-1.07	Mean: 0.07 Range: <0.0002-0.21	0.74	0.2	0.94	0.09
Catalyst production: drying (dry process: worst case)	Mean: 0.37 Range: 0.07-0.84	Mean: 0.07 Range: 0.01-0.2	0.74 Up to 1.7	(0.2)	0.94 1.9	0.09 0.19

Catalyst production: mixing (dry process: worst case)	Mean: 0.19 Range: <0.01-0.44	Mean: 0.04 Range: <0.002-0.09	0.38 Up to 0.88	(0.2)	0.58 Up to 1.1	0.06 Up to 0.1
Catalyst production: forming (dry process: worst case)	Mean: 0.2 Range: 0.004-1.42	Mean: 0.04 Range: 0.0008-0.3	0.4 Up to 2.8	(0.2)	0.6 Up to 3	0.06 Up to 0.3
Catalyst production: precipitation/filtration (dry process: worst case)	Mean: 0.73 Range: 0.06-1.37	Mean: 0.15 Range: 0.012-0.3	1.5 Up to 2.7	(0.2)	1.7 Up to 2.9	0.17 Up to 0.3
Catalyst production: screening (dry process: worst case)	Mean : 0.41 Range: <0.01-1.96	Mean: 0.08 Range: <0.002-0.4	0.82 Up to 3.9	(0.2)	1.0 Up to 4.1	0.1 Up to 0.4
Catalyst production: filling (dry process: worst case)	Mean: 0.61 Range: 0.004-1.66	Mean: 0.12 Range: 0.0008-0.33	1.2 Up to 3.3	(0.2)	1.4 Up to 3.5	0.14 Up to 0.4
Catalyst production: binning off (dry process: worst case)	Mean: 0.52 Range: <0.01-1.32	Mean: 0.1 Range: <0.002-0.03	1.0 Up to 2.6	(0.2)	1.2 Up to 2.8	0.12 Up to 0.28
Catalyst production: maintenance (dry process: worst case)	Mean: 0.37 Range: 0.16-0.59	Mean: 0.07 Range: 0.03-0.12	0.74 Up to 1.2	(0.2)	0.94 Up to 1.4	*0.09* Up to 0.14
Pigment production: dosing and mixing (2005)	0.83	0.17	1.6	(0.2)	1.8	0.18
Pigment production: dosing and mixing (2006)	0.29	0.06	0.6	(0.2)	0.8	0.08
Pigment production: dosing and mixing (2009)	0.14	0.03	0.3	(0.2)	0.5	0.05
Pigment production: calcinations (charge) (2004)	0.33	0.07	0.66	(0.2)	0.9	0.09
Pigment production: calcinations (charge) (2005)	0.055	0.01	0.11	(0.2)	0.3	0.03
Pigment production: calcinations (charge) (2009)	0.43	0.009	0.9	(0.2)	1.1	0.1
Unspecified (“ZnO 8b”): preparing granulates	0.1	0.02	0.2	(0.2)	0.4	0.04
Unspecified (“ZnO 8b”): pressing measuring 2005	0.1	0.02	0.2	(0.2)	0.4	0.04

*RA ZnSO4. 40% respiratory absorption was assumed for ZnSO4, and 10m3 respiratory volume/d

**RA ZnO

***RA Zn3(PO4)2

****It is noted that in the RA, dermal exposures are estimated higher than in the present MEASE modelling, because the use of specialised working gloves is mandatory.

***** DNEL inhalation for ZnCl2/ZnSO4 and other soluble zinc substances is 1.0 mg/m3; for ZnO and other slightly soluble/ insoluble zinc substances: 5mg/m3

Table 35. Occupational exposure data also relevant for the industrial formulation of wet preparations/mixtures by mixing thoroughly zinc compounds with other materials

Data from ZnSO4 RA by Sector	activity	8-hrs Inhalation exposure (mg Zn/m3)	Risk ratio inhalation	Inhalation exposure systemic (mg Zn/d)	Dermal exposure (modelled) systemic (mg/d)	Systemic exposure total (mg Zn/d)	Risk ratio Systemic total
Paint industry*	Emptying of ZnO from big bags into dispensers	0.17-0.28	0.03-0.06	0.34-0.56	0.2	0.54-0.76	0.05-0.08
	Loading powders from 25kg big bags into dispensers	0.1-0.5 Average: 0.29	0.02-0.1 Average: 0.06	0.2-1.0 0.58	0.2	0.4-1.2 0.78	0.04-0.12 0.08
	Loading powders from big bags into dispensers	0.01-1.34 Average 0.27	0.002-0.3 Average 0.06	0.02-2.68 0.54	0.2	0.22-2.88 0.74	0.02-0.3 0.07
Ceramics (1 company)	ZnO loaded from bulk transport to bulk storage	0.1-0.98	0.02-0.2	0.2-2.0	0.2	0.4-2.2	0.04-0.2

*values are for total dust; exposure to dust for short duration; data extrapolated to 8hrs exposure

Table 36. Occupational exposure data and risk characterisation for the scenario “$ZnCl_2$ manufacture”

RA data (RA ZnCl2, table 4.1.3.2A)	Zn in workplace air (mg/m3) total inhalable	Risk ratio inhalation	Systemic inhalation exposure (mg/d)*	Systemic dermal **(mg/d)	Risk ratio systemic total
3 companies	0.2	0.2	0.8	0.4	0.12

* assuming a respiratory absorption of 40% for ZnCl2/ZnSO4 and 20% for ZnO and other zinc compounds, and an inhalation volume of 10m3

** assuming a dermal absorption of 0.2% for dust, no wearing of gloves assumed

A specific use of ZnCl2 in liquid blend is as a flux solution in batch (general) hot dip galvanising. The exposure of workers (via inhalation or the dermal route) comes from the $ZnCl_2$ that is used as a flux on the bath. Since it is not possible to make distinction between exposure from the molten zinc (which is very low at the melting temperature of zinc in the bath) and from the $ZnCl_2$ flux, both exposures are combined in the exposure estimation below, according to the EU risk assessment on $ZnCl_2$ (ECB 2008).
In continuous hot-dip galvanizing zinc chloride is not used as a fluxing or pre-treatment agent.

Table 37. Occupational exposure data for the industrial use of Zinc, alloyed or not, for metal surface treatment (batch hot dip galvanising) or for pyrometallurgical extraction processes.

Estimations of worker exposure	8-hrs Inhalation exposure (mg Zn/m3)	Inhalation exposure systemic (mg Zn/d)	Dermal exposure systemic (mg/d)	Risk ratio Systemic total
Exposure to ZnO and ZnCl2 (simultaneous exposure) (Data from the RA on ZnCl2*)	0.2 + 0.2	(0.8 + 0.4) = 1.2**	0.3***	0.15

*Data reported for batch hot-dip galvanising (RA ZnCl2, table 4.1.3.2.A.).

**assuming 40% respiratory adsorption for zinc chloride, 20% for zinc oxide

***data from RA ZnCl2 taken as worst case (no wearing of gloves assumed)

Conclusion: based on measured data from the risk assessments and data from similar worst case scenarios (e.g. dry ZnO manufacture), and data for $ZnCl_2$ use in batch hot dip galvanising, no risk is predicted for workers, following the risk management measures indicated in this scenario.

9.1.7. GES $ZnCl_2$- 6 : Industrial and professional use of solid substrates containing less than 25%w/w of $ZnCl_2$.

Table 38. GES $ZnCl_2$-6

Exposure Scenario Format (1) addressing uses carried out by workers
9.1.7. Title of Exposure Scenario number GES $ZnCl_2$ - 6 : Industrial and professional use of solid substrates containing less than 25%w/w of $ZnCl_2$.
List of all use descriptors related to the life cycle stage and all the uses under it; include market sector (by PC), if relevant; ***SU: 3, 5, 6b, 9, 10, 16, 17, 18, 20, 22, 0 (Nace 23.9.9)*** ***PROC: 4, 5 ,6, 8b, 9,10, 11, 13, 19*** ***PC: 1, 8, 9a, 9b, 9c,14,15, 18 20, 21, 23, 25, 29, 34, 35, 39,*** ***AC: 1, 2, 3, 5, 6, 7, 0 (coatings for art and creative items)*** ***ERC: 3, 5, 8a, 8d, 10a, 11a***
9.1.7. Exposure Scenario
9.1.7.1. Contributing scenario (1) controlling environmental exposure for the Industrial and professional use of solid substrates containing less than 25%w/w of $ZnCl_2$.
Further specification: This scenario covers both the industrial scale processes and professional use. In the described process, the $ZnCl_2$ containing preparation/mixture is further processed, involving potentially the following steps: • Reception/unpacking of material • Final application, embedding, or shaping to produce the end product or article.
Product characteristics
Product related conditions: $ZnCl_2$ (or Zn compound) in the article is < 25%
Amounts used
Daily and annual amount per site: • The quantities involved in this scenario are 10-50 times smaller than in blending (GES 4-GES 5); the concentration of the zinc substance is also lower (<25%). • Typical quantities for both Industrial and professional are 50T/y (typical), maximum 500T/y (in industrial setting).
Frequency and duration of use

Continuous production is assumed as a worst case. Usually, use is not continuous; this has to be considered when estimating exposure.

Environment factors not influenced by risk management

Flow rate of receiving surface water:

default for generic scenario: 18,000 m3/d, unless specified otherwise

Other given operational conditions affecting environmental exposure

Other given operational conditions: e.g. technology or process techniques determining the initial release of substance from process (via air and waste water); dry or water based processes; conditions related to temperature and pressure; indoor or outdoor use of products; work in confined area or open air;

- Solid, so in principle all dry processes throughout, no process waters. Even when no process waters occur (with dry process throughout), some non-process water can be generated containing zinc (e.g. from cleaning)
- In industrial and professional setting, all processes are performed indoor in a confined area. All residues containing zinc are recycled.

Technical conditions and measures at process level (source) to prevent release

Process design aiming to prevent releases and hence exposure to the environment; this includes in particular conditions ensuring rigorous containment; performance of the containment to be specified (e.g. by quantification of a release factor in section 9.x.2 of the CSR);

- In industrial and professional setting the following applies:
  - Local exhaust ventilation on furnaces and other work areas with potential dust generation.
  - Dust capturing and removal techniques are applied.
  - Process enclosures where relevant and possible.

Technical onsite conditions and measures to reduce or limit discharges, air emissions and releases to soil

Technical measures, e.g. on-site waste water and waste treatment techniques, scrubbers, filters and other technical measures aiming at reducing releases to air, sewage system, surface water or soil; this includes strictly controlled conditions (procedural and control technology) to minimise emissions; specify effectiveness of measures;
specify the size of industrial sewage treatment plant (m3/d), degradation effectiveness and sludge treatment (if applicable);

- In industrial and professional setting, the following applies:
  - No process waters, so possible emissions to water are limited and non-process related.
  - If zinc emissions to water, on-site waste water treatment techniques can be applied to prevent releases to water (if applicable) e.g.: chemical precipitation, sedimentation and filtration (efficiency 90-99.98%).
    - By exposure modelling it is predicted that at use quantities of >100T/y, refinement of the exposure assessment to water and sediment needs to be made (exposure assessment based on real measured data and local parameters). Treatment of the emissions to water may be needed under such conditions (see “exposure estimation and risk characterisation”).
  - Air emissions are controlled by use of bag-house filters and/or other air emission abatement devices e.g. fabric or bag filters, wet scrubbers. This may create a general negative pressure in the building.

Organizational measures to prevent/limit release from site

Specific organisational measures or measures needed to support the functioning of particular technical measures. Those measures need to be reported in particular for demonstrating strictly controlled conditions.

In general, emissions are controlled and prevented by implementing an appropriate management system. This would involve:
  - information and training of workers,
  - regular cleaning of equipment and floors,
  - procedures for process control and maintenance,...
- Treatment and monitoring of releases to outside air, and exhaust gas streams, according to national regulation.
- SEVESO 2 compliance, if applicable.

Conditions and measures related to municipal sewage treatment plant

Size of municipal sewage system/treatment plant (m3/d); specify degradation effectiveness; sludge treatment technique (disposal or recovery); measures to limit air emissions from sewage treatment (if applicable); please note*: the default size of the municipal STP (2000 m3/d) will be rarely changeable for downstream uses.*

In cases where applicable: default size, unless specified otherwise.

Conditions and measures related to external treatment of waste for disposal

Fraction of used amount transferred to external waste treatment for disposal; type of suitable treatment for waste generated by work-ers uses, e.g. hazardous waste incineration, chemical-physical treatment for emulsions, chemical oxidation of aqueous waste; specify effectiveness of treatment;

- If any, all hazardous wastes are treated by certified contractors according to EU and national legislation.
- Users of Zn and Zn-compounds have to favour the recycling channels of the end-of-life products
- Users of Zn and Zn-compounds have to minimize Zn-containing waste, promote recycling routes and, for the remaining, dispose the waste streams according the Waste regulation.

Conditions and measures related to external recovery of waste

Fraction of used amount transferred to external waste treatment for recovery: specify type of suitable recovery operations for waste generated by workers uses, e.g. re-distillation of solvents, refinery process for lubricant waste, recovery of slags, heat recovery out-side waste incinerators; specify effectiveness of measure;

- All residues are recycled or handled and conveyed according to waste legislation.

9.1.7.2. Contributing scenario (2) controlling worker exposure for the Industrial and professional use of solid substrates containing less than 25%w/w of $ZnCl_2$.

Product characteristic

Product related conditions, e.g. the concentration of the substance in a mixture, the physical state of that mixture (solid, liquid; if solid: level of dustiness), package design affecting exposure)

The concentration of $ZnCl_2$ (or Zn compound) in the mixture is < 25%

- The mixture is in the solid state, with a low level of dustiness; however, powder forms can occur, the medium dustiness is therefore applied as a worst case.

Amounts used

Amounts used at a workplace (per task or per shift); note: sometimes this information is not needed for assessment of worker's expo-sure

- The quantities involved in this scenario are 10-50 times smaller than in blending (GES 4-GES 5); the concentration of the zinc substance is also lower (<25%).
- Typical quantities for both Industrial and professional are 50 T/y (typical), or 0.15 T/day, 0.05 T/shift
- maximum use quantity is 500T/y (1.5T/d, 0.5T/shift) in industrial setting.

Frequency and duration of use/exposure

Duration per task/activity (e.g. hours per shift) and frequency (e.g. single events or repeated) of exposure

8 hour shifts (default worst case) are assumed as starting point; it is emphasised that the real duration of exposure could be less. This has to be considered when estimating exposure.

Human factors not influenced by risk management

Particular conditions of use, e.g. body parts potentially exposed as a result of the nature of the activity

Uncovered body parts: (potentially) face

Other given operational conditions affecting workers exposure

Other given operational conditions: e.g. technology or process techniques determining the initial release of substance from process into workers environment; room volume, whether the work is carried out outdoors/indoors, process conditions related to temperature and pressure.

- Industrial / Professional:
    - Dry processes: dry operational conditions throughout the process; no process waters;
    - indoor processes in confined area.

Technical conditions and measures at process level (source) to prevent release

Process design aiming to prevent releases and hence exposure of workers; this in particular includes conditions ensuring rigorous containment; performance of containment to be specified (e.g. by quantification of residual losses or exposure)

- Industrial /professional
  - Local exhaust ventilation on work areas with potential dust generation, dust capturing and removal techniques
  - Process enclosures where appropriate
-

Technical conditions and measures to control dispersion from source towards the worker

Engineering controls, e.g. exhaust ventilation, general ventilation; specify effectiveness of measure

- Industrial /professional:
  - Local exhaust ventilation systems and process enclosures are generally applied
  - Cyclones/filters (for minimizing dust emissions): efficiency 70%-90% (cyclones); dust filters (50-80%)
  - LEV in work area: efficiency 84% (generic LEV)
-

Organisational measures to prevent /limit releases, dispersion and exposure

Specific organisational measures or measures needed to support the functioning of particular technical measures (e.g. training and supervision). Those measures need to be reported in particular for demonstrating strictly controlled conditions (to justify exposure based waiving).

In general, management systems are implemented; They include general industrial hygiene practice e.g.:
  - information and training of workers on prevention of exposure/accidents,
  - procedures for control of personal exposure (hygiene measures)
  - regular cleaning of equipment and floors, extended workers instruction-manuals
  - procedures for process control and maintenance,...
  - personal protection measures (see below)

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

Personal protection, e.g. wearing of gloves, face protection, full body dermal protection, goggles, respirator; specify effectiveness of measure; specify the suitable material for the PPE (where relevant) and advise how long the protective equipment can be used before replacement (if relevant)

Wearing of gloves and protective clothing is compulsory (efficiency >=90%).

With normal handling, no respiratory personal protection (breathing apparatus) is necessary. If risk for exceedance of OEL/DNEL, use e.g.:

-dust filter-half mask P1 (efficiency 75%)

-dust filter-half mask P2 (efficiency 90%)

-dust filter-half mask P3 (efficiency 95%)

-dust filter-full mask P1 (efficiency 75%)

-dust filter-full mask P2 (efficiency 90 %)

-dust filter-full mask P3 (efficiency 97.5%)

Eyes: safety glasses are optional

Exposure estimation and risk characterisation

1. Environment

The processes involved in this scenario are all dry, so there are no process waters. Even when no process waters are involved, occasional non-process-waters can occur having some zinc content, due to e.g. from dust cleaning. The physical form of the preparations is usually solid; the dustiness is then much lower than with the original substance $ZnCl_2$. However, since powder forms can occur, medium dustiness is applied as worst case.

The risk assessments on zinc and zinc compounds reported no measured exposure data on these scenarios. Therefore exposure has to be modelled. Based on the modelling, recommendations can be made (see discussion below).

The resulting exposure estimates and risk characterisations are summarized in table below. The specific environmental release factors are (Verdonck et al., 2010):

-to air: 0.03% - 0.0003 g/g
-to water: 0.02% - 0.0002 g/g

Table 39. Environmental risk characterisation for the Industrial and professional use of solid substrates containing less than 25% w/w of $ZnCl_2$.

	tonnage used (T/y)	PEC water (µg/l)	PEC/PNEC water*	PEC sediment Mg/kgDW)	PEC/PNEC sediment*	PEC soil (mg/kgDW)	PEC/PNEC soil*	PEC STP (mg/l)	PEC/PNEC STP
Industrial / Professional	50 (typical)	3.9	0.19	101	0.43	41	0.39	0.014	0.26
	100 (trigger for refined assessment	5.1	0.25	231	0.98	41	0.39	0.046	0.87

*PECs include the regional PEC

Discussion:

The model predictions indicate that up to a use of 100T/y, no risks are predicted for this scenario.

At uses > 100T/y, a more refined assessment of the possible emissions to water should be made (exposure assessment based on real measured data and local parameters). If needed, some form of water treatment, on site or off-site, according to national legislation and permits, should be applied.

Conclusion

When considering typical use quantities, model calculations predict no risk for the environment for the downstream use processes using $ZnCl_2$. When use quantities exceed a critical level of 100T/y, more refined assessment should be done and risk management measures should be applied to ensure safe use.

Calculation of local exposure- Bioavailability correction

The local exposure at a given site can be calculated specifically using the excel sheet prepared by Arche (see “tools” on http://www.reach-zinc.eu/)

In addition, bioavailability corrections can be integrated in the exposure assessment, if the environmental parameters that are needed for the calculations, are documented.

- For water assessment, bioavailability model correction can be applied when the following water parameters are documented for the receiving water: Dissolved organic carbon (DOC), pH, hardness or Ca-concentration. For the calculations, the “zinc BLM-calculator” excel tool is used to this end (see “tools” on http://www.reach-zinc.eu/). When the local values of these parameters are unknown, regional data can be used as an alternative. Use of regional instead of local values should always be handled with caution.
- For sediment, a generic bioavailability factor of 2 is already integrated in the PNEC, based on AVS/SEM levels and according to the risk assessment (ECB 2008). A further refinement of local bioavailability can be made when local AVS/SEM concentrations are documented. The bioavailable fraction of zinc is given by subtracting local AVS from local SEM-Zn (SEM-Zn - AVS).
- For soil, a worst case bioavailability correction (corresponding to sandy soils) is already integrated. Further refinement for zinc bioavailability in other soil types is possible, when the local soil type is documented, together with pH, CEC (see “tools” on http://www.reach-zinc.eu/)

2. Workers

Occupational exposure to $ZnCl_2$ when using $ZnCl_2$-containing preparations in solid form is possible due to possible dust formation. These dusts may lead to contamination of the facility and to exposure (direct or indirect) of workers, by inhalation and dermal contact.

However, most of the products formed (pellets, fluxes ..) are solid, so dustiness is limited. The mixture is in the solid state, with a low level of dustiness; however, powder forms can occur, the medium dustiness is therefore applied as a worst case. Pulmonary absorption may occur but most of the material that is deposited in the head and the tracheobronchial region is rapidly translocated to the GI tract and part of it will be absorbed in the GI tract.

Because of lack of any measured data, worker exposure is assessed using the MEASE model. As a worst case, professional situation is taken for the model calculations. Distinction is being made between indoor and outdoor use. No LEV is assumed present in the latter situation.

Table 40: Occupational exposure data for the Industrial and professional use of solid substrates containing less than 25%w/w of $ZnCl_2$.

	Inhalation exposure (mg Zn/m3) (total inhalable)*	Risk ratio inhalation**	Inhalation systemic (mg/d)**	Dermal exposure systemic (mg/d) ****	Total systemic exposure (mg/d)	Risk ratio (systemic) total
MEASE modelling: professional (= worst case for industrial) indoor full shift, PROC 4, 5, 6, 8b, 9,10, 13	≤0.675	≤0.675	≤4.0	≤0.12	≤4.1	≤0.4
MEASE modelling: professional (= worst case for industrial) indoor full shift, PROC 11, 19	≤3	≤3	≤12	≤0.12	≤12	≤1.2
with respiratory protection if > 1 hr (e.g.: P1 mask (=MEASE: AFP4-mask)	**≤ 0.75**	**≤ 0.75**	**≤3.0**	**≤0.12**	**≤ 3.1**	**≤0.3**
MEASE modelling: professional (= worst case for industrial) outdoor full shift, PROC 4, 5, 6, 8b, 9,10, 13, 19	≤3	≤3	≤6	≤0.12	≤6	≤0.6
with respiratory protection if > 1 hr (e.g.: P1 mask (=MEASE: AFP4-mask)	**≤ 0.75**	**≤ 0.75**	**≤ 3.0**	≤0.12	≤3.1	≤0.3
MEASE modelling: professional (= worst case for industrial) outdoor full shift, PROC 11	12	12	48	≤0.12	48	4.8
with respiratory protection if > 1 hr (e.g.: MEASE: AFP4-mask)	0.6	0.6	1.2	≤0.12	1.3	0.13

*MEASE parameters were set as follows:

- Solid, medium dustiness
- Content in preparation: 5-25%
- Process category (PROC): as indicated
- Process T: 25°C
- Scale of operation: professional
- Duration of exposure: >240 minutes
- Pattern of use: wide dispersive
- Patter of exposure control: direct handling
- Contact level: extensive
- Implemented RMMs: LEV generic (indoor); no RMM (outdoors)
- Efficiency based on: median estimate
- No RPE
- Use of gloves: properly designed

** DNEL inhalation for ZnCl2 is 1.0 mg/m3, for ZnO 5mg/m3

*** 40% respiratory absorption was assumed for $ZnCl_2$ and ZnSO4, 20% for ZnO; 10m3 respiratory volume/d

****dermal absorption of 0.2% for dust

Conclusion:

Based on modeling of exposure, no risk is predicted indoor for workers/professional users, for the majority of the PROC codes (4, 5, 6, 8b, 9,10, 13) of this scenario, following the risk management measures indicated. For the PROCs 11, 19 however, respiratory protection (e.g. with P1 mask) is required when exposure exceeds 4 hrs.

Outdoors, risk is predicted for the PROCs 4, 5, 6, 8b, 9,10, 13, 19. Wearing of a P1 mask is necessary when exposure exceeds 4 hrs. For PROC 11 higher level respiratory protection is recommended as a function of exposure time, e.g. mask with >95% efficiency when exposure exceeds 4 hrs, mask with efficiency > 90% when exposure exceeds 1 hr, but is less than 4hrs.

9.1.8. GES $ZnCl_2$-7 : Industrial and professional use of dispersions, pastes and polymerised substrates containing less than 25%w/w of $ZnCl_2$.

Table 41. GES $ZnCl_2$-7

Exposure Scenario Format (1) addressing uses carried out by workers
9.1.8.Title of Exposure Scenario number GES $ZnCl_2$ - 7 : Industrial and professional use of dispersions, pastes and polymerised substrates containing less than 25%w/w of $ZnCl_2$.
List of all use descriptors related to the life cycle stage and all the uses under it; include market sector (by PC), if relevant; ***SU: 5, 6, 9, 11, 12, 13, 15, 17, 18, 19, 20, 22*** ***PROC: 7, 8a, 8b, 9, 10, 11, 13, 14, 17, 19, 21*** ***PC:1, 4, 8, 9,14, 19, 20, 21, 24, 25, 28, 29, 31, 32, 35 , 39*** ***AC: 1, 2, 7, 11*** ***ERC: 8a, 8c, 8d, 8f, 10a***
9.1.8. Exposure Scenario
9.1.8.1. Contributing scenario (1) controlling environmental exposure for the Industrial and professional use of dispersions, pastes and polymerised substrates containing less than 25%w/w of $ZnCl_2$.
Further specification: This scenario covers both the industrial scale processes and professional use. In the described process, the $ZnCl_2$ containing preparation/mixture is further processed, involving potentially the following steps: • Reception/unpacking of material

- Final application, spraying, embedding or to produce the end product or article.

Product characteristics

Product related conditions:

$ZnCl_2$ (or Zn compound) in the article is < 25%

Amounts used

Daily and annual amount per site:

- The quantities involved in this scenario are 10-50 times smaller than in blending (GES 4-GES 5); the concentration of the zinc substance is also lower (<25%).
- Typical quantities for both industrial and professional are 50T/y (typical), maximum 500T/y (in industrial setting).

Frequency and duration of use

Continuous production is assumed as a worst case. Usually, use is not continuous; this has to be considered when estimating exposure.

Environment factors not influenced by risk management

Flow rate of receiving surface water:

default for generic scenario: 18,000 m3/d, unless specified otherwise

Other given operational conditions affecting environmental exposure

Other given operational conditions: e.g. technology or process techniques determining the initial release of substance from process (via air and waste water); dry or water based processes; conditions related to temperature and pressure; indoor or outdoor use of products; work in confined area or open air;

- Wet processes. All process and non-process waters should be recycled internally to a maximal extent. Even when no process waters occur, some non-process water can be generated containing zinc (e.g. from cleaning)
- In industrial and professional setting, all processes are performed in a confined area. All residues containing zinc are recycled.

Technical conditions and measures at process level (source) to prevent release

Process design aiming to prevent releases and hence exposure to the environment; this includes in particular conditions ensuring rigorous containment; performance of the containment to be specified (e.g. by quantification of a release factor in section 9.x.2 of the CSR);

- In industrial and professional setting the following applies:
  - Process enclosures where relevant and possible
  - Local exhaust ventilation on furnaces and other work areas with potential dust generation.
  - Dust capturing and removal techniques are applied.
  - Containment of liquid volumes in sumps to collect/prevent accidental spillage

Technical onsite conditions and measures to reduce or limit discharges, air emissions and releases to soil

Technical measures, e.g. on-site waste water and waste treatment techniques, scrubbers, filters and other technical measures aiming at reducing releases to air, sewage system, surface water or soil; this includes strictly controlled conditions (procedural and control technology) to minimise emissions; specify effectiveness of measures;
specify the size of industrial sewage treatment plant (m3/d), degradation effectiveness and sludge treatment (if applicable);

- In industrial and professional setting, the following applies:
  - If zinc emissions to water, on-site waste water treatment techniques can be applied to prevent releases to water (if applicable) e.g.: chemical precipitation, sedimentation and filtration (efficiency 90-99.98%).
    - By exposure modelling it is predicted that at use quantities of >100T/y, refinement of the exposure assessment to water and sediment needs to be made (exposure assessment based on real measured data and local parameters). Treatment of the emissions to water may be needed under such conditions (see "exposure estimation and risk characterisation").
  - Air emissions are controlled by use of bag-house filters and/or other air emission abatement devices e.g. fabric or bag filters, wet scrubbers. This may create a general negative pressure in the building.

Organizational measures to prevent/limit release from site

Specific organisational measures or measures needed to support the functioning of particular technical measures. Those measures need to be reported in particular for demonstrating strictly controlled conditions.

In general, emissions are controlled and prevented by implementing an appropriate management system. This would involve:

- information and training of workers,
- regular cleaning of equipment and floors,
- procedures for process control and maintenance,...

- Treatment and monitoring of releases to outside air, and exhaust gas streams, according to national regulation.
- SEVESO 2 compliance, if applicable.

Conditions and measures related to municipal sewage treatment plant

Size of municipal sewage system/treatment plant (m3/d); specify degradation effectiveness; sludge treatment technique (disposal or recovery); measures to limit air emissions from sewage treatment (if applicable); please note*: the default size of the municipal STP (2000 m^3/d) will be rarely changeable for downstream uses.*

In cases where applicable: default size, unless specified otherwise.

Conditions and measures related to external treatment of waste for disposal

Fraction of used amount transferred to external waste treatment for disposal; type of suitable treatment for waste generated by work-ers uses, e.g. hazardous waste incineration, chemical-physical treatment for emulsions, chemical oxidation of aqueous waste; specify effectiveness of treatment;

- If any, all hazardous wastes are treated by certified contractors according to EU and national legislation.
- Users of Zn and Zn-compounds have to favour the recycling channels of the end-of-life products
- Users of Zn and Zn-compounds have to minimize Zn-containing waste, promote recycling routes and, for the remaining, dispose the waste streams according the Waste regulation.

Conditions and measures related to external recovery of waste

Fraction of used amount transferred to external waste treatment for recovery: specify type of suitable recovery operations for waste generated by workers uses, e.g. re-distillation of solvents, refinery process for lubricant waste, recovery of slags, heat recovery out-side waste incinerators; specify effectiveness of measure;

- All residues are recycled or handled and conveyed according to waste legislation.

9.1.8.2. Contributing scenario (2) controlling worker exposure for the Industrial and professional use of dispersions, pastes and polymerised substrates containing less than 25%w/w of $ZnCl_2$.

Product characteristic

Product related conditions, e.g. the concentration of the substance in a mixture, the physical state of that mixture (solid, liquid; if solid: level of dustiness), package design affecting exposure)

The concentration of $ZnCl_2$ (or Zn compound) in the mixture is < 25%

- Particles can occur sporadically, the low level of dustiness is basically applied.
- Most of the processes imply the use of solutions or pastes; the “solution status” is therefore taken as the worst case.

Amounts used

Amounts used at a workplace (per task or per shift); note: sometimes this information is not needed for assessment of worker’s expo-sure

- The quantities involved in this scenario are 10-50 times smaller than in blending (GES 5-GES 5); the concentration of the zinc substance is also lower (<25%).
- Typical quantities for both Industrial and professional are 50 T/y (typical), or 0.15 T/day, 0.05 T/shift.
- maximum use quantity is 500T/y (1.5T/d, 0.5T/shift) in industrial setting.

Frequency and duration of use/exposure

Duration per task/activity (e.g. hours per shift) and frequency (e.g. single events or repeated) of exposure

8 hour shifts (default worst case) are assumed as starting point; it is emphasised that the real duration of exposure could be less. This has to be considered when estimating exposure.

Human factors not influenced by risk management

Particular conditions of use, e.g. body parts potentially exposed as a result of the nature of the activity

Uncovered body parts: (potentially) face

Other given operational conditions affecting workers exposure

Other given operational conditions: e.g. technology or process techniques determining the initial release of substance from process into workers environment; room volume, whether the work is carried out outdoors/indoors, process conditions related to temperature and pressure.

- Industrial / Professional:
  - Wet processes, all indoor in confined area.

Technical conditions and measures at process level (source) to prevent release

Process design aiming to prevent releases and hence exposure of workers; this in particular includes conditions ensuring rigorous containment; performance of containment to be specified (e.g. by quantification of residual losses or exposure)

- Industrial /professional
  - Local exhaust ventilation on work areas with potential dust generation, dust capturing and removal techniques
  - Process enclosures where appropriate
-

Technical conditions and measures to control dispersion from source towards the worker

Engineering controls, e.g. exhaust ventilation, general ventilation; specify effectiveness of measure

- Industrial /professional:
  - Local exhaust ventilation systems and process enclosures are generally applied
  - Cyclones/filters (for minimizing dust emissions): efficiency 70%-90% (cyclones); dust filters (50-80%)
  - LEV in work area: efficiency 84% (generic LEV)
-

Organisational measures to prevent /limit releases, dispersion and exposure

Specific organisational measures or measures needed to support the functioning of particular technical measures (e.g. training and supervision). Those measures need to be reported in particular for demonstrating strictly controlled conditions (to justify exposure based waiving).

In general, management systems are implemented; They include general industrial hygiene practice e.g.:
  - information and training of workers on prevention of exposure/accidents,
  - procedures for control of personal exposure (hygiene measures)
  - regular cleaning of equipment and floors, extended workers instruction-manuals
  - procedures for process control and maintenance,...
  - personal protection measures (see below)

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

Personal protection, e.g. wearing of gloves, face protection, full body dermal protection, goggles, respirator; specify effectiveness of measure; specify the suitable material for the PPE (where relevant) and advise how long the protective equipment can be used before replacement (if relevant)

Wearing of gloves and protective clothing is compulsory (efficiency >=90%).

With normal handling, no respiratory personal protection (breathing apparatus) is necessary. If risk for exceedance of OEL/DNEL, use e.g.:

-dust filter-half mask P1 (efficiency 75%)

-dust filter-half mask P2 (efficiency 90%)

-dust filter-half mask P3 (efficiency 95%)

-dust filter-full mask P1 (efficiency 75%)

-dust filter-full mask P2 (efficiency 90 %)

-dust filter-full mask P3 (efficiency 97.5%)

Eyes: safety glasses are optional

Exposure estimation and risk characterisation

1. Environment

The processes involved in this scenario are wet. Non-process-waters can occur having some zinc content, due to e.g. from dust cleaning. The physical form of the preparations is usually liquid; the dustiness is then much lower than with the original substance $ZnCl_2$. However, aerosols can occur occasionally, "solution status" is applied as worst case for dustiness in modelling.

The risk assessments on zinc and zinc compounds reported no measured exposure data on these scenarios. Therefore exposure has to be modelled. Based on the modelling, recommendations can be made (see discussion below).

The resulting exposure estimates and risk characterisations are summarized in table below. The specific environmental release factors are (Verdonck et al 2010):

-to air: 0.03% - 0.0003 g/g

-to water: 0.02% - 0.0002 g/g

Table 42. Environmental risk characterisation for the Industrial and professional use of liquid substrates containing less than 25% w/w of $ZnCl_2$.

	tonnage used (T/y)	PEC water (µg/l)	PEC/PNEC water*	PEC sediment Mg/kgDW)	PEC/PNEC sediment*	PEC soil (mg/kgDW)	PEC/PNEC soil*	PEC STP (mg/l)	PEC/PNEC STP
Industrial / Professional	50 (typical)	3.9	0.19	101	0.43	41	0.39	0.014	0.26
	100 (trigger for refined assessment	5.1	0.25	231	0.98	41	0.39	0.046	0.87

*PECs include the regional PEC

Discussion:

The model predictions indicate that up to a use of 100T/y, no risks are predicted for this scenario.

At uses > 100T/y, a more refined assessment of the possible emissions to water should be made (exposure assessment based on real measured data and local parameters). If needed, some form of water treatment, on site or off-site, according to national legislation and permits, should be applied.

Conclusion

When considering typical use quantities, model calculations predict no risk for the environment for the downstream use processes using $ZnCl_2$. When use quantities exceed a critical level of 100T/y, more refined assessment should be done and risk management measures should be applied to ensure safe use.

Calculation of local exposure- Bioavailability correction

The local exposure at a given site can be calculated specifically using the excel sheet prepared by Arche (see "tools" on http://www.reach-zinc.eu/)

In addition, bioavailability corrections can be integrated in the exposure assessment, if the environmental parameters that are needed for the calculations, are documented.

- For water assessment, bioavailability model correction can be applied when the following water parameters are documented for the receiving water: Dissolved organic carbon (DOC), pH, hardness or Ca-concentration. For the calculations, the "zinc BLM-calculator" excel tool is used to this end (see "tools" on http://www.reach-zinc.eu/). When the local values of these parameters are unknown, regional data can be used as an alternative. Use of regional instead of local values should always be handled with caution.
- For sediment, a generic bioavailability factor of 2 is already integrated in the PNEC, based on AVS/SEM levels and according to the risk assessment (ECB 2008). A further refinement of local bioavailability can be made when local AVS/SEM concentrations are documented. The bioavailable fraction of zinc is given by subtracting local AVS from local SEM-Zn (SEM-Zn - AVS).
- For soil, a worst case bioavailability correction (corresponding to sandy soils) is already integrated. Further refinement for zinc bioavailability in other soil types is possible, when the local soil type is documented, together with pH, CEC (see "tools" on http://www.reach-zinc.eu/)

2. Workers

Occupational exposure to zinc chloride when using $ZnCl_2$-containing preparations in liquid form is possible due to aerosol formation. These aerosols may lead to exposure (direct or indirect) of workers, by inhalation and dermal contact.

However, most of the products formed (dispersions, pastes and polymerised substrates, fluxes ..) are liquid, so dustiness is very limited, and “solution status” is applied as worst case for dustiness in modelling. Pulmonary absorption may occur but most of the material that is deposited in the head and the tracheobronchial region is rapidly translocated to the GI tract and part of it will be absorbed in the GI tract.

Because of lack of any measured data, worker exposure is assessed using the MEASE model. As a worst case, professional situation for “solutions” handling is taken for the model calculations. Distinction is made between indoor and outdoor professional use. In the latter situation, no LEV is assumed present.

Table 43. Occupational exposure data for the Industrial and professional use of solid substrates containing less than 25%w/w of $ZnCl_2$.

	Inhalation exposure (mg Zn/m3) (total inhalable)*	Risk ratio inhalation**	Inhalation systemic (mg/d)***	Dermal exposure systemic (mg/d)****	Total systemic exposure (mg/d)	Risk ratio (systemic)

MEASE modelling*: professional (= worst case for industrial); indoor PROCs: **8a, 8b, 9, 10, 13, 14, 15, 17, 21**	≤ 0.675	≤0.675	≤ 2.7	≤ 0.06	≤2.7	≤ 0.27
MEASE modelling: professional (= worst case for industrial) ; indoor full shift, **PROC 7, 11** • without respiratory protection* • **with respiratory protection (e.g.: P1 mask (=MEASE AFP 4 Mask)**	≤ 2.7 **≤ 0.7**	≤ 2.7 **≤ 0.7**	≤ 10.8 **≤ 1.4**	0.09 **0.09**	≤10.9 **≤1.4**	≤ 1.1 **≤ 0.14**
MEASE modelling: professional (= worst case for industrial) ; indoor full shift, **PROC 19*** • **= respiratory protection already included**	**0.3**	**0.3**	**1.2**	**0.03**	**1.2**	**0.12**
MEASE modelling*: professional (= worst case for industrial); outdoor PROCs: **8a, 8b, 9, 10, 13, 14, 17, 21**	**≤ 0.6**	**≤0.6**	**≤0.06**	**0.3**	**≤0.36**	**≤0.04**
MEASE modelling*: professional (= worst case for industrial); outdoor (no LEV assumed) PROC 11 PROC 11 with mask e.g. AFP 20 (95% efficiency)	**12** **0.6**	**12** **0.6**	**48** **2.4**	**0.3** **0.3**	**48** **2.7**	**4.8** **0.3**

*MEASE parameters were set as follows:

- aqueous solution
- Content in preparation: 5-25%
- Process category (PROC): as indicated

- Process T: 25°C
- Scale of operation: professional
- Duration of exposure: >240 minutes,
- Pattern of use: wide dispersive
- Patter of exposure control: direct handling
- Contact level: intermittent
- Implemented RMMs: LEV generic , for outdoor: none
- Efficiency based on: median estimate
- No RPE, unless indicated otherwise
- Use of gloves: properly designed

** DNEL inhalation for ZnCl2 is 1.0 mg/m3
***40% respiratory absorption was assumed for $ZnCl_2$ and ZnSO4, and 10m3 respiratory volume/d
****dermal absorption of 0.2% for dust, 2% for liquid

Conclusion:

For indoor processes, based on modelling of exposure, no risk is predicted for workers/professional users for most of the PROC codes of this scenario (5, 8a, 8b, 9, 10, 13, 14, 17, 21), following the risk management measures indicated. However, for PROCs 7,11 and 19, respiratory protection is required when exposure exceeds 1 hr.

For outdoor professional use, for PROC 11 (non-industrial spraying), a mask should be worn, with an efficiency depending on the time of exposure, e.g.: when >240 minutes exposure: with 95% efficiency.

9.2. Consumer exposure

Introduction

$ZnCl_2$ can be used in several consumer products. Consumer exposure was assessed in detail in the EU risk assessment (Part: human health). In this assessment, it was remarked that the total daily consumer exposure could be higher than from the substance alone, by the use of consumer products containing other zinc substances at the same time. Therefore, the RA made an integrated analysis of human consumer exposure from all main consumer products (containing different zinc substances) combined. Since this combined exposure is the reality of consumer exposure, this approach is also followed in the present analysis.

The risk assessment identified the main possible sources of consumer exposure. Since the pattern of consumption of consumer products containing zinc substances has not changed significantly after the closure of the risk assessment, the analysis made in the RA is considered still relevant for the consumer exposure at present and taken over in this CSR. Conform to the approach followed in the RA, the consumer exposure analysis is identical for all zinc substances. The RA analysis indeed included not only exposure from the products, containing the 6 zinc substances evaluated under 793/93/EEC, but also the exposure from products containing other, e.g. organic zinc substances.

Related to the calculations of exposure, the main assumptions made in the RA were that uptake through inhalation was negligible and that the dermal absorption of the zinc compounds from any of the consumer products is 2% for solutions/suspensions, and 0.2% for dust/powder (same values as applied in the industrial environment).

Consumer exposure analysis of the RA (ECB 2008)

Remark: The section below is identical for all six zinc compounds evaluated under EU Regulation 793/93. Specific information is available for five of the six zinc compounds under evaluation (zinc phosphate, zinc distearate, zinc oxide, zinc chloride and zinc sulphate), as well as for some other zinc compounds not under evaluation. The latter information has also been included, because consumers (knowingly or unknowingly) at the same time can be exposed to several zinc-containing products, and irrespective of the original zinc compounds in these products, exposure will ultimately be to Zn^{2+}.

paint

- Anti-corrosive primer containing 30% zinc phosphate.

Assuming a frequency of 0.5 events/year with a dermal exposure of 2.7 g (paintbrush) or 10.8 g (spraying; roughly estimated as 4x paintbrush) primer/event, the maximum exposure will be 1.62 g zinc phosphate/year ≈ 2.25 mg Zn^{2+}/day. With a dermal absorption of 2% the uptake is estimated to be 0.045 mg Zn^{2+} /day.

- Impregnating agent containing 40% zinc naphthenate.

Assuming a frequency of 0.5 events/year with a dermal exposure of 2.7 g impregnating agent/event, the exposure will be 0.54 g zinc naphthenate/year ≈ 0.44 mg Zn^{2+}/day (percentage of zinc in zinc naphthenate is estimated at 30%). With a dermal absorption of 2% the uptake is estimated to be 0.0088 mg Zn^{2+}/day.

<u>cosmetics</u>

- Eye shadow containing 10% zinc distearate (it mainly concerns glossy, emulsion-like eye shadows).

By an application of 10 mg/event for 3 times/day, the exposure to eye shadow is 30 mg/day, which contains 3 mg zinc distearate ≈ 0.31 mg Zn^{2+}/day. Assuming a dermal absorption of 2% the uptake is estimated to be 0.0062 mg Zn^{2+} /day.

- Sunscreen containing 10% zinc oxide (refers to a protection factor 20-25!).

By an application of 9 g sunscreen/event, 3 events/day during 18 days/year the exposure will be 1332 mg sunscreen/day, being 107 mg Zn^{2+}/day. Assuming a dermal absorption of 2% the uptake is estimated to be 2.14 mg Zn^{2+}/ day.

- Deodorant contains 10-20% large organic zinc compounds, but apparently no ZnO.

The dermal exposure is 3 g or 0.5g/event by using a spray or a roll-on, respectively. In both cases the use is once a day. Maximum dermal exposure to deodorant is 3000 mg/day ≈ 300 mg zinc compounds/day ≈ 30 mg Zn^{2+}/day (percentage of zinc in these zinc compounds is estimated at 10%). Assuming a dermal absorption of 2% the uptake is estimated to be 0.6 mg Zn^{2+}/day.

- Dandruff shampoo containing 5% zinc compounds such as zinc pyrithione and zinc omadine (5% is estimated based on other active components in dandruff shampoos).

By a usage of 12 g shampoo/event for 4 times/week, the dermal exposure to shampoo will be 6800 mg/day with a content of 340 mg zinc compounds. Assuming that 10% of these compounds consist of zinc and that the dermal absorption is 2%, the uptake via the use of dandruff shampoo will be 0.68 mg Zn^{2+}/day.

<u>drugstore products</u>

- 'Baby care' ointment containing 15% zinc oxide for the irritated skin (intensive ointment) or 5% zinc oxide for protective treatment when changing diapers.

The assumption was made that the usage will be 50 g of the intensive ointment/year, leading to a dermal exposure of 7.5 g ZnO/year ≈ 16.5 mg Zn^{2+}/day. Assuming a dermal absorption of 2% the uptake is estimated to be 0.33 mg Zn^{2+}/day.

- Gargle containing 6.88 mg zinc chloride/ml.

Assuming a use of 10 g gargle/event (≈ 10 ml/event), 4 times/day for 4 weeks/year, the exposure during these 4 weeks will be 1120 g gargle/year ≈ 3.1 g gargle/day, which is ≈ 10 mg Zn^{2+}/day. Assuming that almost nothing will be swallowed, there is only buccal uptake via the mucous membranes. As the contact time is very short, the uptake is assumed to be very limited. Hence, with an arbitrary absorption value of 2% the uptake is estimated to be 0.2 mg Zn^{2+}/day.

- Eye drops containing 0.25% zinc sulphate (2.5 mg/ml).

The assumption was made that the usage will be 2 eye drops (0.025 ml/drop)/event, 6 times/day during 4 weeks/year, leading to an exposure of 8.4 ml eye drops/year ≈ 23 mg eye drops/day ≈ 0.058 mg zinc sulphate/day ≈ 0.023 mg Zn^{2+}/day. Assuming an absorption of 2% the uptake is estimated to be 0.00046 mg Zn^{2+}/day.

- Zinc oil containing 60% ZnO, which is merely used medically for the treatment of skin disorders.

The assumption was made that the usage will be 100 g/year, leading to an exposure of 60 g ZnO/year ≈ 0.131 g Zn^{2+}/day. Assuming a dermal absorption of 2% the uptake is estimated to be 2.62 mg Zn^{2+}/day.

Remark: it is noted that with skin disorders uptake might be higher than 2%. However, how much more is not known. Besides, it is not expected that the possible higher amount absorbed will disturb the homeostatic balance.

- Dietary supplements containing zinc.

Results from a recent report on the food intake of the general population in the Netherlands (Hulshof et al., 1998) indicate that approximately 10% of the population uses dietary supplements, which amongst others can contain zinc. As it is not known how much zinc-containing dietary supplements are used and in what frequency, it is difficult to estimate the exposure to zinc from dietary supplements from this report.

A dietary survey in the UK showed that <1-3% of the participants in different age groups took zinc supplements, providing median zinc intakes of 0.3-3.4 mg/day. However, the contribution of this supplemental zinc intake to the population average zinc intakes from food and supplements combined was negligible (EVM, 1999).

<u>Conclusion</u>

The compound specific exposure estimates for the different zinc compounds are taken across to the risk characterisation. However, the total daily exposure to zinc can be higher since several zinc compounds are used in consumer products. Not all of these products are used regularly or at the same time (see above). It is assumed that dandruff shampoo, deodorant, eye shadow, and possibly baby care ointment will be used on a regular basis (more than once a week), resulting in a cumulative uptake of approximately 1.6 mg Zn^{2+}/day. Therefore this value will also be taken across to the risk characterisation, as this is a more realistic calculation of the daily consumer exposure to zinc.

9.3. Indirect exposure of humans via the environment

The EU risk assessment (ECB 2008) assessed the risks for this scenario. Considering that:

-the production and use pattern of zinc and zinc compounds has not changed significantly since the closure of the RA, and

-the RA calculated the exposure through air and water based on the reported emissions data for zinc towards the air and water environment. These emissions have further decreased since the closure of the RA, so the analysis of the RA can be considered as realistic, but conservative for the situation today.

The analysis made in the framework of the EU RA is taken over in the present analysis as a conservative, realistic assessment of exposure of man through environment.

The related sections out of the **zinc chloride** RA are taken over below. It should be noted that in this section the zinc cation is discussed, not the salt from which it originates.

General exposure

The most important exposure to zinc for the general population is by the ingestion of foods. Especially meat and meat products, milk and milk products, bread and starchy foods contribute to the dietary zinc intake.

The risk assessment summarised that average dietary intake of zinc by adults in nine European countries was 9.1-12.3 mg/day. Only for adult males in Germany and Italy a higher daily dietary intake of 14-15 mg/day was reported. Figures for the Netherlands reporting an average daily intake of zinc of 9.4 mg (minimum of 0.6 mg and a maximum of 39 mg) confirmed this range. A 95-percentile value of 15.4 mg (P_5=4.7, P_{10}=5.5, median=9.0, P_{90}=13.8) was calculated. The Dutch intake figures were based on a random group of 6,250 persons.

The differences in zinc intake vary due to source and variety of the food.

An epidemiological study has been carried out by Kreis (1992) in which the health effects of cadmium (and zinc) were investigated in a contaminated area in the southern part of the Netherlands (Kempenland). A population sample aged 30-69, with a residence of at least 15 years in a rural village in Kempenland (NL) was compared with a control population of an unpolluted area. About 75% of the inhabitants of both areas consumed at least half of their vegetables from local gardens. The plasma concentration of zinc did not differ between the exposed (n = 299) and the reference population (n = 295) after adjustment for age and gender. The author concluded that, in contrast to cadmium, zinc exposure probably did not differ between the two villages.

For zinc levels in groundwater, the RA mentioned data for the Netherlands. The National Soil Monitoring Network in the Netherlands reported maximum zinc concentrations in upper groundwater of 1.1 mg/l (cattle farms) and 3.1 mg/l (forest locations). Recent zinc concentrations in large surface water in the Netherlands are reported to be all below 0.1 mg/l. Recent atmospheric zinc concentrations in the Netherlands were reported to be below 0.1 µg/m^3 (annual averages). Higher concentrations, up to 14 µg/m^3, were reported for Belgium (older data).

Under normal conditions, drinking water and ambient air are minor sources of zinc intake. Cleven et al. (1993) estimated the intake by drinking water and ambient air to be <0.01 mg/day and 0.0007 mg/day, respectively. The monitoring data above indicate somewhat higher intakes, but it is to be noted that nowadays in the EU upper groundwater and large surface water are not directly representative for drinking water. It was mentioned that in the Netherlands, monitoring of zinc in drinking water was ceased (at water companies) or about to be ceased (at pumpstations) (pers.comm. by RIVM-LWD, 1999).

It was concluded that the recent average dietary intake of zinc is around 10 mg/day. This value is taken across to the risk characterisation. Compared to this intake via food, intake via drinking water and ambient air is considered negligible.

Local exposure $ZnCl_2$

<u>Estimated local zinc concentrations in water and air around industrial facilities</u>

In the EU risk assessment, surface water maximum local zinc concentrations (PEC_{add}s) of 45.6 µg/l and 3154 µg/l (total zinc) were estimated for the production and processing of zinc chloride, respectively (RA ZnCl2, ECB 2008; see 3.2.1.2).

Maximum atmospheric zinc concentrations (PEC_{add}s) are 0.0525 µg/m^3 and 3.2 µg/m^3, for production and processing, respectively (RA ZnCl2, ECB 2008; see 3.2.1.2).

The PEC_{add}s mentioned above were taken across to the risk characterisation.

9.4. Regional exposure concentrations

The regional (environmental) exposure assessment integrates the environmental exposure following from the use of zinc containing articles by consumers. All exposures to the zinc ion coming from the use of all zinc substances are combined to an “overall” zinc emission and exposure, so no distinction is being made between zinc substances. Consequently, this overall “regional” analysis is relevant for the environmental exposure following from consumer use of all zinc substances.

The analysis presented below is based on the extensive regional exposure assessment conducted in the framework of the Zn risk assessment (ECB, 2008). The following updates were made in the present analysis:

- Extension of the EU RAR diffuse data set developed for EU-15 towards the EU-27 and recalculation of the regional and continental exposure concentrations

- Update of the monitoring data

The EUSES calculations have been run using the new data and the EUSES 2.0 model.

9.4.1. Modelling approach: diffuse source analysis

9.4.1.1. Overview national emission data

For the EU RA, emission data were reported for The Netherlands (1999), Belgium (1995), Sweden (1990-1995), Germany (1998) and UK (1999 and 2000). The diffuse sources analysis for the Netherlands (**Table 119)** revealed that for the water compartment STP effluents, industry, and traffic are important sources of zinc. For air, industry is the largest contributor.

The emissions data reported in the RA zinc were the result of an in-depth discussion and are still considered to be relevant for the situation today, because the use pattern of zinc has not significantly changed since the closure of the RA. However, some updates have been done:

Table 44. Zinc emissions to water, soil and air in the Netherlands (data from the RA from 1999, with some updates) (in t/y).

	Waste water	**Surface water**	**Soil**	**Air**
Agriculture	4	4	850 5)	
Industry	63	31		64
Waste treatment	4	-		
Traffic	140	54 1)	150	22
Consumers	212	8	4	5
Trade and Services 3)	37	2		
Effluents STP	-	95		
Others	0.4	50 2)	238 4)	
Atmospheric deposition	-	8	90	
Total	**460**	**254**	**1332**	**91**

1) Original CCDM figure of 84 t/y was corrected for new (preliminary) estimates for emissions from ship anodes (7 t/y instead of 23.9 t/y) and anodes on lock gates (14 t/y instead of 27.7 t/y)
2) Including emissions from a.o. overflows and separated (rainwater) sewer.
3) Trade and Services (HDO in Dutch) comprises emissions from a.o. car trade, storage firms, educational institutes, medical care, government agencies, recreation and sports and catering industry
4) Emissions from 'Others' to soil mainly comprises emissions from composted/re-used or incinerated sewage treatment sludge .
5) Soil is the primary receiving compartment for zinc emissions from agricultural activities. It has to be noted, however, that owing to runoff etc. a significant part of this load will end up in surface water. Recent figures of 2008 showed a net input (corrected for harvest removal) of 850 t/y (CBS, 2008)

Zinc emissions from sacrificial anodes on e.g. lock gates and ships contribute to water emissions under Traffic. Other zinc emissions from traffic, other than corrosion of crash barriers, are related to wearing of tyres and brakes and emissions from fuel and oil.

Within the target groups Consumers, Effluent STP and Others a significant part of the zinc emissions is due to corrosion of roofing and gutters of houses etc.

Agricultural activities represent the largest source of zinc emission to soil, mainly caused by excretion from animals (manure). For the Netherlands, a total agricultural bruto zinc emission to soil of 2,220 t/a was given for 1999. The estimate was mainly based on total usage of animal feed, its zinc contents and absorption rates of zinc in animals. A large proportion of the feed given to the animals is not absorbed (20-50%). This fraction will pass straight into the manure. Corrected for harvest removal a net input of 1,620 t/y was obtained (ECB 2008). Recent information of the CBS (Netherlands, 2008) revealed that this emission is significantly reduced over the years. For the reference year 2008 a bruto emission to soil of 1,480 t/y and a net input of 850 t/y has been reported. These figures will be used for further calculations.

Table 120 provides a comparison of the zinc emissions to the different environmental compartments (air, water and soil) from the identified diffuse sources between the Netherlands, Germany, Belgium, Sweden and the UK. In this overview those emissions are excluded which are not relevant to the circumstances in other countries (e.g. mining).

Table 45. Comparison of total emission rates (tonnes/year) for The Netherlands, Germany, Belgium and Sweden

Compartment	Netherland (1999)	Germany	Belgium (1995)	Sweden (1990-1995)
Air	91	6,640	440	230 + diffuse emissions
Water	254	5,200	527	260 + diffuse emissions
Soil	2,720	8,670	Not available	1,266[1]
Total	3,065	20,510	967	1,786 + diffuse emissions

1) calculated from Table 3.2 in Landner and Lindeström report (1998). Total of 527 g/ha/y and area of 24,000 km^2.

As discussed in the RA, it would be too speculative to draw sound conclusions on the differences between these four countries because of the imbalance in the data set, the different assessment methods etc. The available dataset of Belgium was e.g. incomplete and the Swedish dataset was rather dated and less complete compared to that of the Netherlands. The information for Germany seemed to be rather complete, although they were compiled from several sources and the reference period for the water emissions was unclear. Nevertheless data from Sweden and the Netherlands were, roughly taken, in the same order of magnitude (total volume of 3065 t/y (NL) versus 2966 (2301) t/y (S). The German data seemed to support this conclusion, as the size of the country and its number of inhabitants in comparison with the Netherlands was reflected in the total emission data for zinc. Generally, the UK total zinc emission input to soil also seemed to fit with the German data for soil, regarding the size of both countries (ECB 2008).

In the EU RA, the Netherlands was selected as EU-region because the most recent, extended and detailed information was available for this country. The area of the Netherlands also corresponds with the area of a regional system (40,000 km^2). Finally, the zinc emissions of the Netherlands were assumed to be representative for an EU regional system, which was generally supported by the above-mentioned comparison with other EU countries.

For reasons of consistency, the same approach, i.e. using the NL as regional model, was applied in the present analysis. It must of course be stated that for specific emission sources (e.g. agriculture) rather large differences may occur between EU regions. Given however the high population density of the Netherlands and the concentration of main diffuse sources e.g. agriculture, the NL data can be considered as realistic worst case for the EU.

9.4.1.2. Continental releases and PEC calculations

The emissions used for the continental scale (foreign emissions) are defined according to the following TGD default equation:

$$Continental\ Emission = 10 * Regional\ Emission - Regional\ Emission$$

However, for zinc most continental emissions to air, water and soil are initially not calculated with this equation, because more realistic extrapolation factors are available from other sources. These extrapolation factors are applied to the emission inventory of the Netherlands in order to extrapolate to the EU 27.

For **industrial** emissions (water and air) a factor of **31** is used to extrapolate the NL data to the EU. This extrapolation factor of 31 is based on the ratio NL inhabitants (16 million) versus EU inhabitants (501 million). The assumption is that there is a relationship between the number of inhabitants and the industrial activities. This is an arbitrary choice, but the standard TGD factor of 10 is considered to be too low for zinc. This because it is known that there are a number of EU Member States with (much) higher zinc production and processing activities than the Netherlands. The EU atmospheric emission becomes about 2,711 t/a (Erreur ! Source du renvoi introuvable. **24**; Note: this value also includes traffic emissions for which another extrapolation factor is used; see below). This value is lower than the estimate available for Germany (7,190 t/a). The background of this value is unknown however, and, additionally, it is unknown to which period the German data refers. It is further known that the last decade a considerable number of emission reduction measures has been taken by industry. Some support for the current estimate of 1,984 t/y for EU extrapolated air emissions from industry comes from very recent and reliable US data. The TRI database gives a total zinc atmospheric emission figure of 6,500 t/a for the US industry in 1998. The TRI database gives a total US industrial emission value of 800 t/y which is very close to the total EU estimated surface water emission of 961 t/y for industry. For comparison, the EU ePRTR (2008) mentions the following emissions for the total EU industry: to air: 1077T; to water: 3070T/y.

For **agricultural soil** emissions a factor of **10** is used on the recent Dutch estimate of 850 t/y (corrected for harvest removal). This is the TGD default factor, and was considered in the EU RA to reflect the extensive concentration of agriculture in the Netherlands, as compared to other countries. . The EU estimate amounts to 10 * 850 t/y = 8,500 t/y.

For **consumers, waste treatment, trade and services, STP effluent and others** the NL/EU inhabitants correction factor of **31** is used as these sectors are all related to consumption aspects. Emissions from corrosion contribute significantly to the emissions from these target groups. The extrapolation factor of 31 is considered applicable to emissions from corrosion as well. It is noted that due to progressive reduction of atmospheric SO2 emissions in Europe during the last decade, the atmospheric corrosion of zinc will have decreased further over the last decade. Support for the extrapolation for consumers etc. on the basis of the inhabitants ratio is given by the fact that more or less similar zinc levels are monitored in the communal sewage sludge of a number of EU countries (see section 9.3.2.1.4.).

For **traffic** emissions to soil an extrapolation factor from the Netherlands to EU of **26** is used based on recent road transport statistics (EUROSTAT, 2009). The same factor of 26 is used for traffic emissions to waste water and surface water. However, a considerable part (about 20 tonnes) of the traffic emissions to surface water comes from emissions of zinc anodes. A lower factor (default) of 5 is used for emissions from anodes, as this usage is expected to be relatively high in the Netherlands.

Details and results of the calculations for the conversion of NL data into the EU are presented in table below

Table 46. Conversion of the NL emission data to EU.

	Surface water NL emission (t/y) and relevant extrapolation factor	**EU (t/y)**	**Soil** NL emission (t/y) and relevant extrapolation factor	**EU (t/y)**	**Air** NL emission (t/y) and relevant extrapolation factor	**EU (t/y)**
Agriculture	4*10	40	850*10	8,500		
Industry	31*31	961			64*31	1,984
Waste treatment	-					
Traffic	34*26	884	150*26	3,900	22*26	572
	20*7	140				
consumers	8*31	248	4*31	124	5*31	155
Trade and services	2*31	62				
Effluents STP	95*31	2,945				
Others	50*31	1,550	238*31	7,378		
EU total		**6,830**		**19,902**		**2,711**
Agricultural soil				**8,500**		
Industrial soil				**11,402**		

Calculation of PEC_{add}

As mentioned, EUSES 2.0 has been used for calculating the regional PEC_{add} values for each environmental compartment. The input for the regional assessment are the emissions to air, wastewater, surface water and agricultural soil. For modelling the behaviour of zinc in the environment, the octanol-water partition coefficient (Kow) and the aqueous solubility are not appropriate. Measured solids-water partition coefficients for sediment, suspended matter and soil (Kp values) are used instead (Chapter R.16 ECHA, 2010).

The modelling for the freshwater compartment have been done using the average Kp SS value of 110,000 l/kg, that was reported for the Netherlands and used throughout the EU RA. The vapour pressure has been fixed at a low value of 1.10^{-10} Pa and the biotic and abiotic degradation rates have been minimised (Chapter R.16 ECHA, 2010 and Appendix R.7.13.2, ECHA 2008). With EUSES the regional environmental concentrations are directly calculated from the regional and continental emission input.

The definition of the continental scale (EU27) in the ECHA guidelines no longer corresponds to the EUSES model characteristics (EU15), since the significant increase in EU surface ($4{,}694\text{x}10^6$ km² versus $3.56\text{x}10^6$) is standard not taken forward to the EUSES model calculations. This would consequently lead to a significant additional loading of both the continental and the regional scale, since the total manufacturing/import and related emissions for the EU 27 will be applied to the former EU 15 surface. In order to avoid this bias the continental area parameters have been adapted to the EU 27 situation before performing the EUSES calculations (i.e continental area EU 27 cont. + region incl sea = 8.36 E+06 km^2 instead of 7.04E+06 km^2 for the EU 15) .

The used regional and continental emissions are presented in **Table 121**. The distribution of the diffuse zinc emissions over the various environmental compartments in Table 119 is based on two additional assumptions: 1) the soil emissions from traffic are all allocated to industrial/urban soil and 2) the soil emissions from consumers and others are allocated to industrial/urban soil except for the emissions from greenhouses. Emissions from greenhouses are added to the agricultural soil (negligible compared to emissions from manure etc.). The sludge application route is not taken into account in this regional assessment, because sewage sludge is not used in several countries and, additionally, it would result in an over conservative agricultural soil scenario in combination with the spread of manure over the soil.

The resulting regional PEC_{add} values (NL-region) are listed in **Table 122**. A PECadd total of 9.31 µg/l and a PECadd dissolved of 3.51 µg/l (Kp of 110,000 l/kg) is obtained for the aquatic compartment.

For the marine aquatic environment a PECadd total of 2.96 µg/l and a PECadd dissolved of 2.88 µg/l (Kp of 6,010 l/kg) is obtained.

For sediments a PECadd of 168 mg/kg wwt (Kp of 73,000 l/kg) is obtained.

It is stated that the PEC_{add} values are not corrected for the natural background concentrations in surface water, sediment and soil.

In the Zn RAR the influence was mentioned of zinc emissions to agricultural soil on the surface water concentrations by leaching and run-off (CIW, 2003). This aspect can be further investigated quantitatively in the EUSES calculations by varying the various emission input routes (e.g. estimation of PEC water with zinc emissions to agricultural soil set at zero, etc.). The impact of agricultural zinc emissions on the regional PEC water is found to be significant (approximately 60%), which is within the same order of magnitude as the preliminary conclusions of the CIW (2003) report (40%). Emissions to industrial soil (mainly from traffic) have a smaller, but still substantial (app. 20%) impact on the PEC water.

Table 47. Input data and results of the regional exposure assessment (all data refer to NL-region).

Input Regional:	
Amount released to air	91 t/y
Aount released to surface water	254 t/y
Amount released to agricultural soil	850 t/y
Amount released to industrial/urban soil	392 t/y
Input Continental:	
Amount released to air	2,711-91= 2,620 t/y
Amount released to surface water	6,830-254 = 6,576 t/y
Amount released to agricultural soil	8,500-850= 7,650 t/y
Amount released to industrial/urban soil	11,402-392= 11,0102 t/y
Results Regional:	
PEC_{add} air	0.0078 µg/m^3
PEC_{add} surface water (total) K_p 110,000 l/kg-freshwater	9.31 µg/l [1)]
PEC_{add} surface water (dissolved) K_p 110,000 l/kg-freshwater	3.51 µg/l [1)]
PEC_{add} surface water (total) K_p 6,010 l/kg –marine water	2.96 µg/l [1)]
PEC_{add} surface water (dissolved) K_p 6,010 l/kg-marine	2.88 µg/l [1)]

water	
PEC_{add} sediment (freshwater) K_p 73,000 l/kg- freshwater	159 mg/kg_{wwt} (418 mg/kg_{dwt})
PEC_{add} sediment (marine) K_p 6,010 l/kg-marine water	7.52 mg/kg_{wwt} (19.8 mg/kg_{dwt})
PEC_{add} agricultural soil	14.2 mg/kg_{wwt} (16.1 mg/kg_{dwt})
PEC_{add} natural soil	0.87 mg/kg_{wwt} (0.9 mg/kg_{dwt})
PEC_{add} industrial/urban soil	38.8 mg/kg_{wwt} (44. mg/kg_{dwt})

1) This value is calculated with a default suspended matter concentration of 15 mg/l.

9.4.2. Measured regional data in the environment

In this section measured zinc concentrations in various environmental compartments are presented.

Measured regional data aquatic compartment

Monitoring data before 2000 have been summarized and extensively discussed in the Zn RAR (ECB, 2008). In this section the regional analysis is discussed using data from 2000 onwards.

Water

Freshwater data

In the framework of the revision of the list of priority substances under the EU Water Framework Directive, recent monitoring data on zinc were reported by the member states to the commission (INERIS and IOW, 2009). For zinc, information was reported by the national water authorities of 20 of 27 member states. The data are from the national water monitoring programmes, and contain substantial influence from local issues e.g. industrial point source monitoring, monitoring of local mining activities, etc. Still, these data are all from the period after the year 2000, so they represent an update on the monitoring data reported in the RA, and are more relevant for the present day water quality in the EU.

Analysis of EU-P90 data

The dataset on updated monitored data for zinc (total concentrations) in EU waters yields an overall EU-90P zinc concentration of 32 µg Zn/l. This value is based on 5,881 stations in 16 countries, and 118,827 data points (INERIS and IOW 2009).

A number of countries also reported dissolved zinc concentrations. Surprisingly, the 90P of the dissolved zinc concentrations is higher than the 90P of the total concentrations. Yet, the dissolved fraction is only part of the total, and thus should be lower, logically. This anomaly can be explained by a number of reasons:

- The country-specific analysis (see below) indicates that 85% of the data in the dissolved dataset were reported by only one country (Spain). A basic methodological problem was identified with this Spanish dataset: the samples were at the spot directly stabilised with HNO_3 to pH 1-2, before sending them out for analysis. As such, zinc was extracted prior to analysis, and the results can not be considered as “dissolved” zinc concentration. The bulk of the “dissolved” dataset is thus not reflecting dissolved concentrations. For this reason, the calculated 90P dissolved concentration (INERIS and IOW 2009) cannot be used[1].
- It is well documented that significant contamination of the sample can occur when the sample is filtered in order to separate the dissolved from the total fraction. As a result of this manipulation, dissolved concentrations higher than total have been measured (STOWA 2007). In the zinc data set, there are 192,051 analyses, of which 118,825 are on whole water and 62,082 on dissolved water (of which 47,818 were from Spain). In most cases however, the analyses are conducted on different stations and separate samples. Only 74 stations have 1,525 samples with analyses on dissolved and whole water at the same date, of which 20 stations corresponding to 36 samples have dissolved concentration above whole water concentration. Although this limited comparison shows that contamination of the samples is possible, the paired data are too limited to conclude on the importance of this effect.
- The dissolved and total zinc concentration data were in most cases not monitored at the same stations nor even in the same countries/regions. The datasets on dissolved and on total are thus covering different areas.

The above may explain why the dissolved 90P is higher than the total 90P. Until there is more detailed information on the origin of the data, this remains unsolved. However, the fundamental uncertainty related to the relevancy of the dissolved concentrations for the current exercise remains. In this respect, it should be recognised that elevated zinc background due to local geological conditions can also be a reason for higher monitored values.

In conclusion, there is significant uncertainty regarding the relevancy of the measured dissolved zinc data for assessing the general water quality in the EU. Given that the total data are measured across the EU, that samples for total concentration analysis are not further manipulated, minimising the chance for contamination and other artefacts, and that there is fundamental uncertainty related to the quality and relevancy of the dissolved

[1] Due to lack of the original data, a 90P for the remaining data (without the data for Spain) cannot be calculated.

monitored data, the total measured zinc concentrations are considered more reliable and more relevant for conducting the regional exposure assessment for zinc.

Based on the general "EU-wide" 90P total concentration and recognizing that the PNEC used in this RA is an added value and is expressed on a dissolved basis, the methodology as set out in the EU RA, needs to be applied in order to convert the total concentrations into a bioavailable/dissolved) PEC add:

a) Correction for natural background:

The PNEC used in the RA is an added value, so has to be added to the background zinc concentration. According to the zinc RA, the natural background must be subtracted from the monitored PEC value. The average zinc background in the EU waters is set at 12 µg/l, with a lower estimate of 3µg/l (RA, EC 2008). So, the PEC add becomes: 32-12 = 20 µg Zn/l (average BG estimation), and 32-3 = 29 µg/l (lower BG estimation).

b) Dissolved concentrations:

The PNEC is expressed on a dissolved concentration basis. PEC and PNEC must be expressed on the same basis, so, the dissolved fraction of the PEC must be calculated from the total fraction. According to general RA methodology, the dissolved concentration can be calculated from the total, using the partition coefficient between zinc in water and suspended matter:

[Me]diss = [Me]total / 1+(Kp*Cs), where

-Kp: water-suspended matter partition coefficient for metal X (for zinc: 110000 l/kg (EU RA))

-Cs = suspended matter concentration (TGD default: 15 mg/l)

Calculated for zinc: [Zn]diss = [Zn]total / 1 + (110000 l/kg * 0.000015g/l) = [Zn]total / 2.7

The dissolved zinc concentration, to be compared with the PNEC is thus: 20/2.7=7.4 µg/l (average BG correction), and 29/2.7=10.7 µg Zn/l (lower BG correction).

c) Inclusion of bioavailability:

Finally, a correction for bioavailability of zinc in the natural waters needs to be made (ECB 2008). Lacking evidence on the physicochemical conditions of the waters in the updated monitoring database, several lines of evidence on EU water conditions can be used for setting an overall, representative but at the same time conservative value for zinc bioavailability:

- Using 50P values reported for dissolved organic carbon (DOC), pH and hardness in the EU, a typical bioavailability of zinc of 0.44 can be calculated (FOREGS 2006).
- In the RA, physicochemical conditions were reported for several EU waters. They allow to calculate typical bioavailability factors for zinc of 0.4-0.5. More recent data confirm this range (IZA 2010)
- In a detailed UK report (UK EA 2005), a general bioavailability factor of 0.6 was applied.
- The value of 0.6 is applied in the present analysis as an average, but conservative estimation of bioavailability of zinc in the EU waters.

The bioavailable fraction of zinc, to be compared with the PNEC according to the RA, is thus: 7.4 µg/l*0.6= 4.4 µg/l, and 10.7*0.6= 6.4 µg/l, resp.

Table below gives a summary of the calculations.

Table 48. Assessment of the recent monitored data on zinc, reported by 20 of 27 EU member states, according to the methodology as applied in the EU RAR on Zinc (ECB, 2008)

Description	Zn concentration (µg/l)
Measured 90 P [Zn] total (20/27 countries ; "PEC2")*	32
PEC added (correction for natural background**)	20 (29)**
PEC dissolved, calculated from total [Me]diss = [Me]total / 1+(Kp*Cs)	7.4 (10.7)
PEC added, bioavailable (Bioavailability correction; typical case EU waters: 0.6***)	4.4 (6.4)

*due to significant uncertainties about the quality of the bulk of the dissolved data, only the PEC total is considered to reflect the general water quality across the EU. Since all data need to be considered for making the assessment of water quality, including data below detection limit, the PEC2 (INERIS 2009) is used in the further analysis.

**equilibrium partitioning coefficient (2.7) and regional background taken from the RA (ECB 2008). Two values are given: average background according to RA, and (between brackets) the calculation done with the lower estimate of the natural background in EU waters (RA)

***Conservative estimation of the average bioavailability of zinc in EU waters, based on data reported in the EU RA.

Analysis of country data

In the same reporting exercise, data on total zinc concentration were reported by 16 member states individually. The country-PEC is, expressed as the 90P of the arithmetic means by sampling station. The PECs are given by country in **Table 124.**

Values in black are obtained from calculating the 90P from > 30 sampling stations, and are considered reliable. Values indicated in black italic are calculated from less than 30 stations and are therefore statistically not reliable (pers. Com. EU Commission, 2010); they are given as supporting evidence, only.

Table 49. Monitored total and added zinc concentrations (µg Zn/l) in EU member states.

Country	Nr of stations	Nr of analyses	90th percentile (all analyses)	90P add	90Padd dissolved	90P add dissolved bio-available
Austria	383	13,330	5.94	2.9	1	0.6
Belgium	*27*	*269*	*30.55*	*27.5-18.6*	*10.1-6.9*	*6.1-4.1*
Cyprus	31	84	121.67	118.7-109.7	44.0-40.6	26.3-24.3
Czech republic	312	20,641	38.47	35.5-26.5	13.1-9.8	7.9-5.9
Denmark	*16*	*317*	*21.41*	*18.4-9.4*	*6.8-3.5*	*4.1-2.1*
Estonia	*11*	*142*	*19.82*	*16.8-7.8*	*6.2-2.9*	*3.7-1.7*
France	968	8,630	36.28	33.3-24.3	12.3-9.0	7.4-5.4
Germany	200	8,644	36.22	33.2-24.2	12.3-9.0	7.4-5.4
Greece	165	628	38.36	35.4-26.4	13.1-9.8	7.9-5.9
Lithuania	*21*	*233*	*35.55*	*32.6-23.6*	*12.1-8.7*	*7.3-5.2*
Luxembourg	*7*	*180*	*31.15*	*28.2-19.2*	*10.4-7.1*	*6.3-4.3*
Netherlands	32	799	29.82	26.8-17.8	9.9-6.6	6.0-4.0
Portugal	318	8,021	21.28	18.3-9.3	6.8-3.4	4.1-2.1
Romania	104	768	64.85	61.9-52.9	22.9-19.6	13.7-11.7
Slovakia	*27*	*764*	*93.71*	*90.71-81.7*	*30.3-33.6*	*18.2-20.2*
United Kingdom	3,254	52,022	26.78	23.8-14.8	8.8-5.5	5.3-3.3

Marine waters

Recent monitoring data (2005-2009) on dissolved Zn concentrations are available for marine and coastal waters of the Netherlands (NL Ministry Rijkswaterstaat, 2010). Similar data (but less recent 1995-1998) are available for the Belgian part of the North Sea.

Netherlands

Dissolved Zn concentrations were reported for 8 marine stations, close to the coast or in open sea. Two stations (Walcheren and Schouwen) are located in Zeeland, South of The Netherlands; near the mouth of the Scheldt River. Goeree and Noordwijk are found in Holland (Goeree in the South of Holland close to Zeeland, and Noordwijk is situated North of Den Haag) and Terschelling and Rottumerplaat are two stations located in the “Wadden” sea.

Dissolved concentrations are available for the years 2005-2009. The overall percentiles based on the whole dataset as well as station percentiles are presented in table below. Data represent the situation from 2007 to 2009. Given the position of Dutch coastal waters at the mouth of major rivers in EU (Rhine, Meuse, Scheldt,...), this area can be considered as a realistic worst case of coastal water influence in the EU.

Table 50. Monitored dissolved zinc concentrations (µg Zn/l) in coastal waters and open sea of the Netherlands (2007-2009)

Station	**# samples**	**Percentile**	**Dissolved Zn concentrations (µg/l)**	**Dissolved Zn concentrations (µg/l) add***
Goeree (2 km off the coast)	34	90P	1.679	0.679
Goeree (6 km off the coast)	34	90P	1.597	0.597
Noordwijk (10 km off the coast)	35	90P	1.606	0.606
Noordwijk (2 km off the coast)	39	90P	1.464	0.464

Rottumerplaat (3 km off the coast)	32	90P	1.628	0.628
Schouwen (10 km off the coast)	34	90P	1.025	0.025
Terschelling (10 km off the coast)	33	90P	1.562	0.562
Walcheren (2 km off the coast)	34	90P	1.195	0.195
Overall	275	50P	0.3	
Overall	**275**	**90P**	**1.58**	**0.58**

**A correction for BG was made on zinc as the proposed marine PNEC is an added value. The default concentration used for background zinc is of 1 µg/L, which is the value proposed for the North Sea in the Zn RA based on a study made by Cleven et al., 1993.*

Belgium

Monitoring data for coastal waters were obtained from the North Sea data centre from the Management Unit of the North Sea Mathematical models (MUMM, 2010). They are less recent (going from 1995 to 1998) than the data found on the Dutch Ministry website. Dissolved zinc concentrations reported as 10, 50 and 90P values are presented in table below.

Table 51. Monitored dissolved zinc concentrations (µg Zn/l) in coastal waters of Belgium (1995-1998)

Area	# samples	Unit	10P	50P	90P	90Padd*
Coastal	141	µg/l	0.41	0.98	1.7	0.7

**A correction for BG was made on zinc as the proposed marine PNEC is an added value. The default concentration used for background zinc is of 1 µg/L, which is the value proposed for the North Sea in the Zn RA based on a study made by Cleven et al., 1993.*

Sediment

Freshwater sediments

Similar to the water compartment data on zinc concentrations in sediments were collected in the framework of the revision of the list of priority substances under the WFD (INERIS and IOW 2009). These data are all from the period after the year 2000, so they represent update on monitoring data for zinc and more relevant than the data in the RA.

Analysis of EU-P90 data

The dataset on updated monitored data for zinc in EU freshwater sediments (fraction < 2 mm) yields an overall EU-90P zinc concentration of 270 mg Zn/kg dwt. This value is based on 1,958 stations and 6,312 data points (INERIS and IOW 2009).

Marine sediments

Monitoring data for marine sediments are available for the Netherlands (NL Ministry Rijkswaterstaat, 2010) and Belgium (MUMM, 2010).

Netherlands

Zinc concentrations based on the 63 µm for the reference years 2000, 2003 and 2006 are available from 35 sampling stations (table below).

Table 52. Monitored sediment concentrations (mg Zn/kg dry wt) in the Netherlands (2000, 2003 and 2006)

Compartment	# samples	Unit	50P	90P	90P whole fraction add*
Marine sediment	141	mg/kg	140	210	82.8

(fraction < 63 µm)		dwt.			

**conversion to whole sediment fraction and background correction.*

Since the PNEC is related to the whole fraction in sediment, a conversion factor was applied to the data based on the 63µm fraction. This factor was obtained from an analysis made by INERIS (2009) of extensive data all over the EU of zinc and cadmium concentrations in the whole (“2mm”) fraction and the 63µm fraction. The 90P for both fractions are compared as follows:

Zinc: 90P 2mm fraction: 270 mg.kg dry wt^{-1} / 90P 63µm fraction: 399 mg.kg dry wt^{-1} = 0.68

After conversion to the whole fraction and a background correction (Zn 50P value from CSR = 60 mg Zn/kg dry wt) a 90P value of 82.8 mg Zn/kg dwt. is obtained.

Belgium

Monitoring data on coastal areas could also be retrieved from the Belgian North Sea Datacentre (http://www.mumm.ac.be/datacentre/index.php), where recent data (2000-2008) can be downloaded using a password.

Overall, the North Sea database contains mainly sediment data based on the 63 µm fraction (“fractionated sediments”). The 10,000 µm fraction ("unfractionated sediments") is reported to a much less extent, and as such, is not representative of the coastal area that we consider here for the regional assessment. The monitoring data based on the 63 µm fraction are presented in table below.

Table 53. Monitored sediment concentrations (mg Zn/kg dry wt) in Belgium

Compartment	# samples	Unit	50P	90P	90P whole fraction add*
Marine sediment (fraction < 63 µm)-coastal area	140	mg/kg dwt.	120	190.6	69.6

**conversion to whole sediment fraction and background correction.*

Since the PNEC is related to the whole fraction in sediment, a conversion factor was applied to the data based on the 63µm fraction. The same factor as applied above for the NL coastal waters, was used: 0.68.

After conversion to the whole fraction and a background correction (Zn 50P value from CSR = 60 mg Zn/kg dry wt) a 90P value of 69.6 mg Zn/kg dwt. is obtained for coastal areas.

Measured regional data Soil

An extensive soil data set is available from the Eurogeosurveys geochemical mapping of agricultural and grazing land soils project (GEMAS) for agricultural (arable) and grassland soils (Reimann et al, 2009).

Arable land

The GEMAS data contained 2,211 agricultural (arable) soil samples spread over Europe (**Table 129).**

Table 54. Monitored total zinc concentrations (mg Zn/kg dwt.) in arable soils in Europe.

Country	Arable soils			
	#	90 p (mg Zn/kg dwt.)	50 p (mg Zn/kg dwt.)	10 p (mg Zn/kg dwt.)
Austria	37	99.3	72.1	42.6
Belgium	14	147.4	53.2	41.4
Bosnia Herzegovina	16	97.0	76.6	49.1
Bulgaria	46	71.4	50.9	36.0
Croatia	31	84.0	65.8	39.5

Cyprius	6	68.4	54.4	36.4
Czech republic	34	114.1	62.9	45.4
Denmark	17	38.3	33.4	16.8
Estonia	18	63.5	30.5	23.8
Finland	155	76.0	29.1	11.8
Macedonia	10	132.1	66.2	56.2
France	225	101.9	46.7	19.5
Germany	154	87.0	44.8	19.0
Greece	87	79.4	54.3	29.8
Hungary	41	76.8	45.8	21.3
Ireland	22	84.9	57.9	31.6
Italy	124	90.9	61.7	38.1
Latvia	27	49.6	24.7	17.3
Lithuania	27	36.8	24.8	18.2
Luxembourg	1	35.8	35.8	35.8
Montenegro	6	107.0	83.9	62.8
Netherlands	15	102.2	46.3	19.8
Norway	136	94.3	44.6	21.1
Poland	135	60.7	24.2	10.4
Portugal	38	90.9	43.1	5.1
Switzerland	18	110.3	62.0	46.1
Slovakia	21	75.3	56.4	37.3
Slovenia	10	96.5	69.3	60.9
Spain	213	70.5	32.7	13.1
Serbia	36	84.9	62.6	48.6
Sweden	182	85.7	46.7	21.9
Ukraine	165	50.0	26.9	9.4
United Kingdom	145	111.8	59.4	25.9

Zinc 90th percentile concentrations for arable soils ranged between 35.8 and 147.4 mg Zn/kg dwt. with a median RWC PEC of 84.9 mg Zn/kg dwt.

Grassland

The GEMAS data contained 2,119 grassland soil samples spread over Europe (**Table 130**).

Table 55. Monitored total zinc concentrations (mg Zn/kg dwt.) in arable soils in Europe.

Country	**Grassland soils**			
	#	90 p (mg Zn/kg dwt.)	50 p (mg Zn/kg dwt.)	10 p (mg Zn/kg dwt.)
Austria	37	110.8	76.9	52.9
Belgium	14	120.8	71.4	37.7
Bosnia Herzegovina	16	89.4	70.4	55.1
Bulgaria	46	74.8	53.4	35.8
Croatia	31	101.7	61.0	47.8
Cyprius	6	43.8	32.8	22.7
Czech republic	34	111.5	68.5	37.1

Denmark	17	38.6	26.7	13.8
Estonia	18	125.1	29.6	16.5
Finland	43	50.7	22.0	8.6
Macedonia	10	93.8	64.0	35.6
France	230	96.7	48.3	19.7
Germany	153	102.5	51.4	19.8
Greece	87	98.0	54.7	27.7
Hungary	41	79.1	50.1	25.0
Ireland	32	105.3	54.3	20.3
Italy	124	108.3	68.2	36.5
Latvia	27	46.5	23.7	11.1
Lithuania	27	35.5	27.0	17.5
Luxembourg	1	34.4	34.4	34.4
Montenegro	6	139.6	78.3	53.8
Netherlands	15	103.0	43.5	15.6
Norway	135	83.4	39.1	18.5
Poland	135	70.0	24.8	12.3
Portugal	38	95.1	32.2	4.0
Switzerland	18	115.4	85.4	54.6
Slovakia	21	75.9	56.2	35.3
Slovenia	10	110.6	75.3	61.7
Spain	213	70.0	34.1	11.9
Serbia	36	90.9	64.9	32.9
Sweden	187	86.6	43.2	21.6
Ukraine	166	50.0	26.5	8.4
United Kingdom	145	111.8	59.4	25.9

Zinc 90th percentile concentrations for grassland soils ranged between 34.4 and 139.6 mg Zn/kg dwt. with a median RWC PEC of 93.8 mg Zn/kg dwt.

Measured regional data Sludge and STP effluent

In the RA, a lot of information was available on the quality of sludge from both communal and private (mostly industrial) STPs in the Netherlands (CBS, 1999). Mean zinc concentrations in communal and private STP sludge amounted to, respectively, 865 mg/kg dwt and 143 mg/kg dwt in 1997. Much higher levels were found in the early eighties: 1739 mg/kg dwt in communal STPs and 617 mg/kg dwt in private STPs (1981 data). Erreur ! Source du renvoi introuvable.**13** gives the distribution of the sludge in Dutch communal STPs into four zinc concentration classes in 1997 and 1981.

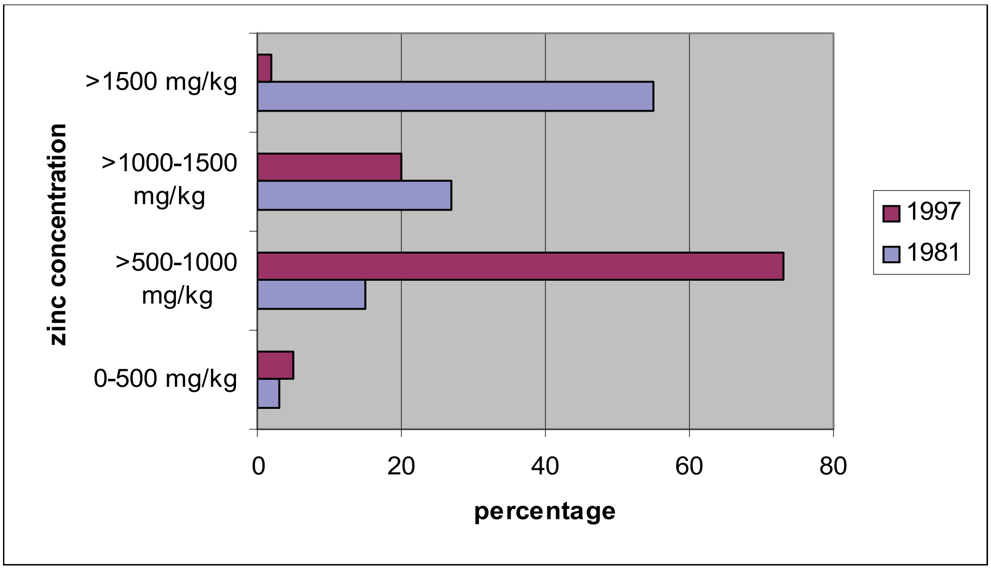

Figure 1. Zinc concentrations (classes) in sludge from communal waste water treatment plants in the Netherlands in 1981 and 1997 (after CBS, 1999).

The EU RA mentioned also other data (all referred in the RA report): UK data (1996/7) were available on the quality of sludge used in agriculture: the median zinc content was 559 mg/kg dwt and the 90th percentile-value was 1,076 mg/kg dwt. Median sludge levels in 1982/3 and 1990/1 were, respectively, 1205 and 889 mg/kg dwt, indicating a decrease in zinc levels during the period 1982-1997. The decreasing trend seemed to be similar to the situation in the Netherlands.

The same held for Germany. In the years 1982 and 1983-85 the Zn contents in sewage sludge used for agriculture were 1480 and 1318 mg/kg/dwt, respectively. More recent German data amounted to 863 (1995), 831 (1996) and 809 (1997) mg/kg dwt, pointing to a clear decrease in zinc levels in German sewage sludge from 1982 to 1997.

For Denmark the calculated load of zinc as a result of normal sewage sludge application in 1997, as a worst case situation in 1997 and 2000, were 3040 g/ha, 16,000 g/ha and 12,000 g/ha respectively. All figures were calculated based on the latest sludge directive in Denmark of 1996. In 1997 the weighted mean for zinc in Danish sewage sludge was 760 mg/kg dw for all sludges and 678 mg/kg dwt for sludges used to amend soils. The 90 P values were 1068 and 1069 mg/kg dwt, respectively.

In conclusion, the zinc sewage sludge concentration in various EU countries (the Netherlands, Germany, UK and Denmark, see table below) all decreased clearly during the 1980s-1990s and they were found to be at more or less the same levels in the RA. Reduced corrosion run-off rates, due to lower SO_2 levels may be one of the explanations for the decreasing trend. The observation of approximately the same (absolute) levels in different countries may point to a more or less similar zinc consumption pattern (at least via the sewage sludge route) in these EU countries.

Table 56. Former and recent zinc sewage sludge concentrations in various EU countries.

	Sludge concentration (mg/kg dwt)	
	Former data	1997
The Netherlands	1,739 (mean: early eighties)	865 (mean)
Germany	1,480 (mean ?; 1982)	809 (mean ?)
U.K.	1,205 (median; 1982/3)	559 (median)
Denmark	-	760 (mean)

For the Netherlands measured effluent concentrations were reported from a large number of (communal) sewage treatment plants in the range of 25-160 µg/l (respectively 5 and 95 percentile; RA zinc).

Measured regional data Air

Zinc concentrations in air reported in the RA are summarised in table below. These data were from the 1980s-1990s. Given the general decrease in zinc emissions to air observed over the last decade, these data can be considered as conservative estimates for the situation today.

Table 57. Measured zinc concentrations in air (EU RA, for references, see ECB 2008).

Location	Concentration ($\mu g/m^3$)	Source
The Netherlands (1995)	0.037-0.054 (annual mean, 4 locations)	Monitoring data LML (1995)
The Netherlands (1992)	0.038-0.057 (annual mean, 4 locations)	Aben et al. (1994)
Bilthoven (NL), 1990/1992	0.08 / 0.043 (annual mean) 0.160 (98%)	CCRX, 1991/1994
Vlaardingen (NL), 1990/1992	0.08 / 0.057 (annual mean) 0.210 (98%)	CCRX, 1991/1994
Houtakker (NL), 1990/1992	0.07 / 0.054 (annual mean) 0.210 (98%)	CCRX, 1991/1994
Belgium (1989/1990)	0.03-42.0 / 0.03-1.56 (monthly averages)	IDE (B), 1991 (A3)
Flanders (B), 1992-1993	0.07-1.02 (mean) 7.75-14.62 (maximum)	Vlaamse Milieumij, 1993 (A4)
The Netherlands	0.065 (calculated annual mean)	Cleven et al, 1993
North Limburg (B) (industrial area)	1-2 (mean)	Cleven et al, 1993
The Netherlands 1996-1998	0.05 (annual mean 1996) 0.04 (annual mean 1997) 0.04 (annual mean 1998)	RIVM, 1999
Beerse and Engis (B) 1985/1986 (industrial area)	3 (annual mean)	Cleven et al, 1993

9.4.3. Comparison of measured and calculated regional zinc concentrations

The risk characterisation should be based on the most realistic exposure information. Hence, it must be decided whether calculated regional concentrations or monitoring data are more useful for the exposure assessment. In this section a comparison is made between the measured concentrations of zinc in the various environmental compartments (section 9.3.2) and the corresponding calculated PEC_{add} values (section 9.3.1). It must be noted that measured concentrations can only directly be compared with calculated concentrations when the natural background concentration is added to the calculated values (**Table 133).**

Table 58. Regional concentrations in the environment

	Predicted (total) regional Exposure Concentrations		Measured (total) regional exposure concentrations		Source of measured data
	value	Unit	90P value	unit	
Freshwater	12.3-21.3[a]	Total µg Zn /l	32	Total µg Zn /l	EU-90P Ineris database (2009)
Marine water	2.88	dissolved µg Zn/l	1.58	dissolved µg Zn/l	NL 2010
Freshwater sediments	558[b]	mg/kg dwt.	270	mg/kg dwt.	EU-90P Ineris database (2009)
Marine sediments	79.8[c]	mg/kg dwt.	190.6-210	mg/kg dwt.	MUMM database (2010)
			210	mg/kg dwt.	Rijkswaterstaat (2010)
Agricultural soil	64.1[d]	mg/kg dwt.	84.9	mg/kg dwt.	PEC (Median of 90P) Gemas database (2009)
Grassland		mg/kg dwt.	93.8	mg/kg dwt.	PEC (median of 90P) Gemas database (2009)
Air	0.0078	µg added/m^3	0.04-0.05	µg/m^3	Netherlands, (1995-1998)

[a] *natural background of 12 and 3 µg/l is included*

[b] *natural background of 140 mg/kg dwt is included*

[c] *natural background of 60 mg/kg dwt (50th percentile) is included*

[d] *natural background of 48 mg/kg dwt (Foregs database 50th percentile, aqua regia) is included*

Water

The calculated regional (NL region) concentrations (PEC_{add}) of zinc in surface water is 9.31 µg/l ($C_{susp.}$ = 15 mg/l) expressed as total Zn (dissolved Zn = 3.51 µg/l). A meaningful comparison of measured and calculated data is possible because a large set of reliable monitoring data of zinc concentrations in surface water is available. Natural background values of 3 and 12 µg/l are added to the calculated concentrations. From this comparison it can be concluded that the modelled data underestimate the measured data. For the risk characterisation the measured data will be used.

Sediment

Freshwater sediment

Also for sediment a meaningful comparison of measured and calculated data is possible. A natural background level of 140 mg/kg dwt can be added to the calculated value (418 mg/kg dwt) yielding a total sediment concentration of 558 mg/kg dwt. The 90th percentile sediment concentration from the recently collected EU data amounts to 270 mg/kg dwt (INERIS & IOW 2009) which is lower than the calculated values, including an added natural background estimate of 140 mg/kg dwt.

Marine sediment

For marine sediments a natural background value of 60 mg/kg dwt. is added. Measured data (190-210 mg/kg dwt) are higher than the modelled data (79.8 mg/kg dwt.)

Both for freshwater sediments and marine sediments preference is given to the measured data and these data have been taken forward to the risk characterisation section.

Air

The calculated regional concentrations (PEC_{add}) of zinc in air are 0.078 $\mu g/m^3$. Recent monitoring data of the Netherlands (0.04-0.05$\mu g/m^3$ for 1995-1998) are found to be in the same order of magnitude. Available Belgian monitoring data are higher than the calculated PEC_{add} for air. It is however noted that these data are older and were obtained partially in industrial areas.

Soil

The calculated regional concentrations (PEC_{add} NL region) of zinc in agricultural and natural soils are respectively 14.2 mg/kg_{wwt} (16.1 mg/kg_{dwt}) and 0.87 mg/kg_{wwt} (0.9 mg/kg_{dwt}). A comparison of the modelled agricultural data with monitoring data for arable land and grassland is performed by adding a natural background of 48 mg/kg dwt (FOREGS database, 50P, aqua regia). The calculated value from agricultural soil (64.1 mg/kg dry wt.) is slightly lower than the monitoring data for arable soil (84.1 mg/kg dwt)

In the risk characterisation both calculated and measured data will be used for the regional scale, but the emphasis will be put on the large number of measured data from various EU regions.