Sicherheitsdatenblatt

gemäß Verordnung (EG) Nr.1907/2006

ABSCHNITT 1: Bezeichnung des Stoffes / der Mischung und Firmenbezeichnung

1.1 Produktidentifikator

1.1.1	**Bezeichnung auf dem Kennzeichnungsschild/ Handelsname:**	**Eisen-II-chlorid-Lösung**
1.1.2	**Zusätzliche Bezeichnungen:**	**Eisen-II-chlorid-Lösung, technisch, enthält Salzsäure**
1.1.3	**REACH Registrierungsnummer:**	**n.a. für Mischungen**

1.2 Relevante identifizierte Verwendungen der Mischung und Verwendungen, von denen abgeraten wird

1.2.1	**Relevante identifizierte Verwendungen**:	Eine komplette Liste der identifizierten Verwendungen, für die ein Expositionsszenarium im Anhang des Sicherheitsdatenblattes angefügt ist, finden Sie im ABSCHNITT 16.
1.2.2	**Verwendungen, von denen abgeraten wird:**	Keine bekannt

1.3 Einzelheiten zum Lieferanten, der das Sicherheitsdatenblatt bereitstellt

1.3.1	**EG-Inverkehrbringer (Hersteller):**	Salzgitter Flachstahl GmbH
1.3.2	**Hausadresse:**	Eisenhüttenstraße 99, 38239 Salzgitter
1.3.3	**Postadresse:**	38223 Salzgitter
1.3.4	**Land**	Deutschland
1.3.5	**Telefon:**	05341 / 21-01
1.3.6	**Telefax:**	05341 / 21-39 21
1.3.7	**Auskunft gebender Bereich:**	Hauptabteilung Arbeitssicherheit Tel. 05341 / 21-22 01 Fax. 05341 / 21-39 21
1.3.8	**E-Mail (sachkundige Person):**	szfg.reach@salzgitter-ag.de
1.4	**Notrufnummer:** (24 h/d besetzt)	05341 / 21-112 (Werkfeuerwehr)

ABSCHNITT 2: Mögliche Gefahren

2.1 Einstufung des Stoffes oder Gemisches

2.1.1 Gemäß Verordnung (EG) Nr. 1272/2008:

Korrosiv gegenüber Metallen, Kategorie 1	H290 Kann gegenüber Metallen korrosiv sein.
Akute Toxizität, Kategorie 4	H302 Gesundheitsschädlich beim Verschlucken.
Hautreizungen, Kategorie 2	H315 Verursacht Hautreizungen.
Sensibilisierung der Haut, Kategorie 1	H317 Kann allergische Hautreaktionen hervorrufen.
Augenschädigung, Kategorie 1	H318 Verursacht schwere Augenschäden.

2.2 Kennzeichnungselemente VO (EG) Nr.1272/2008:

2.2.1 Gefahrenpiktogramme:

GHS05: Ätzend GHS07: Achtung

2.2.2 Signalwort: **Gefahr**

2.2.3 Gefahrenhinweise:

H290 Kann gegenüber Metallen korrosiv sein.
H302 Gesundheitsschädlich beim Verschlucken.
H315 Verursacht Hautreizungen.
H317 Kann allergische Hautreaktionen hervorrufen.
H318 Verursacht schwere Augenschäden.

2.2.4 Sicherheitshinweise:

P280 Schutzhandschuhe/ Schutzkleidung/ Augenschutz/ Gesichtschutz tragen.
P301+P312 Bei Verschlucken: Bei Unwohlsein Giftinformationszentrum oder Arzt anrufen.
P302+P352 Bei Berührung mit der Haut: Mit viel Wasser und Seife waschen.
P305+P351+P338+P310 Bei Kontakt mit den Augen: Einige Minuten lang behutsam mit Wasser ausspülen evt. vorhandene Kontaktlinsen nach Möglichkeit entfernen. Weiter ausspülen. Sofort Giftinformationszentrum oder Arzt anrufen.
P333+P313 Bei Hautreizung oder –ausschlag: Ärztlichen Rat einholen / ärztliche Hilfe hinzuziehen.
P362 Kontaminierte Kleidung ausziehen und vor erneutem Tragen waschen.

2.3 Zusätzliche Gefahrenhinweise für Mensch und Umwelt: Keine.

ABSCHNITT 3: Zusammensetzung / Angaben zu Bestandteilen

3.1 Chemische Charakterisierung (Mischung): Lösung von Eisen-II-chlorid und Salzsäure in Wasser

3.2 Gefährliche Inhaltsstoffe:

REACH Registriernummer: 01-2119498060-41-0003 **Bezeichnung:** Eisen-II-chlorid

EG-Nr.	CAS-Nr.	Anteil [%]	Einstufung VO (EG) Nr.1272/2008	
231-843-4	7758-94-3	20 -25%	Akute Toxizität, Kategorie 4;	H302
			Hautreizungen, Kategorie 2;	H315
			Sensibilisierung der Haut, Kategorie 1;	H317
			Augenschädigung, Kategorie 1;	H318

REACH Registriernummer: 01-2119484862-27 **Bezeichnung:** Hydrogenchlorid

EG-Nr.	CAS-Nr.	Anteil [%]	Einstufung
231-595-7	7647-01-0	<10 %	nach Verordnung (EG) Nr. 1272/2008, Index-Nr.: 017-002-01-X (Salzsäure …%)

Index-Nr.: 017-002-01-X:
Spezifische Konzentrationsgrenzen (VO (EG) Nr.1272/2008):

Hautätzung, Kategorie 1B	≥25%	H314
Hautreizung, Kategorie 2	10 – 25%	H315
Augenreizung, Kategorie 2	10 – 25%	H319
STOT (einmalig), Kategorie 3	≥10%	H335

3.3 Zusatzinformationen: Eisen-II-chlorid technisch kann bis zu 0,1% Nickel-II-chlorid (EINECS 231-743-0, CAS 7718-54-9) enthalten. Dies führt zu der zusätzlichen Einstufung H317.

ABSCHNITT 4: Erste Hilfe Maßnahmen

4.1 Beschreibung der Erste-Hilfe Maßnahmen

4.1.1 Allgemeine Hinweise: **Nach Durchführung der Erste-Hilfe-Maßnahmen sofort Arzt aufsuchen!** Beschmutzte, getränkte Kleidung sofort ausziehen.

4.1.2 Nach Einatmen: Die betroffene Person an die frische Luft bringen. Gesicht abwaschen, Mund und Nase mit Wasser spülen.

4.1.3	**Nach Hautkontakt:**	Betroffene Hautpartie mit viel Wasser spülen.
4.1.4	**Nach Augenkontakt:**	Auge unter Schutz des unverletzten Auges mindestens 10 Minuten unter fließendem Wasser bei weitgespreizten Lidern spülen. Augenarzt hinzuziehen.
4.1.5	**Nach Verschlucken:**	Mund sofort mit Wasser ausspülen und reichlich Wasser trinken lassen. Kein Erbrechen herbeiführen. Sofort Arzt hinzuziehen.
4.2	**Wichtigste akute und verzögert auftretende Symptome und Wirkungen:**	Vergiftungsgefahr beim Verschlucken, Reiz- / Ätzwirkung den Augen und Sensibilisierung der Haut.
4.3	**Hinweise für den Arzt:**	Hinweise zur Toxikologie siehe ABSCHNITT 11.

ABSCHNITT 5: Maßnahmen zur Brandbekämpfung

5.1	**Geeignete Löschmittel:**	Löschmaßnahmen auf die Umgebung abstimmen. Stoff selbst brennt nicht.
5.2	**Aus Sicherheitsgründen ungeeignete Löschmittel:**	Keine.
5.3	**Besondere vom Stoff ausgehende Gefahren:**	Entstehung giftiger, ätzender Gase (Hydrogenchlorid).
5.4	**Besondere Schutzausrüstung bei der Brandbekämpfung:**	Umgebungsluftunabhängiges Atemschutzgerät und Chemikalienschutzanzug tragen.
5.5	**Zusätzliche Hinweise:**	Kontaminiertes Löschwasser getrennt sammeln. Nicht in die Kanalisation, Oberflächenwasser oder Grundwasser gelangen lassen. Bei Kontakt mit Metallen Wasserstoffbildung möglich.

ABSCHNITT 6: Maßnahmen bei unbeabsichtigter Freisetzung

6.1	**Personenbezogene Vorsichtsmaßnahmen:**	Schutzausrüstung ggf. umluftunabhängiges Atemschutzgerät tragen. Ungeschützte Personen fernhalten. Für ausreichende Lüftung sorgen.
6.2	**Umweltschutzmaßnahmen:**	Nicht in den Boden, die Kanalisation oder in Gewässer gelangen lassen.
6.3	**Methoden und Material für Rückhaltung und Reinigung:**	Mit geeignetem flüssigkeitsbindenden Material (Sand, Kieselgur, Säurebinder, Universalbinder) aufnehmen, um Materialschäden zu vermeiden. In geeigneten, geschlossenen Behältern sammeln und zur Entsorgung bringen. Den betroffenen Bereich belüften.

ABSCHNITT 7: Handhabung und Lagerung

7.1 Schutzmaßnahmen zur sicheren Handhabung:

7.1.1	**Hinweise zum sicheren Umgang:**	Aerosolbildung vermeiden. Beim Ab- und Umfüllen Verspritzen vermeiden. Bei Verwendung dieses Produktes nicht essen, trinken oder rauchen.
7.1.2	**Technische Maßnahmen:**	Für ausreichende Belüftung sorgen und ggf. lokale Absaugung verwenden. Notdusche und Augenspülvorrichtung / Spülflasche in Arbeitsplatznähe bereit halten.

7.1.3 Hinweise zum Brand- und Explosionsschutz: Wasserstoffbildung als Reaktionsprodukt möglich. Stoff selbst brennt nicht (vgl. Pkt.5)

7.1.4 Allgemeine Hygienemaßnahmen: Im Arbeitsbereich nicht Essen, Trinken oder Rauchen. Keine Lebensmittel im Arbeitsbereich aufbewahren. Nach Arbeitsende und vor den Pausen Hände waschen.

7.2 Bedingungen zur sicheren Lagerung: Nicht zusammen mit Alkalien (Laugen) lagern. Getrennt von unedlen Metallen aufbewahren.
In korrosionsbeständigen Behältern aufbewahren. Kompatible Materialien: Kunststoffe (PE, PP, PVC), Glasfaser verstärkte Kunststoffe, Epoxidharz-beschichteter Beton.

7.3 Spezifische Endanwendungen: Abwasserbehandlung und Biogasbehandlung: Siehe Expositionsszenarien im Anhang.

ABSCHNITT 8: Begrenzung und Überwachung der Exposition/Persönliche Schutzausrüstung

8.1 Expositionsgrenzwerte

8.1.1 Arbeitsplatzgrenzwerte (TRGS 900):

CAS-Nr.	Bezeichnung	ml/m³	mg/m³	Spitzenbegrenzung
7647-01-0	Hydrogenchlorid	2	3	2 (I)

8.1.2 Arbeitsplatz-Richtgrenzwert (RL 2000/39/EG)

CAS-Nr.	Bezeichnung	8 Stunden		Kurzzeit (15 min)	
		ml/m³ (ppm)	mg/m³	ml/m³ (ppm)	mg/m³
7647-01-0	Hydrogenchlorid	5	8	10	15

8.1.3 DNEL- und PNEC-Werte:

Eisenchlorid:
PNEC Sediment aquatisch: 49,5 g/kg dwt
PNEC terrestisch: 55 g/kg dwt

DNEL (Arbeiter) dermal (Langzeit) 0,57 mg/kg bw/day
DNEL (Verbraucher) dermal (Langzeit) 0,29 mg/kg bw/day

Hydrogenchlorid:
PNEC Frischwasser: 0,036 mg/l
PNEC Meerwasser: 0,036 mg/l
PNEC Kläranlage: 0,036 mg/l

DNEL (Arbeiter) Inhalativ (akut/ Kurzzeit): 15 mg/m^3
DNEL (Arbeiter) Inhalativ (Langzeit): 8 mg/m^3

8.2 Begrenzung und Überwachung der Exposition

8.2.1 Begrenzung und Überwachung der Exposition am Arbeitsplatz: vgl. ABSCHNITT 7

8.2.2 Atemschutz: Bei Auftreten von Dämpfen /Aerosolen Atemschutzgerät mit Filtertyp E und Partikelschutz P2 tragen.

8.2.3 Handschutz: Hautschutzplan erstellen und beachten! Die Chemikalienbeständigkeit der Schutzhandschuhe ist mit dem Lieferanten abzuklären und muss den Spezifikationen der EG-Richtlinie 89/686/EWG und der daraus ergebenden Norm EN374 genügen. Geeignet sind Handschuhe aus folgenden Materialien

Bei Vollkontakt:
Handschuhmaterial: Nitrilkautschuk, NBR
Schichtstärke: 0,35 mm
Durchbruchszeit: > 480 Min.

Bei Kurzzeitkontakt / Spritzkontakt:
Handschuhmaterial: Nitrilkautschuk
Schichtstärke: 0,11 mm
Durchbruchszeit: > 480 Min.

8.2.4 Augenschutz: Dichtsitzende Schutzbrille bzw. Vollvisier-Gesichtsschutz tragen.

8.2.5 Körperschutz: Säurebeständige Schutzkleidung (ggf. mit Kopf und Nackenschutz)

8.3 Begrenzung und Überwachung der Umweltexposition: Siehe ABSCHNITT 7. Es sind keine darüber hinausgehenden Maßnahmen erforderlich.

ABSCHNITT 9: Physikalische und chemische Eigenschaften

9.1 Allgemeine Angaben

9.1.1	**Aggregatzustand:**	flüssig	
9.1.2	**Farbe:**	dunkelgrün	
9.1.3	**Geruch:**	leicht stechend	
9.1.4	**pH-Wert:**	< 1	
9.1.5	**Schmelzpunkt/ -bereich:**	n.z.	
9.1.6	**Siedepunkt/-bereich:**	n.z.	(1013 hPa)
9.1.7	**Dichte:**	ca. 1,35 g/ml	(20°C)
9.1.8	**Wasserlöslichkeit:**	mischbar	(20°C)
9.1.9	**Flammpunkt:**	n.z.	(1013 hPa)
9.1.10	**Zündtemperatur:**	n.z.	(1013 hPa)
9.1.11	**Untere Explosionsgrenze:**	n.z.	
9.1.12	**Obere Explosionsgrenze:**	n.z.	
9.1.13	**Dampfdruck:**	k.D.v.	(20°C)

9.2 Sonstige Angaben: Keine

ABSCHNITT 10: Stabilität und Reaktivität

10.1 Reaktivität: Wirkt korrodierend.

10.2 Chemische Stabilität: Stabil unter normalen Bedingungen.

10.3 Möglichkeit gefährlicher Reaktionen: Bildung von Wasserstoff bei Kontakt mit Metallen. Beim Erhitzen Freisetzung von Hydrogenchlorid.

10.4 Zu vermeidende Bedingungen: Erhitzen und Kontakt mit unedlen Metallen.

10.5 Unverträgliche Materialien: Unedle Metalle.

10.6 Gefährliche Zersetzungsprodukte: k.D.v.

ABSCHNITT 11: Toxikologische Angaben

11.1 Akute Wirkungen

11.1.1 Akute Toxizität:

Für die Mischung sind keine Daten verfügbar.

oral:
Ratte
LD 50: 132 - 881 mg/kg (Fe, metallisch) (CSR)
LD 50: 300 - 2000 mg/kg ($FeCl_2$) (CSR)
LD 50: ca. 237 mg/kg (HCl)
inhalativ:
Ratte, Prüfatmosphäre: Staub/Nebel
LC 50: 45,6 mg/l (HCL) 5 Minuten
LC 50: 8,3 mg/l (HCL) 30 Minuten
dermal:
Ratte
LD 50: > 2000 mg/kg ($FeCL_2$) (CSR)
Kaninchen
LD 50: > 5010 mg/kg (HCL)

11.1.2 Reiz- / Ätzwirkung auf die Haut:

Kaninchen
Für $FeCl_2$: 500 mg (OECD TG 405 und GLP)
Ergebnis: Leicht reizend (CSR)
Für HCl:
Ergebnis: ätzend

11.1.3 Reiz- / Ätzwirkung auf die Augen:

Kaninchen
Für $FeCl_2$: 100 mg (OECD TG 405 und GLP)
Ergebnis: ätzend (CSR)
Für HCl:
Ergebnis: ätzend

11.2 Sensibilisierung:

Es gibt keinen Hinweis darauf, dass Eisensalze sensibilisierend auf die Haut sind, jedoch führt die geringe Menge an Nickelchlorid zu der Einstufung.

11.3 Toxizität bei wiederholter Aufnahme:

$FeCl_2$, Ratte
NOAEL:125 mg/kg/d bis zu 54 Tagen

HCl, Ratte
LOAEL: 10 ppm inhalativ
Dosierungen: 0-10-20-50 ppm bis zu 90 Tagen
Hinweise auf andere Organschäden außer an den Atmungsorganen ergaben sich nicht.

11.4 CMR-Wirkungen (krebserzeugende, erbgutverändernde und fortpflanzungsgef. Wirkung)

11.4.1 Mutagen: Keine Hinweise auf mutagene Wirkung.

11.4.2 Karzinogen: Keine Hinweise auf Karzinogenität.

11.4.3 Reproduktionstoxisch: Keine Hinweise auf Reproduktionstoxizität.

11.5 Zielorgantoxisch (STOT):

11.5.1 Einmalige Exposition:

Für HCl: Kann die Atemwege reizen.
Für $FeCl_2$: Keine Daten verfügbar.

11.5.1 Wiederholte Exposition: Keine Daten verfügbar.

11.6 Aspirationstoxisch: Keine Daten verfügbar.

ABSCHNITT 12: Umweltbezogene Angaben

12.1 Ökotoxizität: Für die Mischung sind keine Daten verfügbar.

12.1.1 Aquatisch:

12.1.1.1 Fischtoxizität:

Kurzzeit:

Für $FeCl_2$ *(Fisch: Oryzias latipes)*
LC50 (96 h): 47 mg/l $Fe_{(gesamt)}$ (CSR)
LC50 (96 h): 6,9 mg/l $Fe_{(gelöst)}$ (CSR)
Für HCl *(Fisch: Leopomis macrochirus)*
LC50 (96 h): 20,5 mg/l HCl (pH 3,25-3,5)

Langzeit:
Für $FeCl_2$ *(Fisch: Salmo gairdneri)*
In vitro LOEC: 0,0005 mg/l (CSR)

12.1.1.2 Daphnientoxizität:

Kurzzeit:
Für $FeCl_2$ *(Wirbellose: Daphnia magna)*
EC50 (48h) 19 mg/l $Fe_{(gesamt)}$
EC50 (48h) 1,6 mg/l $Fe_{(gelöst)}$
Für HCl (*Wirbellose: Daphnia magna)* (CSR)
EC50 (48 h) 0,45 mg/l HCl (pH 4,92) (OECD 202)

12.1.1.3 Algentoxizität:

Kurzzeit:
Für $FeCl_2$ *(Alge: pseudokirchneriella subcapiata)*
EC50 (72h): 6,9 mg/l $Fe_{(gesamt)}$ (CSR)
Für HCl *(Alge:Chlorella vulgaris)*
EC50 (72 h) 0,73 mg/l HCl (pH 4,7) (OECD 201)

12.1.1.4 Bakterientoxizität:

Für HCl *(Belebtschlamm)*
EC50: 0,23 mg/l HCl (pH 5,2) (OECD 209)

12.2 Persistenz und Abbaubarkeit: Die Methoden zur Bestimmung der biologischen Abbaubarkeit sind bei anorganischen Stoffen nicht anwendbar.

12.3 Bioakkumulationspotenzial: Keine Daten verfügbar.

12.4 Mobilität im Boden: Keine Daten verfügbar.

12.5 Ergebnis der Ermittlung der PBT-Eigenschaften: Diese Mischung erfüllt nicht die Kriterien für eine Einstufung als PBT oder als vPvB.

12.6 Weitere ökologische Hinweise: Für HCl:
Schadwirkung auf Fische, Plankton und auf festsitzende Organismen durch pH-Verschiebung.

ABSCHNITT 13: Hinweise zur Entsorgung

13.1 Verfahren zur Abfallbehandlung: Produktreste sind unter der Beachtung der Abfallrichtlinie 2008/98/EG zu entsorgen.

13.2 Vorschlagsliste für Abfallschlüssel/ Abfallbezeichnungen gemäß EAKV: 11 01 05 (saure Beizlösungen)

13.3 Verpackung: keine Daten vorhanden

ABSCHNITT 14: Angaben zum Transport

14.1	**Landtransport ADR/RID und GGVS/GGVE (grenzüberschreitend/Inland):**	
14.1.1	**ADR/RID-GGVS/E Klasse:**	8
14.1.2	**Verpackungsgruppe:**	III
14.1.3	**Klassifizierungscode:**	**-**
14.1.4	**Kemmlerzahl:**	80
14.1.5	**UN-Nummer:**	3264
14.1.6	**Gefahrzettel:**	8
14.1.7	**Bezeichnung des Gutes:**	ätzender saurer anorganischer flüssiger Stoff, n.a.g.
14.1.8	**Tunnelbeschränkungscode:**	**-**
14.1.9	**Begrenzte Mengen:**	**-**
14.2	**Binnenschiffstransport (ADNR):**	-
14.2.1	**ADR/RID-GGVS/E Klasse:**	-
14.2.2	**Verpackungsgruppe:**	-
14.2.3	**Klassifizierungscode:**	-
14.2.4	**Kemmlerzahl:**	-
14.2.5	**UN-Nummer:**	-
14.2.6	**Gefahrzettel:**	-
14.2.7	**Bezeichnung des Gutes:**	-
14.3	**Seeschifftransport (GGVSee):**	kein Seeschifftransport
14.4	**Lufttransport (ICAO-IATA):**	kein Lufttransport

ABSCHNITT 15: Rechtsvorschriften

15.1 Vorschriften zu Sicherheit, Gesundheits- und Umweltschutz/spezifische Rechtsvorschriften für den Stoff oder das Gemisch

15.1.1	**Beschäftigungsbeschränkung:**	Beschäftigungsbeschränkungen für Jugendliche nach § 22 JArbSch.
15.1.2	**Wassergefährdungsklasse:**	Einstufung gemäß (VwVwS, Anhang 2): WGK 1 (schwach wassergefährdend)
15.1.3	**Störfallverordnung:**	n.z.
15.1.4	**Zusätzliche Hinweise zu nationalen Vorschriften:**	Die nationalen Vorschriften sind zu beachten.
15.2	**Stoffsicherheitsbeurteilung:**	Im Rahmen der REACH-Verordnung (EG) Nr.1907/2006 wurde eine Stoffsicherheitsbeurteilung für Eisen-II-chlorid durchgeführt, welche im Stoffsicherheitsbericht (CSR) dokumentiert ist.

ABSCHNITT 16: Sonstige Angaben

16.1 Änderungen: keine

16.2 Liste der relevanten identifizierten Verwendungen der Mischung:

ES I: Manufacturing of Iron Chlorides
ES II: Generic Formulation
ES III: Water Treatment: Treatment of raw and potable waters
ES IV: Water Treatment: Treatment of waste water and WWTP sludge
ES V: Use as a reactive product precursor
ES VI: Industrial and Consumer Use as a metal etchant and a surface treatment agent

16.3 Wortlaut der H- und EUH-Sätze gemäß CLP Verordnung (EG 1272/2008) unter den Abschnitten 2 und 3:

H290 Kann gegenüber Metallen korrosiv sein.
H302 Gesundheitsschädlich beim Verschlucken.
H314 Verursacht schwere Verätzung der Haut und schwere Augenschäden
H315 Verursacht Hautreizungen.
H317 Kann allergische Hautreaktionen hervorrufen.
H318 Verursacht schwere Augenschäden.
H319 Verursacht schwere Augenreizung.
H335 Kann die Atemwege reizen.

16.4 Literatur, Quellen: **Stoffsicherheitsbericht** (*CSR Chemical Safety Report*) “Eisenchlorid” erstellt gemäß Verordnung (EG) Nr.1907/2006. **Institut für Arbeitschutz der gesetzlichen Unfallversicherungen**: GESTIS Stoffdatenbank http://www.dguv.de/ifa/de/gestis/stoffdb/index.jsp

16.5 Weitere Informationen:

Abkürzungen:
k.D.v. = keine Daten vorhanden
n.z. = nicht zutreffend
n.d. = nicht durchführbar
u.a. = unter anderem
n.a. = nicht anwendbar

Erklärung:
Dieses Sicherheitsdatenblatt ist überarbeitet worden gemäß Anhang II der REACH Verordnung (2010). Die in diesem Sicherheitsdatenblatt verwendeten Daten beruhen auf dem Registrierungsdossier und dem Chemischen Sicherheitsbericht für Eisen-II-chlorid. Die Angaben in diesem Sicherheitsdatenblatt stützen sich auf den heutigen Stand unserer Kenntnisse und Erfahrungen. Das Sicherheitsdatenblatt beschreibt die Produkte im Hinblick auf Sicherheitserfordernisse. Die Angaben haben nicht die Bedeutung von Eigenschaftszusicherungen

ANHANG

Exposure Scenario I: Manufacturing of Iron Chlorides

This exposure scenario describes the common manufacturing processes used within the EEA to manufacture iron (II) chloride ($FeCl_2$, ferrous chloride) and iron (III) chloride ($FeCl_3$, ferric chloride) which may be supplied as solids in various hydration states or in aqueous solution.

Description of the process
The pickling process in steel plants is a surface treatment process of belts/strips prior to the coating, rolling (hot or cold) or finishing of these articles. In order to generate a suitable surface on the belts/strips remaining iron oxides (and some other minor impurities) and the first surface layer of iron are removed in continuous pickling lines by treating the belt/strip with hydrochloric acid.

$Fe + 2\ HCl \rightarrow FeCl_2 + H_2\uparrow$
$FeO + 2\ HCl \rightarrow FeCl_2 + H_2O$

The resulting liquid is often filtered to remove percipitates and is stored in tanks. On a regular basis the iron chloride solution is filled in tank vehicles, transported and sold to the costumers or send to the neutralization bath existing in the company as part of a fabrication flow.
The resulting liquid contains mainly water with iron dichloride (up to 30 %) and remaining hydrochloric acid (up to 15 %)

Contributing Exposure Scenarios:
Iron Chlorides: Manufacturing of Iron Chlorides (Exposure Scenario 1 from the Iron Salts Dossier)
Hydrochloric Acid: Industrial End Use of Hydrochloric Acid (Exposure Scenario 4 from the Hydrogen Chloride Dossier)

Both exposure scenarios are attached as such.

Exposure Scenario 1: Manufacturing of Iron Chlorides

Short Title of the Exposure Scenario		
Sector of Use	SU 3	
Product Category	Not applicable	
Process Category	PROC 1, PROC 2, PROC 3, PROC 8b	
Article Category	Not applicable	
Environmental Release Category	ERC 1	
Operational conditions related to frequency, duration and amount of use **Duration, frequency and amount**		
Information type	**Data field**	**Explanation**
Duration of exposure per day at workplace [for one worker]	Up to 8 hours	Worst case assumption
Frequency of exposure at workplace [for one worker]	Daily	
Annual amount used per site	>10000 T/yr manufactured	Manufactured on site not used
Emission days per site	Up to 365	
Operational conditions and risk management measures related to product characteristics **Characteristics of the substance or preparation**		
Information type	**Data field**	**Explanation**
Physical state	Liquid (aqueous solution)	Physical state at STP.
Risk management measures related to the design of product	Precautions against irritation	See below RMM for exposure
Operational conditions related to available dilution capacity and characteristics of exposed human **Operational conditions related to respiration and skin contact**		
Information type	**Data field**	**Explanation**
Respiration volume under conditions of use	10 m^3/d	Default respiration volume for light work.
Area of skin contact with the substance under conditions of use	240 (PROC3) 480 (PROC2, PROC8b)	ECETOC assumptions for exposed skin surface area.
Body weight	70 kg	Default bodyweight for workers.
Other operational conditions of use **For simplicity a manufacturing site producing 5,000 tonnes in total of Fe salts per year is envisaged as a standard for the ES**		
Releases to air Given the highly controlled conditions used in the manufacture of ferrous chloride and ferric chloride to prevent the release of gases such as chlorine or HCl, it can be assumed that the release of iron chloride in any form to air is effectively zero.		
Releases to water Wastewater containing ferrous chloride is usually recycled in-process. Ferrous chloride is freely soluble in water but aqueous solutions exposed to the air oxidise to ferric oxides and hydroxides with the highly insoluble $Fe(OH)_3$ precipitating. Ferric chloride is a little less soluble and is hydrolysed directly to $Fe(OH)_3$. Thus, any release to water will be converted to an insoluble precipitate at a rate dependent on factors such as the ferrous versus ferric content, pH, concentration, and extent of exposure to air, the “parent salt” being no longer present.		
Technical fate of substance and losses from process/use to waste, waste water and air		
Information type	**Data field**	**Explanation**
Amount lost from process/use to waste gas	0	
Amount lost from process/use to waste water	0.0015	
Risk management measures **Risk management measures for industrial site**		
Information type	**Data field**	**Explanation**
Containment and local exhaust ventilation		
Containment plus good work practice required	Yes	
Local exhaust ventilation required plus good work practise	No	
Personal protective equipment (PPE)		
Skin protection	Protective gloves	
Eye protection	Safety glasses	
Clothing	Working clothing worn.	
Respiratory protection	Refer to control technologies below	
Breathing apparatus	Refer to control technologies below	
Other risk management measures related to workers		
Procedural and control technologies	It is assumed that solid salts are handled only in closed systems.	
Training. Monitoring/reporting and auditing systems	Equipment must be well maintained and cleaned daily.	
Risk management measures related to environmental emissions from industrial sites		
Onsite pre-treatment of waste water		Not applicable
Resulting fraction of initially applied amount in waste water released from site to the external sewage system		Not applicable
Air emission abatement		Not applicable
Resulting fraction of applied amount in waste gas released to environment		Not applicable
Onsite waste treatment		Not applicable
Fraction of initially applied amount sent to external waste treatment. This is the sum of direct losses from processes to waste, and the residues from onsite waste water and waste gas treatment.		Not applicable

Municipal or other type of external waste water treatment	Yes	
Effluent (of the waste water treatment plant) discharge rate	10000 m^3/d	
Recovery of sludge for agriculture or horticulture	Yes	

Waste related measures

Details of the treatment of aqueous waste would vary at different sites but as a minimum the effluent treated in either in on-site or municipal secondary biological treatment plants prior to discharge.

Exposure estimation
Workers exposure

Acute/Short-term exposure

Short-term exposure is not relevant.

Long-term exposure

Modifications to the predicted exposures are only assumed where necessary to manage possible risks. Modifications are predominantly for use of personal protective equipment (PPE). The exposure levels from the ECETOC TRA model (2010) are used to estimate occupational exposure.

Dermal exposure
As processes are enclosed, occupational exposure to dust or splashes of liquid is most likely to occur during transfer or transport, or maintenance and clean-out. Given the nature of the industry, it may be assumed that adequate risk management systems are in place to prevent contact with the substance.

Inhalation exposures
Again, accidental exposure during transfer or transport, or maintenance and clean-out is the most likely source of inhalation exposure. This is most likely to be to dust in the preparation of solid products. Again, given the nature of the industry, it may be assumed that adequate risk management systems are in place to prevent contact with the substance.
The dermal and inhalation exposure estimates derived using the ECETOC TRA exposure levels are given below.

Summary of highest long-term exposure concentration to workers
Highest value for relevant tasks.

Routes of exposure	Concentrations	Justification
Dermal local exposure (in µg/cm^2)	200 (PROC8b, in absence of LEV)	The wearing of gloves is accounted for in this value
Dermal systemic exposure via contact with substance as such (in mg/kg bw/d)	0.14 (PROC8b)	The limitation of 10% dermal uptake is assumed in deriving this value. .
Dermal systemic exposure via aqueous solution (in mg/kg bw/d)	0.014 (PROC8b)	The limitation of <1% dermal uptake is assumed in deriving this value.
Inhalation exposure	Negligible for contributing tasks that do not involve handling of solid products leading to evolution of dusts, or spraying of liquid product. See also below	The product is a wet solid salt which will not give rise to airborne dust and therefore no risk of inhalation
Inhalation exposure (in mg/m^3)/8h workday (refers only to any contributing tasks involving handling of solid products leading to evolution of dusts)	i) Negligible, assuming any solids are processed only in a closed system. ii) 1.8 (PROC 8b).(LEV but no PPE)	ii) Derived using Stoffenmanager scenario assuming handling of product with low speed or with little force in medium quantities
Inhalation exposure (in mg/m^3)/8h workday (refers only to any contributing tasks involving spraying of liquid product)	Negligible, assuming any spraying occurs only in a closed system.	

Risk characterisation

The DNEL values and therefore the risk characterisation are in the moment under revision by the Iron Salts Consortium.

Consumer exposure

Consumer exposure is not relevant for the production of iron chlorides.

Environmental exposure

Environmental releases

As a worst-case scenario, it is assumed that the production of iron chlorides, sulphates and chloride sulphates takes place at the same site. The total production level of iron for consideration is approximately 145,000 tonnes Fe per annum. Quantified exposure and risk from production of iron chlorides and iron sulphates in given below.
The BREF for large volume inorganic chemicals (and the additional material relating to ferric chloride specifically) contains useful information about releases to the environment associated with production of these substances.
The Steel industry scenario is thought to be much less than what is reported below because of tonnage amounts and systems used and therefore will produce lower release levels, the scenario below should be used as a worst case.

Environmental releases from production

Compartments	Ferric chloride[1] (all emissions in kg/tonne of product)	Ferric sulphate (all emissions in kg/tonne of product)	Ferrous sulphate (all emissions in kg/tonne of product)
Emissions to air			
Dust		0.03-0.5 (35 mg/m^3) (from solution to solid product)	0.08 (monohydrate) 0.004-0.08 (monohydrate and dried copperas) – bag filters[3]. 0.4 (monohydrate) – wet scrubbing <30-<50 mg/m^3

Emissions to water			
Iron	0.05-5	0.2-0.8 (0.32 kg/m^3)[2] (using pressure oxidation)	0.75 (with wet scrubbing)
Sulfate		0.2-2.0 (0.8 kg/m^3)[2] (using pressure oxidation)	
Zinc	0.005-1.5		
Heavy metals	<5E-04-0.6		
Waste to land			
Solid waste	5-35	<0.8 (insoluble residue associated with removal of contamination)	8-25 (monohydrate)

Notes: [1]Releases are stated to be associated with production of ferrous chloride, but presented in a section discussing production of ferric chloride and ferrous chloride together with subsequent oxidation to increase the proportion of iron (III).
[2]These are the releases to the water stream that drains into the gypsum plant. The actual emissions to surface water are: Fe: 1E-04 kg/t product (0.001 kg/m^3); Sulfates: 0.35 kg/t product (2.3 kg/m^3).
[3]Bag filters may not always be applicable because of the physical nature of this dust. Data taken from EC 2006 (ferrous and ferric sulfates) and EC 2005 (ferric chloride).
This scenario uses 0.15% to waste water, equivalent to 725 kg Fe/d. This is consistent with a release of approx. 0.05-5 kg iron/tonne to waste water. In reality these are understood to be figures prior to neutralisation/settling and amounts passing to waste water may in fact be a far smaller fraction.
Such a site would commonly be served by a larger than normal WWTP. The ESD for synthetic intermediates (from part IV of the TGD: EC 2003) indicates that a treatment plant with a throughput of 10,000 m^3/d with dilution of x40 into receiving water is not unusual for larger industrial locations.
The environmental releases based on 145,000 tpa iron salts are as follows:
Fraction in formulation – 0.5, Number of days – 300, Amount per day – 485 tonnes Fe/day, kg/day to air – 0, Fraction to waste water – 0.0015, kg/day to water – 725 kg Fe/day prior to WWTP, WWTP flow (default) – 1E+07 l/d, Dilution in surface water (default) – 40

Releases to the environment

Compartments	Predicted releases (kg/d)	Explanation / source of measured data
Aquatic (before WWTP)	725	These data correspond to release to sewage
Air (direct + STP)	0	
Soil (direct only)	0	

Standard equations, described in detail in the REACH guidance and implemented within the EUSES 2.1 software, have been used to determine Predicted Environmental Concentrations (PECs) of iron salts in surface water, seawater, sediment and agricultural soil. Regional and continental background concentrations are also taken into account.

Predicted Exposure Concentrations (PEC) for the production

Justification	Local PEC	Justification
Surface water (in mg/l)	6.0E-07	Calculated using EUSES 2.1.1 in accordance with the exposure scenario.
Freshwater sediment (in g/kg dwt)	45.0	Calculated using EUSES 2.1.1 in accordance with the exposure scenario.
Agricultural soil (in g/kg dwt)	53.0	Calculated using EUSES 2.1.1 in accordance with the exposure scenario.

Risk Characterisation

Atmospheric compartment: no basis for risk characterisation
Microbiological activity in WWTP: According to experience, under normal conditions, the iron chlorides cause no disturbance in the normal operation of the biological degradation. Therefore it is inappropriate and unnecessary to conduct a risk characterisation.

Compartments	PEC	PNEC	RCR
Surface water (in mg/l)	6.0E-07	--	--
Freshwater sediment (in g/kg dwt)	45.0	49.5	0.909
Agricultural soil (in g/kg dwt)	53.0	55	0.965

Exposure Scenario 4: Industrial End Use of Hydrogen Chloride

Short Title of the Exposure Scenario		
Sector of Use	SU 3	
Product Category	Not applicable	
Process Category	PROC 1, PROC 2, PROC 3, PROC 4, PROC 9, PROC 10, PROC 13, PROC 15, PROC 19	
Article Category	Not applicable	
Environmental Release Category	ERC 4, ERC 6b	
Operational conditions related to frequency, duration and amount of use **Duration, frequency and amount**		
Information type	**Data field**	**Explanation**
Duration of exposure per day at workplace [for one worker]	Up to 8 hours	Worst case assumption
Frequency of exposure at workplace [for one worker]	Daily	
Emission days per site	Up to 360	
Operational conditions and risk management measures related to product characteristics **Characteristics of the substance or preparation**		
Information type	**Data field**	
Physical state	Liquid (aqueous solution)	
Concentration Range	Up to 40 % in the product	
Amount per use and period		
Differs between millilitres (sampling) and cubic metres (material transfer)		
Other operational conditions of use		
The temperature of use is not above 20°C over the room temperature.		
A good industrial hygiene has to be implemented.		
The workers are trained to keep the exposures as low as possible.		
Risk management measures		
Personnel protection measures		
Due to the corrosive properties of the substance suitable personnel protective equipment has to be worn at all times. For PROC 2 and 3: In addition suitable gloves according EN 374 have to be worn.		
PROC 2: In addition suitable gloves according EN 374 have to be worn.		
PROC 3: In addition suitable gloves according EN 374 have to be worn.		
PROC 10: In addition suitable gloves according EN 374 have to be worn.		
PROC 13: In addition suitable gloves according EN 374 have to be worn.		
PROC 15: In addition suitable gloves according EN 374 have to be worn.		
PROC 19: In addition suitable gloves according EN 374 have to be worn. Perform the activity only up to15 minutes or wear a respiratory protection apparatus according to EN 140 with type A filter or better.		
Organizational protection measures		
PROC 9: Areas of spillage have to be cleared immediately.		
PROC 10: Areas of spillage have to be cleared immediately.		
PROC 13: Let the product flow off the working piece. Use where possible automatisation.		
Technical protection measures		
PROC 1: The substance has to be handled in a closed system. Transfer systems have to be emptied before decoupling.		
PROC 2: The substance has to be handled in a closed system. Material transport has to be done under LEV or be embanked. Transfer systems have to be emptied before decoupling.		
PROC 3: The substance has to be handled in a closed system. System has to be emptied before the equipment is opened or maintained. Material transport has to be done under LEV or be embanked. Transfer systems have to be emptied before decoupling.		
PROC 4: The substance has to be handled in bulk and semi-bulk systems. Drum pumps have to be used where applicable. System has to be emptied and flushed before the equipment is opened or maintained. LEVs have to be used where emission can occur.		
PROC 9: The substance has to be handled in a closed system. System has to be emptied and flushed before the equipment is opened or maintained. Material transport has to be done under LEV or be embanked. Transfer systems have to be emptied before decoupling.		
PROC 10: A good general and controlled form of ventilation (5 to 15 air changes an hour) has to be guaranteed. System has to be emptied and flushed before the equipment is opened or maintained.		
PROC 13: At material transfer locations and other openings use exhaust devices. In deaerated cabin use laminar air current.		
PROC 15: Use in fume cupboard or with exhaust device. Perform the activities only up to 4 hours.		
Consumer exposure		
Consumer exposure is not relevant for the end use of hydrochloric acid.		
Environmental release measures		
Water: The whole contaminated waste water has to be treated in an industrial or public WWTP with a primary and secondary treatment step. Leakage has to be prevented. Adequate protective measures according to a “spillage plan” have to be in place to minimise the impact of episodic release.		
Exposure estimation **Workers exposure**		
The method used for exposure estimation is ECETOC TRA. The LEV is set to 90 % (PROC 15: 80 %) efficiency.		
Dermal exposure		
During the use of acidic substances and formulations direct contact is accidently. Therefore it is assumed that the daily exposition can be neglected. The dermal exposure was not assessed quantitatively.		
Inhalation exposure		
PROC	**Derived Effect Level (DEL)**	
1	0.02 mg/m³	
2	1.50 mg/m³	

3	3.75 mg/m³
4	3.00 mg/m³
9	7.50 mg/m³
10	7.50 mg/m³
13	7.50 mg/m³
15	3.00 mg/m³ (15 min – 1 h)
15	1.80 mg/m³ (1 h – 4 h)
19	7.50 mg/m³ (respiratory protection apparatus with half mask)
19	7.50 mg/m³ (< 15 min)

Risk characterisation

PROC	DEL (mg/m³)	DNEL (mg/m³)	RCR	Remarks
1	0.02	8	0.0025	
2	1.50	8	0.19	
3	3.75	8	0.47	
4	3.00	8	0.375	
9	7.50	8	0.94	
10	7.50	8	0.94	
13	7.50	8	0.94	
15	3.00	8	0.375	15 min – 1 h
15	1.80	8	0.225	1 h – 4 h
19	7.50	8	0.94	respiratory protection apparatus with half mask
19	7.50	8	0.94	< 15 min

Long-term exposure

The exposition was not derived because the substance has only local dermal and/or inhalation effects and no systemic effects.

Environmental exposure

The substance dissociates in contact with water. The only effect is the very low pH value. Therefore any exposition after the WWTP treatment can be assumed as insignificant and without any risk.

Exposure Scenario II: Generic Formulation

This exposure scenario describes the common processes in which iron salts (ferrous Chloride and Ferrous Sulphate) are used within generic formulation of other products that are produced within the EU.

Description of the process
The iron salts are most frequently manufactured and used in the form of aqueous formulations. Some formulation is understood to be necessary in connection with some of the end uses.
Formulation associated with use in water treatment (raw/potable waters):
Formulation is carried out by specialist formulators at the point of use. Manufacturers' datasheets for relevant iron salts mention the need to dissolve or dilute the as-supplied products prior to use for treatment of raw water. For example, $FeClSO_{4(aq)}$ supplied at a concentration of 41% should be used "undiluted as delivered or diluted with water to a ratio of 1:30 at most" and ferrous sulphate heptahydrate supplied as a solid "should be diluted to give a saturated or concentrated solution containing at least 25% actives" (Kronos 2009). It is, therefore, presumed that this formulation step (dilution) takes place at the point of use. In the case of raw water intended for public supply this would be at a facility dedicated to water treatment; in the case of industry this would be at the industrial site where the water will be used, hence there is no need to account this as a separate step for the environmental assessment.
Formulation associated with use in water treatment (waste waters/ WWTP sludges):
Formulation is carried out by specialist formulators at the point of use. Formulation for this application is essentially a dilution step to produce the required concentration, where supplied as solid or concentrate. Other chemicals such as alkali may be added. Since it is presumed to occur at the point of use there is no need to account this as a separate step for the environmental assessment.
Formulation associated with use in biogas treatment at WWTP:
Formulation for this application is essentially a dilution step to produce the required concentration, where supplied as solid or concentrate. Other chemicals such as alkali may be added. Since it is presumed to occur at the point of use there is no need to account this as a separate step for the environmental assessment.
Formulation associated with use as an etchant:
The ESD for the electronics industry (Environment Agency 2009) estimates releases to waste water of 0.3-2.0% depending on the size of the site. The consumption at a typical site is unknown but the ESD indicates that consumption of more than 1 tonne per year of any etchant chemical constitutes 'large scale' use as these are relatively small operations. To be conservative, consumption of 50 tonnes per year is assumed.

Contributing Exposure Scenarios:
Iron Chlorides: Generic Formulation and Pelletisation of Iron Chlorides (Exposure Scenario 3 from the Iron Salts Dossier)
Hydrochloric Acid: Formulation and Packaging of Hydrochloric Acid (Exposure Scenario 3 from the Hydrogen Chloride Dossier)

Both exposure scenarios are attached as such.

ES 3: Generic formulation including pelletisation of Iron Chlorides

Short title of the exposure scenario		
Sector of Use	SU 3, SU 8	
Product Category	PC 14, PC 15, PC 20, PC 37	
Process Category	PROC 1, PROC 2, PROC 3, PROC 4, PROC 5, PROC 8b, PROC 9, PROC 14, PROC 15	
Article Category	Not applicable	
Environmental Release Category	ERC 2, ERC 5	
Operational conditions related to frequency, duration and amount of use		
Information type	**Data field**	**Explanation**
Used amount of substance per day	170 kg salt; 420 kg solution	
Duration of exposure per day at workplace [for one worker]	<8 h day	
Frequency of exposure at workplace [for one worker]	daily	
Annual amount used per site kg/y	50 t/y	
Emission days per site	300	
Operational conditions and risk management measures related to product[1] characteristics		
Information type	**Data field**	**Explanation**
Physical state	Liquid (aqueous solution) or Solid salts (assumed to be in granular/flake form rather than powdered)	Physical state at STP.
Risk management measures related to the design of product	Precautions against irritation	As necessary
Operational conditions related to available dilution capacity and characteristics of exposed humans		
Information type	**Data field**	**Explanation**
Respiration volume under conditions of use	10 m^3/d	Default respiration volume for light work.
Area of skin contact with the substance under conditions of use	240 (PROC1, PROC3, PROC15) 480 (PROC2, PROC4, PROC5, PROC8b, PROC9, PROC14)	ECETOC assumptions for exposed skin surface area.
Body weight	70 kg	Default bodyweight for workers
Other operational conditions of use		
Information type	**Data field**	**Explanation**
Fraction of applied amount lost from process/use to waste gas	0	
Fraction of applied amount lost from process/use to waste water	Variable depending on industry; different levels of control are typical. Worst case approx. 2% (e.g. Formulation of etchants)	
Risk management measures		
Information type	**Data field**	**Explanation**
Containment and local exhaust ventilation		
Containment plus good work practice required	Yes	
Local exhaust ventilation required plus good work practise	No	
Personal protective equipment (PPE)		
Skin protection	Protective gloves	
Eye protection	Safety glasses	
Clothing	Working clothing worn.	
Respiratory protection	Refer to control technologies below	
Breathing apparatus	Refer to control technologies below	
Other risk management measures related to workers		
Procedural and control technologies	It is assumed that solid salts are handled only in closed systems or with LEV	
Training. Monitoring/reporting and auditing systems	Equipment must be well maintained and cleaned daily.	
Risk management measures related to environmental emissions from industrial sites		
Onsite pre-treatment of waste water		
Resulting fraction of initially applied amount in waste water released from site to the external sewage system		
Air emission abatement		
Resulting fraction of applied amount in waste gas released to environment		
Onsite waste treatment		
Fraction of initially applied amount sent to external waste treatment. This is the sum of direct losses from processes to waste, and the residues from onsite waste water and waste gas treatment.		
Municipal or other type of external waste water treatment	Yes	
Effluent (of the waste water treatment plant) discharge rate	2000 m^3/d	
Recovery of sludge for agriculture or horticulture	Yes	

[1] "Product" includes substances, preparations and articles

Waste related measures

Any solid wastes are ultimately assumed to be disposed of via landfill or incineration.
Details of the treatment of aqueous waste would vary at different sites but as a minimum the effluent treated in either in on-site or municipal secondary biological treatment plants prior to discharge.

Exposure estimation
Workers exposure

Acute/Short-term exposure

Short-term exposure is not relevant.

Long-term exposure

Modifications to the predicted exposures are only assumed where necessary to manage possible risks. Modifications are predominantly for use of personal protective equipment (PPE). The presence of local exhaust ventilation (LEV) is taken into account in scenarios where this is considered likely. The exposure levels from the ECETOC TRA model (2010) are used to estimate occupational exposure.
Dermal exposure is most likely to occur through accidental spillage or during formulation (transfer and charging of storage, mixing, and feed vessels), where mechanical handling is not in place.
The dermal and inhalation exposure estimates derived using the ECETOC TRA exposure levels

Summary of highest long-term exposure concentration to workers
Highest value for relevant tasks

Routes of exposure	Concentrations	Justification
Dermal local exposure (in µg/cm^2)	400 (PROC5, in absence of LEV)	The wearing of gloves is accounted for in this value
Dermal systemic exposure via contact with substance as such (in mg/kg bw/d)	0.7 (PROC4)	The limitation of 10% dermal uptake is assumed in deriving this value.
Dermal systemic exposure via aqueous solution (in mg/kg bw/d)	0.07 (PROC4)	The limitation of <1% dermal uptake is assumed in deriving this value.
Inhalation exposure	Negligible for contributing tasks that do not involve handling of solid products leading to evolution of dusts, or spraying of liquid product See also below	
Inhalation exposure (in mg/m^3)/8h workday[2] (refers only to any contributing tasks involving handling of solid products leading to evolution of dusts)	i) Negligible, assuming any solids are processed only in a closed system. ii) 1.8 (PROC 8b).(LEV but no PPE)	ii) Derived using Stoffenmanager scenario assuming handling of product with low speed or with little force in medium quantities
Inhalation exposure (in mg/m^3)/8h workday[3] (refers only to any contributing tasks involving spraying of liquid product)	n/a	n/a

Risk Characterisation

The DNEL values and therefore the risk characterisation are in the moment under revision by the Iron Salts Consortium.

Consumer exposure

Consumer exposure is not relevant for this scenario

Environmental exposure
Summary of the releases to the environment

Compartments	Release from point source (kg/d) (local exposure estimation)	Justification
Aquatic (before WWTP)	3.3	
Air (direct + STP)	0	
Soil (direct releases only)	0	

Standard equations, described in detail in the REACH guidance and implemented within the EUSES 2.1 software, have been used to determine Predicted Environmental Concentrations (PECs) of iron salts in surface water, seawater, sediment and agricultural soil.
Regional and continental background concentrations are also taken into account.

Predicted Exposure Concentrations (PEC)

Compartments	Local PEC	Justification
Surface water (in mg/l)	2.4E-06	Calculated using EUSES 2.1.1 in accordance with the exposure scenario.
Freshwater sediment (in g/kg dwt)	45.0	Calculated using EUSES 2.1.1 in accordance with the exposure scenario.
Industrial soil (in g/kg dwt)	50.1	Calculated using EUSES 2.1.1 in accordance with the exposure scenario.

Risk Characterisation

Compartments	PEC	PNEC	RCR
Surface water (in mg/l)	2.4E-06	---	
Freshwater sediment (in g/kg dwt)	45.0	49.5	0.909
Industrial soil (in g/kg dwt)	50.1	55	0.91

[2] air concentration at the workplace

[3] air concentration at the workplace

Exposure Scenario 3: Formulation of Hydrochloric Acid

Short Title of the Exposure Scenario		
Sector of Use	SU 10	
Product Category	Not applicable	
Article Category	Not applicable	
Process Category	PROC 1, PROC 2, PROC 3, PROC 4, PROC 5; PROC 8b, PROC 9	
Environmental Release Category	ERC 2	
Operational conditions related to frequency, duration and amount of use **Duration, frequency and amount**		
Information type	**Data field**	**Explanation**
Duration of exposure per day at workplace [for one worker]	Up to 8 hours	Worst case assumption
Frequency of exposure at workplace [for one worker]	Daily	
Emission days per site	Up to 360	
Operational conditions and risk management measures related to product characteristics **Characteristics of the substance or preparation**		
Information type	**Data field**	
Physical state	Liquid (aqueous solution)	
Concentration Range	Up to 20 % in the product	
Amount per use and period		
Differs between millilitres (sampling) and cubic metres (material transfer)		
Other operational conditions of use		
The temperature of use is above 20°C over the room temperature.		
A good industrial hygiene has to be implemented.		
The workers are trained to keep the exposures as low as possible.		
Risk management measures		
Personal protection measures		
Due to the corrosive properties of the substance suitable personnel protective equipment has to be worn at all times. For PROC 2, 3, 5 and 8b: In addition suitable gloves according EN 374 have to be worn.		
Organizational protection measures		
For PROC 8b and 9: Areas of spillage have to be cleared immediately.		
Technical protection measures		
PROC 1: The substance has to be handled in a closed system. Transfer systems have to be emptied before decoupling.		
PROC 2: The substance has to be handled in a closed system. Material transport has to be done under LEV or be embanked. Transfer systems have to be emptied before decoupling.		
PROC 3: The substance has to be handled in a closed system. System has to be emptied and flushed before the equipment is opened or maintained. Material transport has to be done under LEV or be embanked. Transfer systems have to be emptied before decoupling.		
PROC 4: The substance has to be handled in bulk and semi-bulk systems. Drum pumps have to be used where applicable. System has to be emptied and flushed before the equipment is opened or maintained. LEVs have to be used where emission can occur.		
PROC 5: The substances have to be transferred directly into the mixing vessel. Drum pumps have to be used. If pouring is used additional precautionary measures have to be implemented: Embankment of spillage, splash protection for skin and eyes and breathing equipment against inhalation of aerosols/vapour have to be worn. System has to be emptied and flushed before the equipment is opened or maintained.		
PROC 8b: Substance has to be handled in a closed system. LEVs have to be used where emission can occur. System has to be emptied and flushed before the equipment is opened or maintained.		
PROC 9: The substance has to be handled in a closed system. System has to be emptied before the equipment is opened or maintained. Material transport has to be done under LEV or be embanked. Transfer systems have to be emptied before decoupling.		
Consumer exposure		
Consumer exposure is not relevant for the end use of hydrochloric acid.		
Environmental release measures		
Water: The whole contaminated waste water has to be treated in an industrial or public WWTP with a primary and secondary treatment step. Leakage has to be prevented. Adequate protective measures according to a “spillage plan” have to be in place to minimise the impact of episodic release.		
Exposure estimation **Workers exposure**		
The method used for exposure estimation is ECETOC TRA. The LEV is set to 90 % efficiency.		
Dermal exposure		
During the use of acidic substances and formulations direct contact is accidently. Therefore it is assumed that the daily exposition can be neglected. The dermal exposure was not assessed quantitatively.		
Inhalation exposure		
PROC	**Derived Effect Level (DEL)**	
1	0.02 mg/m³	
2	1.50 mg/m³	
3	3.75 mg/m³	
4	3.00 mg/m³	
5	7.50 mg/m³	
8b	7.50 mg/m³	
9	7.50 mg/m³	

Risk characterisation			
PROC	**DEL (mg/m³)**	**DNEL (mg/m³)**	**RCR**
1	0.02	8	0.0025
2	1.50	8	0.19
3	3.75	8	0.47

4	3.00	8	0.375
5	7.50	8	0.94
8b	7.50	8	0.94
9	7.50	8	0.94
Long-term exposure			
The exposition was not derived because the substances has only local dermal and/or inhalation effects and no systemic effects.			
Environmental exposure			
The substance dissociates in contact with water. The only effect is the very low pH value. Therefore any exposition after the WWTP treatment can be assumed as insignificant and without any risk.			

Exposure Scenario III: Water Treatment: Treatment of raw and potable waters

This generic exposure scenario describes the use of selected iron salts in the treatment of raw water in the supply of either potable water or industrial process water. Disposal is relevant only in that the treatment process produces a sludge which contains the residue of the iron salt treating agent. This has been considered as “losses in use”.

Description of the process
When added to water, iron salts act as both excellent coagulants and flocculants. The chemical processes involved are complex but ultimately an insoluble gelatinous precipitate of ferric hydroxide is formed which bridges and traps all the particles (Kemmer 1988, Letterman, 1999).
Potable water: Typical doses for treatment of drinking water are given as 4-10 mg/litre as iron (WHO 2006). Another source indicates approx. 15-25 g Iron salt flocculant added per m3 raw water (Kronos 1997). The exact nature of typical salts is not defined in the WHO report but there is ample indication elsewhere that all combinations of ferrous or ferric and chloride or sulfate salts plus ferric chlorosulfate are used (for example, Cheremisinoff 2002).
Pulp and paper production: Typical dosage rates are in the range 5-100 mg/litre.

Contributing Exposure Scenarios:
Iron Chlorides: Iron Salts water treatment (Exposure Scenario 4 from the Iron Salts Dossier)
Hydrochloric Acid: Industrial End Use of Hydrochloric Acid (Exposure Scenario 4 from the Hydrogen Chloride Dossier)

Both exposure scenarios are attached as such.

Exposure Scenario 4: Water treatment: treatment of raw and potable waters by Iron Chlorides

Short title of the exposure scenario		
Sector of Use	SU 3	
Product Category	PC 20, PC 37	
Process Category	PROC 2, PROC 5, PROC 8b	
Article Category	Not applicable	
Environmental Release Category	ERC 4	
Operational conditions related to frequency, duration and amount of use **Duration, frequency and amount**		
Information type	**Data field**	**Explanation**
Duration of exposure per day at workplace [for one worker]	Up to 8 hours	Default value.
Frequency of exposure at workplace [for one worker]	Daily	
Annual amount used per site	210 T Fe/y	
Emission days per site	300	
Operational conditions and risk management measures related to product characteristics **Characteristics of the substance or preparation**		
Information type	**Data field**	**Explanation**
Physical state	Liquid (aqueous solution) or Solid salts (assumed to be in granular / flake form rather than powdered)	Physical state at STP.
Risk management measures related to the design of product	Precautions against irritation	As necessary
Operational conditions related to available dilution capacity and characteristics of exposed human **Operational conditions related to respiration and skin contact**		
Information type	**Data field**	**Explanation**
Respiration volume under conditions of use	10 m^3/d	Default respiration volume for light work.
Area of skin contact with the substance under conditions of use	480 (PROC2, PROC5, PROC8b)	ECETOC assumptions for exposed skin surface area.
Body weight	70 kg	Default bodyweight for workers.
Other operational conditions of use **For simplicity a manufacturing site producing 5,000 tonnes in total of Fe salts per year is envisaged as a standard for the ES**		
Releases in use Given the low volatility and the high water solubility of the substances, direct releases to air and soil can be considered negligible; thus it can be assumed that the entire release is via water and not volatilised. The coagulation and flocculation processes result in near total conversion of the as-supplied iron salts to insoluble ferric hydroxide. However, as some iron salts may remain in settled sludge, the use of sewage sludge for land treatment may lead to releases to soil. In waterways, partitioning to sediment is possible. Hence, dredging of sediments may also lead to releases to soil.		
Technical fate of substance and losses from process/use to waste, waste water and air		
Information type	**Data field**	**Explanation**
Fraction of applied amount lost from process/use to waste gas	0	
Fraction of applied amount lost from process/use to waste water	1	
Risk management measures **Risk management measures for industrial site**		
Information type	**Data field**	**Explanation**
Containment and local exhaust ventilation		
Containment plus good work practice required	Yes	
Local exhaust ventilation required plus good work practise	No	
Personal protective equipment (PPE)		
Skin protection	Protective gloves	
Eye protection	Safety glasses	
Clothing	Working clothing worn.	
Respiratory protection	If handling solid salts, Filter mask P2 (FFP2) must be used, in the absence of LEV	
Breathing apparatus	None	

Exposure Scenario 4: Industrial End Use of Hydrogen Chloride

Short Title of the Exposure Scenario		
Sector of Use	SU 3	
Product Category	Not applicable	
Process Category	PROC 1, PROC 2, PROC 3, PROC 4, PROC 9, PROC 10, PROC 13, PROC 15, PROC 19	
Article Category	Not applicable	
Environmental Release Category	ERC 4, ERC 6b	
Operational conditions related to frequency, duration and amount of use **Duration, frequency and amount**		
Information type	**Data field**	**Explanation**
Duration of exposure per day at workplace [for one worker]	Up to 8 hours	Worst case assumption
Frequency of exposure at workplace [for one worker]	Daily	
Emission days per site	Up to 360	
Operational conditions and risk management measures related to product characteristics **Characteristics of the substance or preparation**		
Information type	**Data field**	
Physical state	Liquid (aqueous solution)	
Concentration Range	Up to 40 % in the product	
Amount per use and period		
Differs between millilitres (sampling) and cubic metres (material transfer)		
Other operational conditions of use		
The temperature of use is not above 20°C over the room temperature.		
A good industrial hygiene has to be implemented.		
The workers are trained to keep the exposures as low as possible.		
Risk management measures		
Personnel protection measures		
Due to the corrosive properties of the substance suitable personnel protective equipment has to be worn at all times. For PROC 2 and 3: In addition suitable gloves according EN 374 have to be worn.		
PROC 2: In addition suitable gloves according EN 374 have to be worn.		
PROC 3: In addition suitable gloves according EN 374 have to be worn.		
PROC 10: In addition suitable gloves according EN 374 have to be worn.		
PROC 13: In addition suitable gloves according EN 374 have to be worn.		
PROC 15: In addition suitable gloves according EN 374 have to be worn.		
PROC 19: In addition suitable gloves according EN 374 have to be worn. Perform the activity only up to15 minutes or wear a respiratory protection apparatus according to EN 140 with type A filter or better.		
Organizational protection measures		
PROC 9: Areas of spillage have to be cleared immediately.		
PROC 10: Areas of spillage have to be cleared immediately.		
PROC 13: Let the product flow off the working piece. Use where possible automatisation.		
Technical protection measures		
PROC 1: The substance has to be handled in a closed system. Transfer systems have to be emptied before decoupling.		
PROC 2: The substance has to be handled in a closed system. Material transport has to be done under LEV or be embanked. Transfer systems have to be emptied before decoupling.		
PROC 3: The substance has to be handled in a closed system. System has to be emptied before the equipment is opened or maintained. Material transport has to be done under LEV or be embanked. Transfer systems have to be emptied before decoupling.		
PROC 4: The substance has to be handled in bulk and semi-bulk systems. Drum pumps have to be used where applicable. System has to be emptied and flushed before the equipment is opened or maintained. LEVs have to be used where emission can occur.		
PROC 9: The substance has to be handled in a closed system. System has to be emptied and flushed before the equipment is opened or maintained. Material transport has to be done under LEV or be embanked. Transfer systems have to be emptied before decoupling.		
PROC 10: A good general and controlled form of ventilation (5 to 15 air changes an hour) has to be guaranteed. System has to be emptied and flushed before the equipment is opened or maintained.		
PROC 13: At material transfer locations and other openings use exhaust devices. In deaerated cabin use laminar air current.		
PROC 15: Use in fume cupboard or with exhaust device. Perform the activities only up to 4 hours.		
Consumer exposure		
Consumer exposure is not relevant for the end use of hydrochloric acid.		
Environmental release measures		
Water: The whole contaminated waste water has to be treated in an industrial or public WWTP with a primary and secondary treatment step. Leakage has to be prevented. Adequate protective measures according to a “spillage plan” have to be in place to minimise the impact of episodic release.		
Exposure estimation **Workers exposure**		
The method used for exposure estimation is ECETOC TRA. The LEV is set to 90 % (PROC 15: 80 %) efficiency.		
Dermal exposure		
During the use of acidic substances and formulations direct contact is accidently. Therefore it is assumed that the daily exposition can be neglected. The dermal exposure was not assessed quantitatively.		
Inhalation exposure		
PROC	**Derived Effect Level (DEL)**	
1	0.02 mg/m³	
2	1.50 mg/m³	

3	3.75 mg/m³
4	3.00 mg/m³
9	7.50 mg/m³
10	7.50 mg/m³
13	7.50 mg/m³
15	3.00 mg/m³ (15 min – 1 h)
15	1.80 mg/m³ (1 h – 4 h)
19	7.50 mg/m³ (respiratory protection apparatus with half mask)
19	7.50 mg/m³ (< 15 min)

Risk characterisation

PROC	DEL (mg/m³)	DNEL (mg/m³)	RCR	Remarks
1	0.02	8	0.0025	
2	1.50	8	0.19	
3	3.75	8	0.47	
4	3.00	8	0.375	
9	7.50	8	0.94	
10	7.50	8	0.94	
13	7.50	8	0.94	
15	3.00	8	0.375	15 min – 1 h
15	1.80	8	0.225	1 h – 4 h
19	7.50	8	0.94	respiratory protection apparatus with half mask
19	7.50	8	0.94	< 15 min

Long-term exposure

The exposition was not derived because the substance has only local dermal and/or inhalation effects and no systemic effects.

Environmental exposure

The substance dissociates in contact with water. The only effect is the very low pH value. Therefore any exposition after the WWTP treatment can be assumed as insignificant and without any risk.

Exposure Scenario IV: Water Treatment: Treatment of Waste water and WWTP sludge

This generic exposure scenario describes the use of selected iron salts in the treatment of raw water in the supply of either potable water or industrial process water. Disposal is relevant only in that the treatment process produces a sludge which contains the residue of the iron salt treating agent. This has been considered as “losses in use”.

Description of the process
When added to water, iron salts act as both excellent coagulants and flocculants. The chemical processes involved are complex but ultimately an insoluble gelatinous precipitate of ferric hydroxide is formed which bridges and traps all the particles (Kemmer 1988, Letterman, 1999).
The EU BREF (2006) for waste treatment indicates that coagulation/Flocculation agents are typically used at a level of 1-7 kg/m^3 waste water. A concentration of 3 kg of 40 % iron salt solution/tonne effluent is reported as auxiliary in treatment by anaerobic digestion in the BREF.

Contributing Exposure Scenarios:
Iron Chlorides: Water Treatment: Treatment of Waste Waters and WWTP sludge by Iron Chlorides (Exposure Scenario 5 from the Iron Salts Dossier)
Hydrochloric Acid: Industrial End Use of Hydrochloric Acid (Exposure Scenario 4 from the Hydrogen Chloride Dossier)

Both exposure scenarios are attached as such.

Exposure Scenario 5: Water treatment: treatment of Waste Waters and WWTP sludge by Iron Chloride

Short title of the exposure scenario		
Sector of Use	SU 3	
Product Category	PC 20	
Process Category	PROC 2, PROC 5, PROC 8b	
Article Category	Not applicable	
Environmental Release Category	ERC 4, ERC 5	
Operational conditions related to frequency, duration and amount of use **Duration, frequency and amount**		
Information type	**Data field**	**Explanation**
Duration of exposure per day at workplace [for one worker]	Up to 8 hours	Default value.
Frequency of exposure at workplace [for one worker]	Daily	
Annual amount used per site	85 T Fe/y	
Emission days per site	365	
Operational conditions and risk management measures related to product characteristics **Characteristics of the substance or preparation**		
Information type	**Data field**	**Explanation**
Physical state	Liquid (aqueous solution) or Solid salts (assumed to be in granular / flake form rather than powdered)	Physical state at STP.
Risk management measures related to the design of product	Precautions against irritation	As necessary
Operational conditions related to available dilution capacity and characteristics of exposed human **Operational conditions related to respiration and skin contact**		
Information type	**Data field**	**Explanation**
Respiration volume under conditions of use	10 m^3/d	Default respiration volume for light work.
Area of skin contact with the substance under conditions of use	480 (PROC2, PROC5, PROC8b)	ECETOC assumptions for exposed skin surface area.
Body weight	70 kg	Default bodyweight for workers.
Other operational conditions of use **For simplicity a manufacturing site producing 5,000 tonnes in total of Fe salts per year is envisaged as a standard for the ES**		
Releases in use Given the low volatility and the high water solubility of the substances, direct releases to air and soil can be considered negligible; thus it can be assumed that the entire release is via water and not volatilised. The coagulation and flocculation processes result in near total conversion of the as-supplied iron salts to insoluble ferric hydroxide. However, as some iron salts may remain in settled sludge, the use of sewage sludge for land treatment may lead to releases to soil. In waterways, partitioning to sediment is possible. Hence, dredging of sediments may also lead to releases to soil. The typical final concentration of 50 g Fe/kg dry sludge solids is used in EUSES as the basis of the soil exposure scenario from coagulant use. As an overall worst case: a loading of 100 g/m^3 for the total flow of a typical municipal WWTP would be equivalent to approx. 200 kg Fe/d and this is assumed in the model for the coagulant use.		
Technical fate of substance and losses from process/use to waste, waste water and air		
Information type	**Data field**	**Explanation**
Fraction of applied amount lost from process/use to waste gas	0	
Fraction of applied amount lost from process/use to waste water	1	
Risk management measures **Risk management measures for industrial site**		
Information type	**Data field**	**Explanation**
Containment and local exhaust ventilation		
Containment plus good work practice required	Yes	
Local exhaust ventilation required plus good work practise	No	
Personal protective equipment (PPE)		
Skin protection	Protective gloves	
Eye protection	Safety glasses	
Clothing	Working clothing worn.	
Respiratory protection	If handling solid salts, Filter mask P2 (FFP2) must be used, in the absence of LEV	
Breathing apparatus	None	

Exposure Scenario 4: Industrial End Use of Hydrogen Chloride

Short Title of the Exposure Scenario		
Sector of Use	SU 3	
Product Category	Not applicable	
Process Category	PROC 1, PROC 2, PROC 3, PROC 4, PROC 9, PROC 10, PROC 13, PROC 15, PROC 19	
Article Category	Not applicable	
Environmental Release Category	ERC 4, ERC 6b	
Operational conditions related to frequency, duration and amount of use **Duration, frequency and amount**		
Information type	**Data field**	**Explanation**
Duration of exposure per day at workplace [for one worker]	Up to 8 hours	Worst case assumption
Frequency of exposure at workplace [for one worker]	Daily	
Emission days per site	Up to 360	
Operational conditions and risk management measures related to product characteristics **Characteristics of the substance or preparation**		
Information type	**Data field**	
Physical state	Liquid (aqueous solution)	
Concentration Range	Up to 40 % in the product	
Amount per use and period		
Differs between millilitres (sampling) and cubic metres (material transfer)		
Other operational conditions of use		
The temperature of use is not above 20°C over the room temperature.		
A good industrial hygiene has to be implemented.		
The workers are trained to keep the exposures as low as possible.		
Risk management measures		
Personnel protection measures		
Due to the corrosive properties of the substance suitable personnel protective equipment has to be worn at all times. For PROC 2 and 3: In addition suitable gloves according EN 374 have to be worn.		
PROC 2: In addition suitable gloves according EN 374 have to be worn.		
PROC 3: In addition suitable gloves according EN 374 have to be worn.		
PROC 10: In addition suitable gloves according EN 374 have to be worn.		
PROC 13: In addition suitable gloves according EN 374 have to be worn.		
PROC 15: In addition suitable gloves according EN 374 have to be worn.		
PROC 19: In addition suitable gloves according EN 374 have to be worn. Perform the activity only up to15 minutes or wear a respiratory protection apparatus according to EN 140 with type A filter or better.		
Organizational protection measures		
PROC 9: Areas of spillage have to be cleared immediately.		
PROC 10: Areas of spillage have to be cleared immediately.		
PROC 13: Let the product flow off the working piece. Use where possible automatisation.		
Technical protection measures		
PROC 1: The substance has to be handled in a closed system. Transfer systems have to be emptied before decoupling.		
PROC 2: The substance has to be handled in a closed system. Material transport has to be done under LEV or be embanked. Transfer systems have to be emptied before decoupling.		
PROC 3: The substance has to be handled in a closed system. System has to be emptied before the equipment is opened or maintained. Material transport has to be done under LEV or be embanked. Transfer systems have to be emptied before decoupling.		
PROC 4: The substance has to be handled in bulk and semi-bulk systems. Drum pumps have to be used where applicable. System has to be emptied and flushed before the equipment is opened or maintained. LEVs have to be used where emission can occur.		
PROC 9: The substance has to be handled in a closed system. System has to be emptied and flushed before the equipment is opened or maintained. Material transport has to be done under LEV or be embanked. Transfer systems have to be emptied before decoupling.		
PROC 10: A good general and controlled form of ventilation (5 to 15 air changes an hour) has to be guaranteed. System has to be emptied and flushed before the equipment is opened or maintained.		
PROC 13: At material transfer locations and other openings use exhaust devices. In deaerated cabin use laminar air current.		
PROC 15: Use in fume cupboard or with exhaust device. Perform the activities only up to 4 hours.		
Consumer exposure		
Consumer exposure is not relevant for the end use of hydrochloric acid.		
Environmental release measures		
Water: The whole contaminated waste water has to be treated in an industrial or public WWTP with a primary and secondary treatment step. Leakage has to be prevented. Adequate protective measures according to a “spillage plan” have to be in place to minimise the impact of episodic release.		
Exposure estimation **Workers exposure**		
The method used for exposure estimation is ECETOC TRA. The LEV is set to 90 % (PROC 15: 80 %) efficiency.		
Dermal exposure		
During the use of acidic substances and formulations direct contact is accidently. Therefore it is assumed that the daily exposition can be neglected. The dermal exposure was not assessed quantitatively.		
Inhalation exposure		
PROC	**Derived Effect Level (DEL)**	
1	0.02 mg/m³	
2	1.50 mg/m³	

3	3.75 mg/m³
4	3.00 mg/m³
9	7.50 mg/m³
10	7.50 mg/m³
13	7.50 mg/m³
15	3.00 mg/m³ (15 min – 1 h)
15	1.80 mg/m³ (1 h – 4 h)
19	7.50 mg/m³ (respiratory protection apparatus with half mask)
19	7.50 mg/m³ (< 15 min)

Risk characterisation

PROC	DEL (mg/m³)	DNEL (mg/m³)	RCR	Remarks
1	0.02	8	0.0025	
2	1.50	8	0.19	
3	3.75	8	0.47	
4	3.00	8	0.375	
9	7.50	8	0.94	
10	7.50	8	0.94	
13	7.50	8	0.94	
15	3.00	8	0.375	15 min – 1 h
15	1.80	8	0.225	1 h – 4 h
19	7.50	8	0.94	respiratory protection apparatus with half mask
19	7.50	8	0.94	< 15 min

Long-term exposure

The exposition was not derived because the substance has only local dermal and/or inhalation effects and no systemic effects.

Environmental exposure

The substance dissociates in contact with water. The only effect is the very low pH value. Therefore any exposition after the WWTP treatment can be assumed as insignificant and without any risk.

Exposure Scenario V: Use as a reactive product precursor

This generic exposure scenario describes the use of selected iron salts as precursors in the preparation of iron oxide pigments and other iron compounds. The salts are used in the process "as supplied" without formulating. Three industrial processes will be considered which are representative of the overall category: one high temperature, solid-phase conversion and two solution/precipitation reactions. No consumer (or professional) use of this type is expected; this will not be considered further at this time. By definition these are conversion processes so the iron chloride or sulphate is not expected to be present at the end but there are potential losses or potential for exposure in-process. Some consideration will be made of the waste re-processing, recycling, and disposal as appropriate.

Description of the process

Roasting of copperas (ferrous sulphate heptahydrate) to give ferric oxide

Ferrous sulphate heptahydrate (copperas) may be converted to ferrous sulphate monohydrate by heating in a kiln. This process is covered elsewhere. The monohydrate is further heated to complete dehydration and then calcined (with loss of SO_3, which is captured and converted to sulphuric acid) to form impure ferric oxide. This is washed to remove any soluble salts, mainly ferrous and ferric sulphates. This wash liquor is treated for disposal. It is not clear whether the dissolved salts are returned to the process or are precipitated as oxides which are land filled (EC 2007a).

The roasting and calcination process is continuous and enclosed. Only likely source of exposure or release would be to dust during charging. The fate of the wash liquor is a potential source of exposure dependent on how it is handled in a particular process.

Precipitation process

This is a reaction between aqueous ferrous sulphate and alkali (NaOH, $Ca(OH)_2$, ammonia) with oxidation by air (EC 2007b). It is carried out in a batch process, in large tanks open to the atmosphere, at moderately high temperatures (65°C-100°C). Reaction conditions determine the exact product, which may be black, red, yellow, or orange, which is produced as a precipitate. This process can take a few hours or can take many days. The precipitate is collected by filtration and washed. The wash liquor primarily contains soluble non-Fe salts such as sodium sulphate (Schwertmann and Cornell 2003). Opportunities for losses to air are nil. There is the possibility for spillage and loss to water in charging or through accident (industrial accidents are outside the scope of REACH. Only routine non-intentional releases associated with handling are considered here).

Preparation of iron blue (Prussian Blue)

Insoluble blue pigments based on Fe(II)/Fe(III)/cyano complexes have been known for more than 300 years with names such as Prussian Blue or Turnbull's Blue. Although commonly referred to as ferric ferrocyanide, as recently as 1980 the structure was still a matter of some debate (Cotton and Wilkinson 1980). More recent analyses show that as well as ferrous and ferric ions, they also contain another cation (Na^+, K^+, NH_4^+). Industrially the pigment, generically called Iron Blue, is prepared by, firstly, precipitation in large stirred batch reactors by simultaneous or sequential addition of alkali hexacyanoferrate(II) [alkali ferrocyanide] and either solid ferrous sulphate or ferrous chloride solution to dilute acid. This gives a white suspension which is aged by heating. This suspension is oxidised to give the characteristic blue colour by the addition of chlorate. The, now intensely blue, suspended precipitate is isolated by filtration and washed free of all soluble salts, then dried (spray drying is used), ground, and bagged (Buxbaum and Pfaff 2005). Opportunities for losses of the initial iron salt to air are nil. There is the possibility for spillage and loss to water in charging or through accident (industrial accidents are outside the scope of REACH. Only routine non-intentional releases associated with handling are considered here).

Description of the process

Ferrous sulphate and chloride are freely soluble in water but aqueous solutions exposed to the air oxidise to ferric oxides and hydroxides, with the highly insoluble $Fe(OH)_3$ precipitating. Thus, any release to wastewater will be converted to an insoluble precipitate at a rate dependent on factors such as the pH, concentration, and extent of exposure to air, the "parent salt" being no longer present

Contributing Exposure Scenarios:

Iron Chlorides: Use as a reactive product precursor (Iron Chloride) (Exposure Scenario 7 from the Iron Salts Dossier)
Hydrochloric Acid: Industrial End Use of Hydrochloric Acid (Exposure Scenario 4 from the Hydrogen Chloride Dossier)
Hydrochloric Acid: Use as an Intermediate (Hydrogen Chloride) (Exposure Scenario 2 from the Hydrogen Chloride Dossier)

All three exposure scenarios are attached as such.

ES 7: Use as reactive product precursor (Iron Chloride)

Short title of the exposure scenario		
Sector of Use	SU 3, SU 8, SU 9, SU 10, SU 14	
Product Category	PC 9, PC 18, PC 19, PC 20	
Process Category	PROC 2, PROC 3, PROC 4, PROC 8b, PROC 9, PROC 15, PROC 22, PROC 26	
Article Category	Not applicable	
Environmental Release Category	ERC 1, ERC 4, ERC 5, ERC 6a, ERC 6b	
Operational conditions related to frequency, duration and amount of use		
Duration, frequency and amount		
Information type	**Data field**	**Explanation**
Used amount of substance at site per day	Approx. 20 tonnes iron salt per day	
Duration of exposure per day at workplace [for one worker]	8 h/day	Default value.
Frequency of exposure at workplace [for one worker]	daily	
Used amount of substance at site per year	6000 tonnes/year	
Emission days per site	300 d/y	Default value.
Operational conditions and risk management measures related to product[1] characteristics		
Characteristics of the substance or preparation		
Information type	**Data field**	**Explanation**
Physical state	Liquid (aqueous solution) or Solid salts (assumed to be in granular/flake form rather than powdered)	Physical state at STP.
Risk management measures related to the design of product	Precautions against irritation	As necessary
Operational conditions related to available dilution capacity and characteristics of exposed humans		
Operational conditions related to respiration and skin contact		
Information type	**Data field**	**Explanation**
Respiration volume under conditions of use	10 m3/d	Default respiration volume for light work.
Area of skin contact with the substance under conditions of use	240 (PROC3, PROC15) 480 (PROC2, PROC4, PROC8b, PROC9) 1980 (PROC22) PROC26 – not specified by ECETOC but assumed to be approx. 1980	ECETOC assumptions for exposed skin surface area.
Body weight	70 kg	Default bodyweight for workers.
Other operational conditions of use		
Releases to air The only likely source of release to air would be to dust during charging of solid salts, most especially copperas. However, in view of the low volatility of iron salts it is not envisaged that releases to air are realistic. Releases to water There is the possibility for spillage and loss to water in charging or through accident when using aqueous iron salts or processing waste liquor. It is, however, necessary to consider the potential releases of iron in any form. The ERC default is 5% released to water with production processes taking place on 20 days/year. These defaults are not realistic for the industry. It is far more realistic to consider a scenario in which the production process takes place on say 300 days per year and with the known extent of reprocessing of process water and rinse water, a far lower percentage waste is anticipated. This scenario uses: 0.5% to waste water, equivalent to 100 kg salt/d Equivalent to approx. 40 kg Fe/d		
Technical fate of substance and losses from process/use to waste, waste water and air		
Information type	**Data field**	**Explanation**
Fraction of applied amount lost from process/use to waste gas	0	
Fraction of applied amount lost from process/use to waste water	0.005	
Risk management measures		
Risk management measures for industrial site		
Information type	**Data field**	**Explanation**
Containment and local exhaust ventilation		
Containment plus good work practice required	Yes	
Local exhaust ventilation required plus good work practise	No	
Personal protective equipment (PPE)		
Skin protection	Protective gloves	
Eye protection	Safety glasses	
Clothing	Working clothing worn.	
Respiratory protection	Refer to control technologies below	
Breathing apparatus	Refer to control technologies below	
Other risk management measures related to workers		

1 "Product" includes substances, preparations and articles

Procedural and control technologies	It is assumed that solid salts are handled only in closed systems or with LEV	
Training. Monitoring/reporting and auditing systems	Equipment must be well maintained and cleaned daily.	
Risk management measures related to environmental emissions from industrial sites		
Onsite pre-treatment of waste water		
Resulting fraction of initially applied amount in waste water released from site to the external sewage system		
Air emission abatement		
Resulting fraction of applied amount in waste gas released to environment		
Onsite waste treatment		
Fraction of initially applied amount sent to external waste treatment. This is the sum of direct losses from processes to waste, and the residues from onsite waste water and waste gas treatment.		
Municipal or other type of external waste water treatment	Yes	
Effluent (of the waste water treatment plant) discharge rate	2000 m3/d	
Recovery of sludge for agriculture or horticulture	Yes	
Waste related measures		
Any solid wastes are ultimately assumed to be disposed of via landfill or incineration. Details of the treatment of aqueous waste would vary at different sites but as a minimum the effluent treated in either in on-site or municipal secondary biological treatment plants prior to discharge.		
Exposure estimation		
Workers exposure		
Acute/Short-term exposure		
Short-term exposure is not relevant		
Long-term exposure		
Modifications to the predicted exposures are only assumed where necessary to manage possible risks. Modifications are predominantly for use of personal protective equipment (PPE). The presence of local exhaust ventilation (LEV) is taken into account in scenarios where this is considered likely. The exposure levels from the ECETOC TRA model (2010) are used to estimate occupational exposure. Dermal exposure Dermal exposure is most likely to occur through accidental spillage or during transfer and charging of storage and feed vessels where mechanical handling is not in place. Inhalation exposures Transfer and charging of solid iron salts in powder or granular form could give the potential for inhalation. Use of iron salts in solution is unlikely to give any opportunity for inhalation; chances of aerosol formation are negligible. Where spray drying of the isolated product, e.g. Iron Blue pigment, this is done after a wash step to remove soluble salts; thus, there is little likelihood of the initial iron salt, e.g., ferrous sulfate or ferrous chloride, which is soluble, being released during spray drying.		
Summary of highest long-term exposure concentration to workers Highest value for relevant tasks.		
Routes of exposure	Concentrations	Justification
Dermal local exposure (in µg/cm2)	200 (PROC8b, in absence of LEV)	The wearing of gloves is accounted for in this value
Dermal systemic exposure via contact with substance as such (in mg/kg bw/d)	0.7 (PROC4)	The limitation of 10% dermal uptake is assumed in deriving this value.
Dermal systemic exposure via aqueous solution (in mg/kg bw/d)	0.07 (PROC4)	The limitation of <1% dermal uptake is assumed in deriving this value.
Inhalation exposure	Negligible for contributing tasks that do not involve handling of solid products leading to evolution of dusts, or spraying of liquid product See also below	
Inhalation exposure (in mg/m3)/8h workday2 (refers only to any contributing tasks involving handling of solid products leading to evolution of dusts)	i) Negligible, assuming any solids are processed only in a closed system. ii) 1.8 (PROC 8b).(LEV but no PPE)	 ii) Derived using Stoffenmanager scenario assuming handling of product with low speed or with little force in medium quantities
Inhalation exposure (in mg/m3)/8h workday3 (refers only to any contributing tasks involving spraying of liquid product)	n/a	n/a

[2] air concentration at the workplace

[3] air concentration at the workplace

Risk characterisation			
The DNEL values and therefore the risk characterisation are in the moment under revision by the Iron Salts Consortium.			
Consumer exposure			
Exposure to consumers is not relevant to this exposure scenario.			
Environmental exposure			
Standard equations, described in detail in the REACH guidance and implemented within the EUSES 2.1 software, are then used to determine Predicted Environmental Concentrations (PECs) in surface water, seawater, sediment and agricultural soil. Regional and continental background concentrations are also taken into account			
Predicted Exposure Concentrations (PEC)			
Compartments		**Local PEC**	**Justification**
Surface water (in mg/l)		2.4E-06	Calculated using EUSES 2.1.1 in accordance with the exposure scenario.
Freshwater sediment (in g/kg dwt)		45.0	Calculated using EUSES 2.1.1 in accordance with the exposure scenario.
Agricultural soil (in g/kg dwt)		50.8	Calculated using EUSES 2.1.1 in accordance with the exposure scenario.
Risk characterisation			
Compartments	**PEC**	**PNEC**	**RCR**
Surface water (in mg/l)	2.4E-06	--	
Freshwater sediment (in g/kg dwt)	45.0	49.5	0.909
Agricultural soil (in g/kg dwt)	50.8	55	0.924

Exposure Scenario 4: Industrial End Use of Hydrogen Chloride

Short Title of the Exposure Scenario		
Sector of Use	SU 3	
Product Category	Not applicable	
Process Category	PROC 1, PROC 2, PROC 3, PROC 4, PROC 9, PROC 10, PROC 13, PROC 15, PROC 19	
Article Category	Not applicable	
Environmental Release Category	ERC 4, ERC 6b	
Operational conditions related to frequency, duration and amount of use **Duration, frequency and amount**		
Information type	**Data field**	**Explanation**
Duration of exposure per day at workplace [for one worker]	Up to 8 hours	Worst case assumption
Frequency of exposure at workplace [for one worker]	Daily	
Emission days per site	Up to 360	
Operational conditions and risk management measures related to product characteristics **Characteristics of the substance or preparation**		
Information type	**Data field**	
Physical state	Liquid (aqueous solution)	
Concentration Range	Up to 40 % in the product	
Amount per use and period		
Differs between millilitres (sampling) and cubic metres (material transfer)		
Other operational conditions of use		
The temperature of use is not above 20°C over the room temperature.		
A good industrial hygiene has to be implemented.		
The workers are trained to keep the exposures as low as possible.		
Risk management measures		
Personnel protection measures		
Due to the corrosive properties of the substance suitable personnel protective equipment has to be worn at all times. For PROC 2 and 3: In addition suitable gloves according EN 374 have to be worn.		
PROC 2: In addition suitable gloves according EN 374 have to be worn.		
PROC 3: In addition suitable gloves according EN 374 have to be worn.		
PROC 10: In addition suitable gloves according EN 374 have to be worn.		
PROC 13: In addition suitable gloves according EN 374 have to be worn.		
PROC 15: In addition suitable gloves according EN 374 have to be worn.		
PROC 19: In addition suitable gloves according EN 374 have to be worn. Perform the activity only up to15 minutes or wear a respiratory protection apparatus according to EN 140 with type A filter or better.		
Organizational protection measures		
PROC 9: Areas of spillage have to be cleared immediately.		
PROC 10: Areas of spillage have to be cleared immediately.		
PROC 13: Let the product flow off the working piece. Use where possible automatisation.		
Technical protection measures		
PROC 1: The substance has to be handled in a closed system. Transfer systems have to be emptied before decoupling.		
PROC 2: The substance has to be handled in a closed system. Material transport has to be done under LEV or be embanked. Transfer systems have to be emptied before decoupling.		
PROC 3: The substance has to be handled in a closed system. System has to be emptied before the equipment is opened or maintained. Material transport has to be done under LEV or be embanked. Transfer systems have to be emptied before decoupling.		
PROC 4: The substance has to be handled in bulk and semi-bulk systems. Drum pumps have to be used where applicable. System has to be emptied and flushed before the equipment is opened or maintained. LEVs have to be used where emission can occur.		
PROC 9: The substance has to be handled in a closed system. System has to be emptied and flushed before the equipment is opened or maintained. Material transport has to be done under LEV or be embanked. Transfer systems have to be emptied before decoupling.		
PROC 10: A good general and controlled form of ventilation (5 to 15 air changes an hour) has to be guaranteed. System has to be emptied and flushed before the equipment is opened or maintained.		
PROC 13: At material transfer locations and other openings use exhaust devices. In deaerated cabin use laminar air current.		
PROC 15: Use in fume cupboard or with exhaust device. Perform the activities only up to 4 hours.		
Consumer exposure		
Consumer exposure is not relevant for the end use of hydrochloric acid.		
Environmental release measures		
Water: The whole contaminated waste water has to be treated in an industrial or public WWTP with a primary and secondary treatment step. Leakage has to be prevented. Adequate protective measures according to a “spillage plan” have to be in place to minimise the impact of episodic release.		
Exposure estimation **Workers exposure**		
The method used for exposure estimation is ECETOC TRA. The LEV is set to 90 % (PROC 15: 80 %) efficiency.		
Dermal exposure		
During the use of acidic substances and formulations direct contact is accidently. Therefore it is assumed that the daily exposition can be neglected. The dermal exposure was not assessed quantitatively.		
Inhalation exposure		
PROC	**Derived Effect Level (DEL)**	
1	0.02 mg/m³	
2	1.50 mg/m³	
3	3.75 mg/m³	

4	3.00 mg/m³
9	7.50 mg/m³
10	7.50 mg/m³
13	7.50 mg/m³
15	3.00 mg/m³ (15 min – 1 h)
15	1.80 mg/m³ (1 h – 4 h)
19	7.50 mg/m³ (respiratory protection apparatus with half mask)
19	7.50 mg/m³ (< 15 min)

Risk characterisation

PROC	DEL (mg/m³)	DNEL (mg/m³)	RCR	Remarks
1	0.02	8	0.0025	
2	1.50	8	0.19	
3	3.75	8	0.47	
4	3.00	8	0.375	
9	7.50	8	0.94	
10	7.50	8	0.94	
13	7.50	8	0.94	
15	3.00	8	0.375	15 min – 1 h
15	1.80	8	0.225	1 h – 4 h
19	7.50	8	0.94	respiratory protection apparatus with half mask
19	7.50	8	0.94	< 15 min

Long-term exposure

The exposition was not derived because the substance has only local dermal and/or inhalation effects and no systemic effects.

Environmental exposure

The substance dissociates in contact with water. The only effect is the very low pH value. Therefore any exposition after the WWTP treatment can be assumed as insignificant and without any risk.

Exposure Scenario 2: Use as an intermediate (Hydrogen Chloride)

Short Title of the Exposure Scenario		
Sector of Use	SU 3	
Product Category	Not applicable	
Process Category	PROC 1, PROC 2, PROC 3, PROC 4, PROC 9	
Article Category	Not applicable	
Environmental Release Category	ERC 6a	
Operational conditions related to frequency, duration and amount of use **Duration, frequency and amount**		
Information type	**Data field**	**Explanation**
Duration of exposure per day at workplace [for one worker]	Up to 8 hours	Worst case assumption
Frequency of exposure at workplace [for one worker]	Daily	
Emission days per site	Up to 360	
Operational conditions and risk management measures related to product characteristics **Characteristics of the substance or preparation**		
Information type	**Data field**	
Physical state	Liquid (aqueous solution)	
Concentration Range	Up to 40 % in the product	
Amount per use and period		
Differs between millilitres (sampling) and cubic metres (material transfer)		
Other operational conditions of use		
The temperature of use is not above 20°C over the room temperature.		
If the process temperature is higher, the substance temperature in the areas where the workers can come into contact has to be room temperature.		
A good industrial hygiene has to be implemented.		
The workers are trained to keep the exposures as low as possible.		
Risk management measures		
Personnel protection measures		
Due to the corrosive properties of the substance suitable personnel protective equipment has to be worn at all times. For PROC 2 and 3: In addition suitable gloves according EN 374 have to be worn.		
Organizational protection measures		
For PROC 9: Areas of spillage have to be cleared immediately.		
Technical protection measures		
PROC 1: The substance has to be handled in a closed system. Transfer systems have to be emptied before decoupling.		
PROC 2: The substance has to be handled in a closed system. Material transport has to be done under LEV or be embanked. Transfer systems have to be emptied before decoupling.		
PROC 3: The substance has to be handled in a closed system. System has to be emptied before the equipment is opened or maintained. Material transport has to be done under LEV or be embanked. Transfer systems have to be emptied before decoupling.		
PROC 4: The substance has to be handled in bulk and semi-bulk systems. Drum pumps have to be used where applicable. System has to be emptied and flushed before the equipment is opened or maintained. LEVs have to be used where emission can occur.		
PROC 9: The substance has to be handled in a closed system. System has to be emptied before the equipment is opened or maintained. Material transport has to be done under LEV or be embanked. Transfer systems have to be emptied before decoupling.		
Consumer exposure		
Consumer exposure is not relevant for the formulation of hydrochloric acid.		
Environmental release measures		
Water: The whole contaminated waste water has to be treated in an industrial or public WWTP with a primary and secondary treatment step. Leakage has to be prevented. Adequate protective measures according to a “spillage plan” have to be in place to minimise the impact of episodic release.		
Exposure estimation **Workers exposure**		
The method used for exposure estimation is ECETOC TRA. The LEV is set to 90 % efficiency.		
Dermal exposure		
During the use of acidic substances and formulations direct contact is accidently. Therefore it is assumed that the daily exposition can be neglected. The dermal exposure was not assessed quantitatively.		
Inhalation exposure		
PROC	**Derived Effect Level (DEL)**	
1	0.02 mg/m³	
2	1.50 mg/m³	
3	3.75 mg/m³	
4	3.00 mg/m³	
9	7.50 mg/m³	

Risk characterisation			
PROC	**DEL (mg/m³)**	**DNEL (mg/m³)**	**RCR**
1	0.02	8	0.0025
2	1.50	8	0.19
3	3.75	8	0.47
4	3.00	8	0.375
9	7.50	8	0.94
Long-term exposure			
The exposition was not derived because the substance has only local dermal and/or inhalation effects and no systemic effects.			
Environmental exposure			

The substance dissociates in contact with water. The only effect is the very low pH value. Therefore any exposition after the WWTP treatment can be assumed as insignificant and without any risk.

Exposure Scenario VI: Industrial and Consumer Use as a metal etchant and a surface treatment agent

This generic exposure scenario describes the use of aqueous ferric chloride as a metal etchant in the process commonly called photochemical machining or milling. Industrial users tend to be SMEs. Disposal is an important consideration as used etchant solution still contains substantial levels of ferric chloride. Many users regenerate the used solution themselves and/or send it to third parties for further processing, a practice ultimately with economic as well as environmental benefits but with potential for releases in process.

Description of the process
Photochemical machining is described as being “almost universally” done in a spray etching machine. The article to be treated is carried on a conveyor into a chamber where it is “vigorously sprayed with hot etchant from batteries of nozzles above and below” (Qualitech 2009). One may presume that the excess etchant and run-off is captured within the machine and stored for re-use, recycle, or disposal.
An alternative process is dipping of the article to be treated batchwise in a bath of ferric chloride; it is not clear whether this process is much practised. The ESD for the electronics industry (Environment Agency 2009) refers to the high level of wastage in dipping tank etching, noting that “There is a high level of carry-over of solution into rinsing and cleaning tanks and although initial rinse solutions may be recycled back into the plating tank, there is the potential for a high level of waste. Large volumes of water are involved and it is assumed that a high proportion will be discharged as waste water.” This model assumes that the inorganic salt etchant substances are freely soluble in water.
An estimated 50% release to waste water is possible, though the waste water may be collected for treatment or regeneration rather than passing to WWTP, depending on various other factors. Even if it is assumed that the release is to WWTP, this will be subject to local discharge monitoring and pH controls, and dilution and pH adjustment would be expected to lead to the precipitation of almost all iron as solid waste prior to release of the waste stream to WWTP. Therefore the emission scenario is controlled so that iron levels in influent are limited by the water solubility.

Contributing Exposure Scenarios:
Iron Chlorides: Industrial and Consumer Use as a metal etchant and surface treatment agent (Iron Chlorides) (Exposure Scenario 10 from the Iron Salts Dossier)
Hydrochloric Acid: Industrial End Use of Hydrochloric Acid (Exposure Scenario 4 from the Hydrogen Chloride Dossier)
Hydrochloric Acid: Consumer End Use of Hydrochloric Acid (Exposure Scenario 6 from the Hydrogen Chloride Dossier)

All three exposure scenarios are attached as such.

ES 10a and c: Industrial and consumer use as a metal etchant and surface treatment agent (Iron Chlorides)

Short title of the exposure scenario worker		
Sector of use	SU 3, SU 10, SU 15, SU 16	
Product Category	PC 14, PC 15	
Process Category	PROC 5, PROC 7, PROC 8b, PROC13	
Article Category	Not applicable	
Environmental Release Category	ERC 2, ERC 6b	
Short title of the exposure scenario consumer		
Sector of use	SU 21	
Product Category	PC 14	
Process Category	Not applicable	
Article Category	Not applicable	
Environmental Release Category	ERC 2 ERC 6b	
Operational conditions related to frequency, duration and amount of use		
Duration, frequency and amount		
Information type	**Data field**	**Explanation**
Used amount of substance per day	167 kg salt; 420 kg solution (approx. 67 kg Fe)	
Duration of exposure per day at workplace [for one worker]	Up to 8 hours	Default value.
Frequency of exposure at workplace [for one worker]	Daily	
Annual amount used per site	20 T Fe/y	
Emission days per site	300	
Operational conditions and risk management measures related to product[1] characteristics		
Characteristics of the substance or preparation		
Information type	**Data field**	**Explanation**
Physical state	Liquid (aqueous solution) or Solid salts (assumed to be in granular/flake form rather than powdered)	Physical state at STP.
Risk management measures related to the design of product	Precautions against irritation	As necessary
Operational conditions related to available dilution capacity and characteristics of exposed humans		
Operational conditions related to respiration and skin contact		
Information type	**Data field**	**Explanation**
Respiration volume under conditions of use	10 m^3/d	Default respiration volume for light work.
Area of skin contact with the substance under conditions of use	480 (PROC5, PROC8b, PROC13) 1500 (PROC7)	ECETOC assumptions for exposed skin surface rea.
Body weight	70 kg	Default bodyweight for workers.
Please note that the respiration volume is accounted for when deriving the DNEL		
Other operational conditions of use		
Technical fate of substance and losses from process/use to waste, waste water and air		
Information type	**Data field**	**Explanation**
Fraction of applied amount lost from process/use to waste gas	0	
Fraction of applied amount lost from process/use to waste water	0.02 (handling) + 0.5 (use)	
Risk management measures		
Risk management measures for industrial site		
Information type	**Data field**	**Explanation**
Containment and local exhaust ventilation		
Containment plus good work practice required	Yes	
Local exhaust ventilation required plus good work practise	No	
Personal protective equipment (PPE)		
Skin protection	Protective gloves	
Eye protection	Safety glasses	
Clothing	Working clothing worn.	
Respiratory protection	Refer to control technologies below	
Breathing apparatus	Refer to control technologies below	
Other risk management measures related to workers		
Procedural and control technologies	It is assumed that solid salts are handled only in closed systems or with LEV. If performing spraying, it is assumed that closed systems apply	
Training. Monitoring/reporting and auditing systems	Equipment must be well maintained and cleaned daily.	
Risk management measures related to environmental emissions from industrial sites		

[1] "Product" includes substances, preparations and articles

Onsite pre-treatment of waste water		
Resulting fraction of initially applied amount in waste water released from site to the external sewage system		
Air emission abatement		
Resulting fraction of applied amount in waste gas released to environment		
Onsite waste treatment		
Fraction of initially applied amount sent to external waste treatment. This is the sum of direct losses from processes to waste, and the residues from onsite waste water and waste gas treatment.		
Municipal or other type of external waste water treatment	Yes	
Effluent (of the waste water treatment plant) discharge rate	2000 m^3/d	
Recovery of sludge for agriculture or horticulture	Yes	

Waste related measures

A study was carried out in 1999 into the regeneration and disposal of ferric chloride solution which had been used for metal etching (Allen and Ler 1999). At that time, many using companies practised limited regeneration usually with chlorine or by electrolysis. It should be noted that even a single regeneration step can reduce the volume of ferric chloride solution required to treat a given amount of metal by more than 50% *versus* using fresh ferric chloride solution and regenerating four times reduced the required volume to <10% versus using fresh solution. This regeneration converts ferrous chloride back to ferric chloride but the solution will eventually contain too high a concentration of other dissolved metal ions and cease to work as desired with an effect on etch rate or quality of the final products. At this stage most companies sent the liquid waste etchant back to a "chemical company" for complete regeneration (chlorination to ferric chloride; reclamation of dissolved metals such as Cu or Ni) or disposal. Disposal techniques involved "stabilization and solidification" of the waste, which is likely to involve hydrolysis to ferric hydroxide/oxide precipitate, followed by landfill.

Exposure estimation

Workers exposure

Acute/Short-term exposure

Short-term exposure is not relevant

Long-term exposure

Modifications to the predicted exposures are only assumed where necessary to manage possible risks. Modifications are predominantly for use of personal protective equipment (PPE). The presence of local exhaust ventilation (LEV) is taken into account in scenarios where this is considered likely. The exposure levels from the ECETOC TRA model (2010) are used to estimate occupational exposure.

Dermal exposure

Dermal exposure is most likely to occur through accidental spillage or during transfer and charging of storage and feed vessels where closed liquid handling (pumps etc.) is not in place. If dipping in baths is a standard process, then this brings additional hazards where articles to be etched are manipulated by hand. LEV is assumed to be present for each life-cycle stage (PROC 5, 7, 8 and 13). The exposed skin surface area for PROC 5 and 13 is 480 cm^2, for PROC 7 it is 1,500 cm^2 and for PROC 8 960 cm^2 skin is exposed.

Inhalation exposures

Use of iron salts in solution is unlikely to give any opportunity for inhalation; chances of aerosol formation outside dedicated equipment are small. For inhalation exposure estimates, LEV efficiency of 90% is assumed.

Summary of highest long-term exposure concentration to workers

Highest value for relevant tasks.

Routes of exposure	Concentrations	Justification
Dermal local exposure (in µg/cm^2)	400 (PROC5, 7, in absence of LEV)	The wearing of gloves is accounted for in this value
Dermal systemic exposure via contact with substance as such (in mg/kg bw/d)	0.14 (PROC8b)	The limitation of 10% dermal uptake is assumed in deriving this value. Note that while PROC7 is relevant to this scenario it is assumed that spraying would only apply to aqueous salt (see row below)
Dermal systemic exposure via aqueous solution (in mg/kg bw/d)	0.09 (PROC7)	The limitation of <1% dermal uptake is assumed in deriving this value.
Inhalation exposure	Negligible for contributing tasks that do not involve handling of solid products leading to evolution of dusts, or spraying of liquid product See also below	
Inhalation exposure (in mg/m^3)/8h workday[2] (refers only to any contributing tasks involving handling of solid products leading to evolution of dusts)	i) Negligible, assuming any solids are processed only in a closed system. ii) 1.8 (PROC 8b).(LEV but no PPE)	ii) Derived using Stoffenmanager scenario assuming handling of product with low speed or with little force in medium quantities
Inhalation exposure (in mg/m^3)/8h workday[3] (refers only to any contributing tasks involving spraying of liquid product)	Negligible, assuming any spraying is undertaken only in a closed system.	

Risk characterisation

[2] air concentration at the workplace

[3] air concentration at the workplace

The DNEL values and therefore the risk characterisation are at the moment under revision by the Iron Salts Consortium.		
Consumer exposure		
Consumers may purchase ferric chloride solution for art work. This is the subject of this part of the scenario. Etching solution is likely to be strongly acidic and hazardous and this has a number of implications, particularly that the systemic effects of the iron salt present in the formulation is likely to be significantly dominated by other hazardous substances, probably corrosive. Consumers' use of such products is likely to be carefully controlled and it is certainly not anticipated to include any spraying scenarios.		
Risk management measures related to consumers' use		
Information type	**Data field**	**Explanation**
Personal protective equipment (PPE) required under regular conditions of consumer use		
Type of PPE (gloves, etc)	Protective gloves and safety glasses	Reasonable expectation, given the corrosive properties of the solution and the specialist applications.
Instructions addressed to consumers		
	As necessary, consumers should be advised to avoid contact with skin/eyes and/or to Use suitable protection	Classification and labelling of preparations containing ≥10% iron salt (or less, depending on what other substances are present) would require hazard communication according to the legislation
Risk management measures related to emissions to the environment		
Municipal or other type of waste water treatment	Yes	Assume standard municipal WWTP with disposal of sludge by agricultural spreading.
Effluent (of the waste water treatment plant) discharge rate	2,000 m^3/d	Default

Summary of highest long-term exposure concentration to consumers		
Routes of exposure	**Concentrations**	**Justification**
Dermal local exposure (in µg/cm^2)	5000	ECETOC TRA Consumer tool estimate, assuming that gloves are not worn, a highly improbable scenario.
Dermal systemic exposure (in mg/kg bw/d)	≤0.36	The limitation of ≤1% dermal uptake from aqueous solution is assumed in deriving this value. This value assuming that gloves are not worn, a highly improbable scenario.
Inhalation exposure	Negligible for contributing tasks that do not involve handling of solid products leading to evolution of dusts, or spraying of liquid product See also below	
Inhalation exposure (in mg/m^3)/day[4] (refers only to any contributing tasks involving handling of solid products leading to evolution of dusts)	n/a	n/a
Inhalation exposure (in mg/m^3)/day[5] (refers only to any contributing tasks involving spraying of liquid product)	n/a	n/a
Risk characterisation		
The DNEL values and therefore the risk characterisation are at the moment under revision by the Iron Salts Consortium.		
Environmental exposure		
Environmental releases		
Although ferric chloride solution is sprayed, this is done inside a dedicated chamber so losses to air are assumed to be negligible. However, the entire PCM process involves transfer of the solution from container to container or to equipment, followed by capture, transfer, regeneration and/or disposal of the spent solution. Each step has potential for accidental release to groundwater or wastewater. The potential for approx 2% loss is estimated in The ESD for the electronics industry (Environment Agency 2009) to cover such handling losses. A summary of the local releases to air, waste water and industrial soil is given in the table below.		

Summary of environmental releases			
Life cycle stage	**Formulation**	**Handling losses**	**Industrial use – etching**
Annual consumption at main site	50 t/y	50 t/y	50 t/y
Fraction in formulation	0.4	0.4	0.4
Number of days	300	300	300
Amount per day	170 kg salt; 420 kg solution	167 kg salt; 420 kg solution	164 kg salt; 420 kg solution
Fraction to air	-	-	-
Amount to air	0 kg/day	0 kg/day	0 kg/day

[4] air concentration at the location of consumer use

[5] air concentration at the location of consumer use

Fraction to waste water	0.02	0.02	0.5
Amount to waste water	3.3 kg salt/day	3.3 kg salt/day	85 kg salt/day
WWTP flow (default)	2E+06 L/day	2E+06 L/day	2E+06 L/day
Dilution in surface water (default)	10	10	10

For full exposure assessment and risk characterisation, direct discharge of 50% of Iron salts to surface water without further treatment is considered as a worst case scenario for the use stage. In reality it is far more realistic to consider that a site consuming such quantities of product would be using professional chemical collection and disposal contractors and these quantities of product would not therefore pass to drain.
Standard equations, described in detail in the REACH guidance and implemented within the EUSES 2.1 software, are then used to determine Predicted Environmental Concentrations (PECs) in surface water, seawater, sediment and agricultural soil.
Regional and continental background concentrations are also taken into account.

Predicted Exposure Concentrations (PEC) for handling + etching

Compartments	Local PEC	Justification
Surface water (in mg/l)	2.5E-06	Calculated using EUSES 2.1.1 in accordance with the exposure scenario.
Freshwater sediment (in g/kg dwt)	45.0	Calculated using EUSES 2.1.1 in accordance with the exposure scenario.
Agricultural soil (in g/kg dwt)	51.8	Calculated using EUSES 2.1.1 in accordance with the exposure scenario.

Risk characterisation for handling + etching

Compartments	PEC	PNEC	RCR
Surface water (in mg/l)	2.4E-06	---	
Freshwater sediment (in g/kg dwt)	45.0	49.5	0.909
Agricultural soil (in g/kg dwt)	50.1	55	0.91

Exposure Scenario 4: Industrial End Use of Hydrogen Chloride

Short Title of the Exposure Scenario		
Sector of Use	SU 3	
Product Category	Not applicable	
Process Category	PROC 1, PROC 2, PROC 3, PROC 4, PROC 9, PROC 10, PROC 13, PROC 15, PROC 19	
Article Category	Not applicable	
Environmental Release Category	ERC 4, ERC 6b	
Operational conditions related to frequency, duration and amount of use **Duration, frequency and amount**		
Information type	**Data field**	**Explanation**
Duration of exposure per day at workplace [for one worker]	Up to 8 hours	Worst case assumption
Frequency of exposure at workplace [for one worker]	Daily	
Emission days per site	Up to 360	
Operational conditions and risk management measures related to product characteristics **Characteristics of the substance or preparation**		
Information type	**Data field**	
Physical state	Liquid (aqueous solution)	
Concentration Range	Up to 40 % in the product	
Amount per use and period		
Differs between millilitres (sampling) and cubic metres (material transfer)		
Other operational conditions of use		
The temperature of use is not above 20°C over the room temperature.		
A good industrial hygiene has to be implemented.		
The workers are trained to keep the exposures as low as possible.		
Risk management measures		
Personnel protection measures		
Due to the corrosive properties of the substance suitable personnel protective equipment has to be worn at all times. For PROC 2 and 3: In addition suitable gloves according EN 374 have to be worn.		
PROC 2: In addition suitable gloves according EN 374 have to be worn.		
PROC 3: In addition suitable gloves according EN 374 have to be worn.		
PROC 10: In addition suitable gloves according EN 374 have to be worn.		
PROC 13: In addition suitable gloves according EN 374 have to be worn.		
PROC 15: In addition suitable gloves according EN 374 have to be worn.		
PROC 19: In addition suitable gloves according EN 374 have to be worn. Perform the activity only up to15 minutes or wear a respiratory protection apparatus according to EN 140 with type A filter or better.		
Organizational protection measures		
PROC 9: Areas of spillage have to be cleared immediately.		
PROC 10: Areas of spillage have to be cleared immediately.		
PROC 13: Let the product flow off the working piece. Use where possible automatisation.		
Technical protection measures		
PROC 1: The substance has to be handled in a closed system. Transfer systems have to be emptied before decoupling.		
PROC 2: The substance has to be handled in a closed system. Material transport has to be done under LEV or be embanked. Transfer systems have to be emptied before decoupling.		
PROC 3: The substance has to be handled in a closed system. System has to be emptied before the equipment is opened or maintained. Material transport has to be done under LEV or be embanked. Transfer systems have to be emptied before decoupling.		
PROC 4: The substance has to be handled in bulk and semi-bulk systems. Drum pumps have to be used where applicable. System has to be emptied and flushed before the equipment is opened or maintained. LEVs have to be used where emission can occur.		
PROC 9: The substance has to be handled in a closed system. System has to be emptied and flushed before the equipment is opened or maintained. Material transport has to be done under LEV or be embanked. Transfer systems have to be emptied before decoupling.		
PROC 10: A good general and controlled form of ventilation (5 to 15 air changes an hour) has to be guaranteed. System has to be emptied and flushed before the equipment is opened or maintained.		
PROC 13: At material transfer locations and other openings use exhaust devices. In deaerated cabin use laminar air current.		
PROC 15: Use in fume cupboard or with exhaust device. Perform the activities only up to 4 hours.		
Consumer exposure		
Consumer exposure is not relevant for the end use of hydrochloric acid.		
Environmental release measures		
Water: The whole contaminated waste water has to be treated in an industrial or public WWTP with a primary and secondary treatment step. Leakage has to be prevented. Adequate protective measures according to a “spillage plan” have to be in place to minimise the impact of episodic release.		
Exposure estimation **Workers exposure**		
The method used for exposure estimation is ECETOC TRA. The LEV is set to 90 % (PROC 15: 80 %) efficiency.		
Dermal exposure		
During the use of acidic substances and formulations direct contact is accidently. Therefore it is assumed that the daily exposition can be neglected. The dermal exposure was not assessed quantitatively.		
Inhalation exposure		
PROC	**Derived Effect Level (DEL)**	
1	0.02 mg/m³	
2	1.50 mg/m³	

3	3.75 mg/m³
4	3.00 mg/m³
9	7.50 mg/m³
10	7.50 mg/m³
13	7.50 mg/m³
15	3.00 mg/m³ (15 min – 1 h)
15	1.80 mg/m³ (1 h – 4 h)
19	7.50 mg/m³ (respiratory protection apparatus with half mask)
19	7.50 mg/m³ (< 15 min)

Risk characterisation

PROC	DEL (mg/m³)	DNEL (mg/m³)	RCR	Remarks
1	0.02	8	0.0025	
2	1.50	8	0.19	
3	3.75	8	0.47	
4	3.00	8	0.375	
9	7.50	8	0.94	
10	7.50	8	0.94	
13	7.50	8	0.94	
15	3.00	8	0.375	15 min – 1 h
15	1.80	8	0.225	1 h – 4 h
19	7.50	8	0.94	respiratory protection apparatus with half mask
19	7.50	8	0.94	< 15 min

Long-term exposure

The exposition was not derived because the substance has only local dermal and/or inhalation effects and no systemic effects.

Environmental exposure

The substance dissociates in contact with water. The only effect is the very low pH value. Therefore any exposition after the WWTP treatment can be assumed as insignificant and without any risk.

Exposure Scenario 6: Consumer End Use of Hydrogen Chloride

Short Title of the Exposure Scenario		
Sector of Use	SU 21	
Product Category	PC 20, PC 21, PC 35, PC 37, PC 38	
Process Category	Not applicable	
Article Category	Not applicable	
Environmental Release Category	ERC 8b, ERC 8e	
Operational conditions related to frequency, duration and amount of use **Duration, frequency and amount**		
Information type	**Data field**	**Explanation**
Duration of exposure per day at workplace [for one worker]	Up to 4 hours	To 5 times a year
Frequency of exposure at workplace [for one worker]	Daily	
Emission days per site	Up to 360	
Operational conditions and risk management measures related to product characteristics **Characteristics of the substance or preparation**		
Information type	**Data field**	
Physical state	Liquid (aqueous solution)	
Concentration Range	Up to 20 % in the product	
Amount per use and period		
500 ml per use		
Other operational conditions of use		
The temperature of use is not above 20°C over the room temperature.		
Risk management measures		
Personnel protection measures		
The substance causes only local irritating effects. Therefore suitable gloves and safety glasses have to be worn during the use and handling.		
Consumer exposure		
Consumer exposure is not relevant for the end use of hydrochloric acid.		
Environmental release measures		
Water: The whole contaminated waste water has to be treated in an industrial or public WWTP with a primary and secondary treatment step. Leakage has to be prevented. Adequate protective measures according to a “spillage plan” have to be in place to minimise the impact of episodic release.		
Exposure estimation **Consumer**		
Dermal exposure		
During the use of acidic substances and formulations direct contact is accidently. Therefore it is assumed that the daily exposition can be neglected. The dermal exposure was not assessed quantitatively.		
Inhalation exposure		
Worst-case calculation with ConsExpo showed that there is no unacceptable risk.		
Long-term exposure		
The exposition was not derived because the substance has only local dermal and/or inhalation effects and no systemic effects.		
Environmental exposure		
The substance dissociates in contact with water. The only effect is the very low pH value. Therefore any exposition after the WWTP treatment can be assumed as insignificant and without any risk.		