

9.1.1. Exposure scenario 1: Manufacturing and industrial application of powdery solid iron salt products that may lead to significant dust formation

The exposure scenario covers activities involving the industrial use of powdery solid iron salts or solid mixtures containing iron salts and that may lead to the formation of significant amounts of inhalable iron salt dust in the air of workplaces. The present exposure scenario 1 covers the following industrial processes performed in a variety of industrial sectors, which are related to a number of environmental release categories and may result in the manufacture of articles.

Sector of use	Description
8	Manufacture of bulk, large scale chemicals
9	Manufacture of fine chemicals
10	Formulation (mixing) of preparations and/or re-packaging
13	Manufacture of non-metallic mineral products (plasters, cement)
14	Manufacture of basic metals, including alloys
15	Manufacture of fabricated metal products, except machinery and equipment
16	Manufacture of computer, electronic and optical products, electrical equipment
19	Building and construction work
24	Scientific research and development

Process category	Activity
1	Use in closed process with no likelihood of exposure
2	Use in closed process with occasional controlled exposure
3	Use in closed batch process for synthesis or formulation
4	Use in batch and other processes where opportunity for exposure arises
5	Mixing or blending in batch processes for formulation of preparations and articles
8a	Transfer of substance or preparations from/to vessels at non-dedicated facilities
8b	Transfer of substance or preparations from/to vessels at dedicated facilities
9	Transfer of substance or preparations into small containers (dedicated filling lines, including weighing)
14	Production of mixtures or articles by tableting, compression, extrusion, pelletisation
15	Use as laboratory agent
22	Potentially closed processing operations with minerals/metals at elevated temperatures
26	Handling of solid inorganic substances at ambient temperature

Environmental release category	Description
1	Manufacture of substances
2	Formulation of preparations
4	Industrial use of processing aids in processes and products, not becoming part of articles
5	Industrial use resulting in inclusion into or onto a matrix
6a	Industrial use resulting in manufacture of another substance (use of intermediates)
6b	Industrial use of reactive processing aids

Article category	Description
01	Adhesive, sealant and coating
4	Stone, plaster, cement, glass and ceramic articles

9.1.1.1. Description of activities and processes covered in the exposure scenario

The exposure scenario describes the manufacture and industrial use of iron(II) chloride (FeCl₂, ferrous chloride), iron(III) chloride (FeCl₃, ferric chloride), iron(II) sulphate (FeSO₄, ferrous sulphate) and iron(III) sulphate (Fe₂(SO₄)₃, ferric sulphate) which may be supplied as solids in various hydration states.

The solid substances or solid mixtures containing them may be transferred in enclosed or open dedicated or non-dedicated systems in large or small amounts, be blended and mixed with other substances in enclosed or open vessels and be used for different purposes in closed or open continuous or batch processes. Finally, the solid substances or solid and wetted mixtures containing them may be processed by compaction, forming of pellets or tablets, etc.

9.1.1.2. Controlling environmental exposure

9.1.1.2.1. Product characteristics

The present exposure scenario considers powdery iron salt products that are manufactured, transferred, formulated, re-packaged, bagged, delivered to and handled by industrial downstream users.

9.1.1.2.2. Amount used

The amount of substance manufactured and used may vary considerably over the wide range of processes and use sites described in the present scenario and may range from a few hundred kilograms to hundreds of tonnes per day. In some cases such as the laboratory use, a few grams may be used per day. In the assessment of environmental exposure, a typical use amount of 25 g iron per m³ treated water and a reasonable highest use amount of 250 g iron per m³ treated water were considered.

9.1.1.2.3. Frequency and duration of use

The majority of processes described in the present exposure scenario are running on 300 to 365 days a year. Processes may run continuously or may be operated as batch processes meaning that interruptions of the processes may occur.

9.1.1.2.4. Environmental factors not influenced by risk management measures

The modelling of environmental concentrations was based on the default description of process parameters and landscape in EUSES. A dilution factor of 10 was used for the calculation of PECs in freshwater in the example with the typical use amount of iron salt and a dilution factor of 40 was used in the example with the reasonable highest use amount of iron salt. The corresponding dilution factors for seawater were 100 and 400, respectively. The flow rate of the recipient and the dilution factors can be changed by using the appropriate equation for scaling of the risk characterisation ratios (see section 9.4.3.1).

9.1.1.2.5. Other given operational conditions affecting environmental exposure

Some of the processes described in the present exposure scenario may be operated in confined areas.

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

Many of the processes described in section 9.1 are operated in enclosed systems, namely those involving the use of chlorine, hydrochloric, sulphuric or nitric acids.

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

Sites manufacturing or using solid iron salt products are generally equipped with dust abatement techniques to avoid atmospheric emissions as much as possible. The most common abatement techniques include bag filters or wet scrubbing units (BREF document, European Commission 2006).

The waste water produced in the described processes and containing dissolved iron salts as well as heavy metal impurities is either recycled in the processes or collected and treated, for example by means of precipitation, before released to further waste water treatment or the environment (BREF document, European Commission 2006).

9.1.1.2.8. Conditions and measures related to industrial waste water treatment (onsite or external)

The volume of waste water emitted per day was 2000 m³ for the majority of processes as this is the standard condition in EUSES. The volumetric waste water flow can be changed by using the appropriate equation for scaling of the risk characterisation ratios (see section 9.4.3.1).

9.1.1.2.9. Conditions and measures related to external recovery of waste

Frequently, industrial waste water produced at the sites is treated by precipitation to remove iron and heavy metal impurities. The resulting solids, for example hydroxides, are disposed of mainly in landfills according to local environmental regulations.

9.1.1.3. Controlling worker exposure

9.1.1.3.1. Product characteristics

The present exposure scenarios considers powdery iron salt products that are manufactured, transferred, formulated, re-packaged, bagged, delivered to and handled by industrial downstream users.

9.1.1.3.2. Amount used

The amount of substance manufactured and used may considerably vary over the wide range of processes and use sites described in the present scenario and may range from a few hundred kilograms to hundreds of tonnes per day. In some cases such as the laboratory use, a few grams may be used per day.

9.1.1.3.3. Frequency and duration of use

The generic human exposure assessment is based on daily exposure occurring during a full working shift of 8 hours if not otherwise indicated. A worker may be exposed on 220 days per year under normal conditions.

9.1.1.3.4. Human factors not influenced by risk management

The worker under normal conditions has a breathing rate of 10 m³ per 8 hour shift. The exposed skin area per activity was used as defined in the MEASE exposure assessment tool (EBRC Consulting 2010) and as shown in Table 155.

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

Many of the processes covered in the present generic exposure scenario are operated in enclosed systems, namely those involving the use of chlorine, hydrochloric, sulphuric or nitric acids.

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

Sites manufacturing or using solid iron salt products are generally equipped with dust abatement techniques to avoid atmospheric emissions as much as possible. The most common abatement techniques include bag filters or wet scrubbing units.

The facilities where solid iron salt products are directly handled by workers should be equipped with efficient local exhaust ventilation systems.

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

In the absence of local exhaust ventilation workers directly handling solid iron salt products should wear respiratory masks with appropriate dust filters (BREF document, European Commission 2006).

Workers directly handling solid iron salt products should wear chemical resistant gloves and safety goggles as well as appropriate working clothes and boots.

9.1.1.4. Controlling consumer exposure

No consumer exposure is anticipated with the industrial activities described in the present exposure scenario.

9.1.1.5. Controlling exposure during the service life of articles

A number of article categories are listed for the present exposure scenario. Since the iron salts will be bound into the solid matrix of articles, no release of iron salts from articles during the service life is anticipated under reasonable use conditions. An assessment of human and environmental exposure to iron salts due to release of substance from articles during the service life is not performed in the present document.

9.1.2. Exposure scenario 2: Manufacturing and industrial application of granular solid iron salt products that may lead to moderate dust formation

The exposure scenario covers activities involving the industrial use of granular solid iron salts or solid mixtures containing iron salts and that may lead to the formation of moderate amounts of inhalable iron salt dust in the air of workplaces. The present exposure scenario 2 covers the following industrial processes performed in a variety of industrial sectors, which are related to a number of environmental release categories and may result in the manufacture of articles.

Sector of use	Description
8	Manufacture of bulk, large scale chemicals
9	Manufacture of fine chemicals

Iron (II & III) salts category

Sector of use	Description
10	Formulation (mixing) of preparations and/or re-packaging
13	Manufacture of non-metallic mineral products (plasters, cement)
14	Manufacture of basic metals, including alloys
15	Manufacture of fabricated metal products, except machinery and equipment
16	Manufacture of computer, electronic and optical products, electrical equipment
19	Building and construction work
24	Scientific research and development

Process category	Activity
1	Use in closed process with no likelihood of exposure
2	Use in closed process with occasional controlled exposure
3	Use in closed batch process for synthesis or formulation
4	Use in batch and other processes where opportunity for exposure arises
5	Mixing or blending in batch processes for formulation of preparations and articles
8a	Transfer of substance or preparations from/to vessels at non-dedicated facilities
8b	Transfer of substance or preparations from/to vessels at dedicated facilities
9	Transfer of substance or preparations into small containers (dedicated filling lines, including weighing)
14	Production of mixtures or articles by tableting, compression, extrusion, pelletisation
15	Use as laboratory agent
22	Potentially closed processing operations with minerals/metals at elevated temperatures
26	Handling of solid inorganic substances at ambient temperature

Environmental release category	Description
1	Manufacture of substances
2	Formulation of preparations
4	Industrial use of processing aids in processes and products, not becoming part of articles
5	Industrial use resulting in inclusion into or onto a matrix
6a	Industrial use resulting in manufacture of another substance (use of intermediates)
6b	Industrial use of reactive processing aids

Article category	Description
01	Adhesive, sealant and coating
4	Stone, plaster, cement, glass and ceramic articles

9.1.2.1. Description of activities and processes covered in the exposure scenario

The exposure scenario describes the manufacture and industrial use of iron(II) chloride (FeCl₂, ferrous chloride), iron(III) chloride (FeCl₃, ferric chloride), iron(II) sulphate (FeSO₄, ferrous sulphate) and iron(III) sulphate (Fe₂(SO₄)₃, ferric sulphate) which may be supplied as solids in various hydration states.

The solid substances or solid mixtures containing them may be transferred in enclosed or open dedicated or non-dedicated systems in large or small amounts, be blended and mixed with other substances in enclosed or open vessels and be used for different purposes in closed or open continuous or batch processes. Finally, the solid substances or solid and wetted mixtures containing them may be processed by compaction, forming of pellets or tablets, etc.

9.1.2.2. Controlling environmental exposure

9.1.2.2.1. Product characteristics

The present exposure scenario considers granular iron salt products that are manufactured, transferred, formulated, re-packaged, bagged, delivered to and handled by industrial downstream users.

9.1.2.2.2. Amount used

The amount of substance manufactured and used may vary considerably over the wide range of processes and use sites described in the present scenario and may range from a few hundred kilograms to hundreds of tonnes per day. In some cases such as the laboratory use, a few grams may be used per day. In the assessment of environmental exposure, a typical use amount of 25 g iron per m³ waste water and a reasonable highest use amount of 250 g iron per m³ waste water were considered.

9.1.2.2.3. Frequency and duration of use

The majority of processes described in the present exposure scenario are running on 300 to 365 days a year. Processes may run continuously or may be operated as batch processes meaning that interruptions of the processes may occur.

9.1.2.2.4. Environmental factors not influenced by risk management measures

The modelling of environmental concentrations was based on the default description of process parameters and landscape in EUSES. A dilution factor of 10 was used for the calculation of PECs in freshwater in the example with the typical use amount of iron salt and a dilution factor of 40 was used in the example with the reasonable highest use amount of iron salt. The corresponding dilution factors for seawater were 100 and 400, respectively. The dilution factor for seawater was 100. The flow rate of the recipient and the dilution factors can be changed by using the appropriate equation for scaling of the risk characterisation ratios (see section 9.4.3.1).

9.1.2.2.5. Other given operational conditions affecting environmental exposure

Some of the processes described in the present exposure scenario may be operated in confined areas.

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

Many of the processes described in section 9.1 are operated in enclosed systems, namely those involving the use of chlorine, hydrochloric, sulphuric or nitric acids.

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

Sites manufacturing or using solid iron salt products are generally equipped with dust abatement techniques to avoid atmospheric emissions as much as possible. The most common abatement techniques include bag filters or wet scrubbing units (BREF document, European Commission 2006).

The waste water produced in the described processes and containing dissolved iron salts as well as heavy metal impurities is either recycled in the processes or collected and treated, for example by means of precipitation, before released to further waste water treatment or the environment (BREF document, European Commission 2006).

9.1.2.2.8. Conditions and measures related to industrial waste water treatment (onsite or external)

The volume of waste water emitted per day was 2000 m³ for the majority of processes as this is the standard condition in EUSES. The volumetric waste water flow can be changed by using the appropriate equation for scaling of the risk characterisation ratios (see section 9.4.3.1).

9.1.2.2.9. Conditions and measures related to external recovery of waste

Frequently, industrial waste water produced at the sites is treated by precipitation to remove iron and heavy metal impurities. The resulting solids, for example hydroxides, are disposed of mainly in landfills according to local environmental regulations.

9.1.2.3. Controlling worker exposure

9.1.2.3.1. Product characteristics

The present exposure scenario considers granular iron salt products that are manufactured, transferred, formulated, re-packaged, bagged, delivered to and handled by industrial downstream users.

9.1.2.3.2. Amount used

The amount of substance manufactured and used may considerably vary over the wide range of processes and use sites described in the present scenario and may range from a few hundred kilograms to hundreds of tonnes per day. In some cases such as the laboratory use, a few grams may be used per day.

9.1.2.3.3. Frequency and duration of use

The generic human exposure assessment is based on daily exposure occurring during a full working shift of 8 hours if not otherwise indicated. A worker may be exposed on 220 days per year under normal conditions.

9.1.2.3.4. Human factors not influenced by risk management

The worker under normal conditions has a breathing rate of 10 m³ per 8 hour shift. The exposed skin area per activity was used as defined in the MEASE exposure assessment tool (EBRC Consulting 2010) and as shown in Table 155.

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

Many of the processes covered in the present generic exposure scenario are operated in enclosed systems, namely those involving the use of chlorine, hydrochloric, sulphuric or nitric acids.

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

Sites manufacturing or using solid iron salt products are generally equipped with dust abatement techniques to avoid atmospheric emissions as much as possible. The most common abatement techniques include bag filters or wet scrubbing units (BREF document, European Commission 2006).

The facilities where solid iron salt products are directly handled by workers should be equipped with efficient local exhaust ventilation systems.

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

In the absence of local exhaust ventilation workers directly handling solid iron salt products should wear respiratory masks with appropriate dust filters.

Workers directly handling solid iron salt products should wear chemical resistant gloves and safety goggles as well as appropriate working clothes and boots.

9.1.2.4. Controlling consumer exposure

No consumer exposure is anticipated with the industrial activities described in the present exposure scenario.

9.1.2.5. Controlling exposure during the service life of articles

A number of article categories are listed for the present exposure scenario. Since the iron salts will be bound into the solid matrix of articles, no release of iron salts from articles during the service life is anticipated under reasonable use conditions. An assessment of human and environmental exposure to iron salts due to release of substance from articles during the service life is not performed in the present document.

9.1.3. Exposure scenario 3: Manufacturing and industrial application of coarse solid iron salt products that may lead to low dust formation

The exposure scenario covers activities involving the industrial use of coarse solid iron salts or solid mixtures containing iron salts and that may lead to the formation of low amounts of inhalable iron salt dust in the air of workplaces. The present exposure scenario 3 covers the following industrial processes performed in a variety of industrial sectors, which are related to a number of environmental release categories and may result in the manufacture of articles.

Sector of use	Description
8	Manufacture of bulk, large scale chemicals
9	Manufacture of fine chemicals
10	Formulation (mixing) of preparations and/or re-packaging
13	Manufacture of non-metallic mineral products (plasters, cement)
14	Manufacture of basic metals, including alloys
15	Manufacture of fabricated metal products, except machinery and equipment
16	Manufacture of computer, electronic and optical products, electrical equipment
19	Building and construction work
24	Scientific research and development

Process category	Activity
1	Use in closed process with no likelihood of exposure
2	Use in closed process with occasional controlled exposure
3	Use in closed batch process for synthesis or formulation
4	Use in batch and other processes where opportunity for exposure arises
5	Mixing or blending in batch processes for formulation of preparations and articles
8a	Transfer of substance or preparations from/to vessels at non-dedicated facilities

Process category	Activity
8b	Transfer of substance or preparations from/to vessels at dedicated facilities
9	Transfer of substance or preparations into small containers (dedicated filling lines, including weighing)
14	Production of mixtures or articles by tableting, compression, extrusion, pelletisation
15	Use as laboratory agent
22	Potentially closed processing operations with minerals/metals at elevated temperatures
26	Handling of solid inorganic substances at ambient temperature

Environmental release category	Description
1	Manufacture of substances
2	Formulation of preparations
4	Industrial use of processing aids in processes and products, not becoming part of articles
5	Industrial use resulting in inclusion into or onto a matrix
6a	Industrial use resulting in manufacture of another substance (use of intermediates)
6b	Industrial use of reactive processing aids

Article category	Description
01	Adhesive, sealant and coating
4	Stone, plaster, cement, glass and ceramic articles

9.1.3.1. Description of activities and processes covered in the exposure scenario

The exposure scenario describes the manufacture and industrial use of iron(II) chloride (FeCl₂, ferrous chloride), iron(III) chloride (FeCl₃, ferric chloride), iron(II) sulphate (FeSO₄, ferrous sulphate) and iron(III) sulphate (Fe₂(SO₄)₃, ferric sulphate) which may be supplied as solids in various hydration states.

The solid substances or solid mixtures containing them may be transferred in enclosed or open dedicated or non-dedicated systems in large or small amounts, be blended and mixed with other substances in enclosed or open vessels and be used for different purposes in closed or open continuous or batch processes. Finally, the solid substances or solid and wetted mixtures containing them may be processed by compaction, forming of pellets or tablets, etc.

9.1.3.2. Controlling environmental exposure

9.1.3.2.1. Product characteristics

The present exposure scenario considers coarse iron salt products that are manufactured, transferred, formulated, re-packaged, bagged, delivered to and handled by industrial downstream users.

9.1.3.2.2. Amount used

The amount of substance manufactured and used may vary considerably over the wide range of processes and use sites described in the present scenario and may range from a few hundred kilograms to hundreds of tonnes per day. In some cases such as the laboratory use, a few grams may be used per day. In the assessment of environmental exposure, a typical use amount of 25 g iron per m³ waste water and a reasonable highest use amount of 250 g iron per m³ waste water were considered.

9.1.3.2.3. Frequency and duration of use

The majority of processes described in the present exposure scenario are running on 300 to 365 days a year. Processes may run continuously or may be operated as batch processes meaning that interruptions of the processes may occur.

9.1.3.2.4. Environmental factors not influenced by risk management measures

The modelling of environmental concentrations was based on the default description of process parameters and landscape in EUSES. A dilution factor of 10 was used for the calculation of PECs in freshwater in the example with the typical use amount of iron salt and a dilution factor of 40 was used in the example with the reasonable highest use amount of iron salt. The corresponding dilution factors for seawater were 100 and 400, respectively. The dilution factor for seawater was 100. The flow rate of the recipient and the dilution factors can be changed by using the appropriate equation for scaling of the risk characterisation ratios (see section 9.4.3.1).

9.1.3.2.5. Other given operational conditions affecting environmental exposure

Some of the processes described in the present exposure scenario may be operated in confined areas.

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

Many of the processes described in section 9.1 are operated in enclosed systems, namely those involving the use of chlorine, hydrochloric, sulphuric or nitric acids.

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

Sites manufacturing or using solid iron salt products are generally equipped with dust abatement techniques to avoid atmospheric emissions as much as possible. The most common abatement techniques include bag filters or wet scrubbing units (BREF document, European Commission 2006).

The waste water produced in the described processes and containing dissolved iron salts as well as heavy metal impurities is either recycled in the processes or collected and treated, for example by means of precipitation, before released to further waste water treatment or the environment (BREF document, European Commission 2006).

9.1.3.2.8. Conditions and measures related to industrial waste water treatment (onsite or external)

The volume of waste water emitted per day was 2000 m³ for the majority of processes as this is the standard condition in EUSES. The volumetric waste water flow can be changed by using the appropriate equation for scaling of the risk characterisation ratios (see section 9.4.3.1).

9.1.3.2.9. Conditions and measures related to external recovery of waste

Frequently, industrial waste water produced at the sites is treated by precipitation to remove iron and heavy metal impurities. The resulting solids, for example hydroxides, are disposed of mainly in landfills according to local environmental regulations.

9.1.3.3. Controlling worker exposure

9.1.3.3.1. Product characteristics

The present exposure scenario considers granular iron salt products that are manufactured, transferred, formulated, re-packaged, bagged, delivered to and handled by industrial downstream users.

9.1.3.3.2. Amount used

The amount of substance manufactured and used may considerably vary over the wide range of processes and use sites described in the present scenario and may range from a few hundred kilograms to hundreds of tonnes per day. In some cases such as the laboratory use, a few grams may be used per day.

9.1.3.3.3. Frequency and duration of use

The generic human exposure assessment is based on daily exposure occurring during a full working shift of 8 hours if not otherwise indicated. A worker may be exposed on 220 days per year under normal conditions.

9.1.3.3.4. Human factors not influenced by risk management

The worker under normal conditions has a breathing rate of 10 m³ per 8 hour shift. The exposed skin area per activity was used as defined in the MEASE exposure assessment tool (EBRC Consulting 2010) and as shown in Table 155.

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

Many of the processes covered in the present generic exposure scenario are operated in enclosed systems, namely those involving the use of chlorine, hydrochloric, sulphuric or nitric acids.

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

Sites manufacturing or using solid iron salt products are generally equipped with dust abatement techniques to avoid atmospheric emissions as much as possible. The most common abatement techniques include bag filters or wet scrubbing units (BREF document, European Commission 2006).

The facilities where solid iron salt products are directly handled by workers should be equipped with efficient local exhaust ventilation systems.

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

In the absence of local exhaust ventilation workers directly handling solid iron salt products should wear respiratory masks with appropriate dust filters.

Workers directly handling solid iron salt products should wear chemical resistant gloves and safety goggles as

well as appropriate working clothes and boots.

9.1.3.4. Controlling consumer exposure

No consumer exposure is anticipated with the industrial activities described in the present exposure scenario.

9.1.3.5. Controlling exposure during the service life of articles

A number of article categories are listed for the present exposure scenario. Since the iron salts will be bound into the solid matrix of articles, no release of iron salts from articles during the service life is anticipated under reasonable use conditions. An assessment of human and environmental exposure to iron salts due to release of substance from articles during the service life is not performed in the present document.

9.1.4. Exposure scenario 4: Manufacturing and industrial application of liquid iron salt products

The exposure scenario covers activities involving the industrial use of liquid mixtures containing iron salts. The present exposure scenario 4 covers the following industrial processes performed in a variety of industrial sectors, which are related to a number of environmental release categories and may result in the manufacture of articles.

Sector of use	Description
8	Manufacture of bulk, large scale chemicals
9	Manufacture of fine chemicals
10	Formulation (mixing) of preparations and/or re-packaging
13	Manufacture of non-metallic mineral products (plasters, cement)
14	Manufacture of basic metals, including alloys
15	Manufacture of fabricated metal products, except machinery and equipment
16	Manufacture of computer, electronic and optical products, electrical equipment
19	Building and construction work
24	Scientific research and development

Process category	Activity
1	Use in closed process with no likelihood of exposure
2	Use in closed process with occasional controlled exposure
3	Use in closed batch process for synthesis or formulation
4	Use in batch and other processes where opportunity for exposure arises
5	Mixing or blending in batch processes for formulation of preparations and articles
7	Industrial spraying
8a	Transfer of substance or preparations from/to vessels at non-dedicated facilities
8b	Transfer of substance or preparations from/to vessels at dedicated facilities
9	Transfer of substance or preparations into small containers (dedicated filling lines, including weighing)
10	Roller application or brushing
13	Treatment of articles by dipping and pouring
15	Use as laboratory agent

Environmental release category	Description
1	Manufacture of substances
2	Formulation of preparations
4	Industrial use of processing aids in processes and products, not becoming part of articles
5	Industrial use resulting in inclusion into or onto a matrix
6a	Industrial use resulting in manufacture of another substance (use of intermediates)
6b	Industrial use of reactive processing aids

Article category	Description
01	Adhesive, sealant and coating
4	Stone, plaster, cement, glass and ceramic articles

9.1.4.1. Description of activities and processes covered in the exposure scenario

The exposure scenario describes the manufacture and industrial use of iron(II) chloride (FeCl₂, ferrous chloride), iron(III) chloride (FeCl₃, ferric chloride), iron(II) sulphate (FeSO₄, ferrous sulphate), iron(III) sulphate (Fe₂(SO₄)₃, ferric sulphate) and iron(III) chlorosulphate (FeClSO₄, ferric chlorosulphate) which may be supplied as aqueous solutions of varying concentrations.

The liquid mixtures containing iron salts may be transferred in enclosed or open dedicated or non-dedicated systems in large or small amounts, be blended and mixed with other substances in enclosed or open vessels and be used for different purposes in closed or open continuous or batch processes.

9.1.4.2. Controlling environmental exposure

9.1.4.2.1. Product characteristics

The present exposure scenario considers liquid mixtures containing iron salts that are manufactured, transferred, formulated, re-packaged, loaded and unloaded, delivered to and handled by industrial downstream users.

9.1.4.2.2. Amount used

The amount of substance manufactured and used may vary considerably over the wide range of processes and use sites described in the present scenario and may range from a few hundred kilograms to hundreds of tonnes per day. In some cases such as the laboratory use, a few grams may be used per day. In the assessment of environmental exposure, a typical use amount of 25 g iron per m³ waste water and a reasonable highest use amount of 250 g iron per m³ waste water were considered.

9.1.4.2.3. Frequency and duration of use

The majority of processes described in the present exposure scenario are running on 300 to 365 days a year. Processes may run continuously or may be operated as batch processes meaning that interruptions of the processes may occur.

9.1.4.2.4. Environmental factors not influenced by risk management measures

The modelling of environmental concentrations was based on the default description of process parameters and landscape in EUSES. A dilution factor of 10 was used for the calculation of PECs in freshwater in the example with the typical use amount of iron salt and a dilution factor of 40 was used in the example with the reasonable highest use amount of iron salt. The corresponding dilution factors for seawater were 100 and 400, respectively. The dilution factor for seawater was 100. The flow rate of the recipient and the dilution factors can be changed by using the appropriate equation for scaling of the risk characterisation ratios (see section 9.4.3.1).

9.1.4.2.5. Other given operational conditions affecting environmental exposure

Some of the processes described in the present exposure scenario may be operated in confined areas.

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

Many of the processes described in section 9.1 are operated in enclosed systems, namely those involving the use of chlorine, hydrochloric, sulphuric or nitric acids.

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

The waste water produced in the described processes and containing dissolved iron salts as well as heavy metal impurities is either recycled in the processes or collected and treated, for example by means of precipitation, before released to further waste water treatment or the environment (BREF document, European Commission 2006).

9.1.4.2.8. Conditions and measures related to industrial waste water treatment (onsite or external)

The volume of waste water emitted per day was 2000 m³ for the majority of processes as this is the standard condition in EUSES. The volumetric waste water flow can be changed by using the appropriate equation for scaling of the risk characterisation ratios (see section 9.4.3.1).

9.1.4.2.9. Conditions and measures related to external recovery of waste

Frequently, industrial waste water produced at the sites is treated by precipitation to remove iron and heavy metal impurities. The resulting solids, for example hydroxides, are disposed of mainly in landfills according to local environmental regulations.

9.1.4.3. Controlling worker exposure

9.1.4.3.1. Product characteristics

The present exposure scenario considers liquid mixtures containing iron salts that are manufactured, transferred, formulated, re-packaged, loaded and unloaded, delivered to and handled by industrial downstream users.

9.1.4.3.2. Amount used

The amount of substance manufactured and used may considerably vary over the wide range of processes and use sites described in the present scenario and may range from a few hundred kilograms to hundreds of tonnes (litres to m³) per day. In some cases such as the laboratory use, a few grams (millilitres) may be used per day.

9.1.4.3.3. Frequency and duration of use

The generic human exposure assessment is based on daily exposure occurring during a full working shift of 8 hours if not otherwise indicated. A worker may be exposed on 220 days per year under normal conditions.

9.1.4.3.4. Human factors not influenced by risk management

The worker under normal conditions has a breathing rate of 10 m³ per 8 hour shift. The exposed skin area per activity was used as defined in the MEASE exposure assessment tool (EBRC Consulting 2010) and as shown in Table 155.

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

Many of the processes covered in the present generic exposure scenario are operated in enclosed systems, namely those involving the use of chlorine, hydrochloric, sulphuric or nitric acids or industrial spraying applications. The majority of these processes are likely to be automated and operated by remote control.

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

The facilities where liquid mixtures containing iron salts are directly handled by workers should be equipped with efficient local exhaust ventilation systems. Industrial spraying normally is performed in enclosed equipment or areas that may be segregated from the working area to avoid the distribution of aerosols in the air of workplaces.

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

Since aqueous solutions of the relevant iron salts exhibit irritating or corrosive properties, workers and consumers having direct contact with the solutions need to wear appropriate equipment protecting the skin and the eyes, such as chemical resistant gloves, safety goggles and appropriate working clothes and boots.

In the absence of local exhaust ventilation workers directly handling liquid mixtures containing iron salts should wear respiratory masks with appropriate filters. The use of breathing masks is also necessary in situations where workers are directly spraying liquids containing iron salts.

9.1.4.4. Controlling consumer exposure

No consumer exposure is anticipated with the industrial activities described in the present exposure scenario.

9.1.4.5. Controlling exposure during the service life of articles

A number of article categories are listed for the present exposure scenario. Since the iron salts will be bound into the solid matrix of articles, no release of iron salts from articles during the service life is anticipated under reasonable use conditions. An assessment of human and environmental exposure to iron salts due to release of substance from articles during the service life is not performed in the present document.

9.2. Generic exposure scenario describing professional applications of iron salts

The present generic exposure scenario is applicable to a broad range of identified professional uses of iron salt products, which are briefly described in the following. It should be noted that the generic scenario is not restricted to the identified uses described below. It may in fact be applicable also to other uses associated with similar occupational professional activities.

Professional use of cements

Iron sulphate is commonly used to reduce the content of hexavalent chromium in cements, which is limited to 2 ppm by European legislation. A concentration of approximately 0.5 % iron salts is mixed into the cement powder, which is delivered to professional downstream users in paper bags normally containing between 2.5 and 50 kg. The reaction between iron sulphate and chromium takes place only after wetting of the cement.

Professional use in land remediation applications

Ferrous salts are used as remediating agents to improve quality of both water and soil at contaminated sites. One particular field of application is the removal of hazardous contaminants such as hexavalent chromium in soil. Soil remediation products can be delivered to professional users as granular solids that need to be dissolved in water prior to use or as aqueous solutions.

Professional use as laboratory agent

Professional laboratories use different iron salt products. Staff may need to transfer, weigh and blend relatively small amounts of iron salt products.

Use in agrochemicals

Solid agrochemical products in granular or flake form are available to professional users. The solid products may be distributed manually. In most cases, users will transfer the products into a distribution system (open vessel, irrigation system in greenhouses, fertigation tank of a tractor) and may need to dissolve or dilute the products in water before use. In addition, also aqueous solutions containing iron salts may be available to professionals. The solid or dissolved products are applied to the ground at indoor sites (greenhouses) or outdoor sites (fields, parks, sport fields).

Professional use in sealants and coatings

Iron sulphate is reportedly used in sealant paints for wood. This is described as a sealant rather than a coating. The iron sulphate is also in the end product and its function is to protect the painted surface.

9.2.1. Exposure scenario 5: Professional application of powdery solid iron salt products that may lead to significant dust formation

The exposure scenario covers activities involving the professional use of powdery solid iron salts or solid mixtures containing iron salts and that may lead to the formation of significant amounts of inhalable iron salt dust in the air of workplaces. The present exposure scenario 5 covers the following professional processes performed in a variety of sectors, which are related to a number of environmental release categories and may result in the manufacture of articles.

Sector of use	Description
1	Agriculture, forestry, fishery
10	Formulation
13	Manufacture of non-metallic mineral products (plasters, cement)
19	Building and construction work
24	Scientific research and development

Process category	Activity
1	Use in closed process with no likelihood of exposure
2	Use in closed process with occasional controlled exposure
3	Use in closed batch process (synthesis or formulation)
4	Use in batch and other process (synthesis) where opportunity for exposure arises
5	Mixing or blending in batch processes for formulation of preparations and articles
8a	Transfer of substance or preparations from/to vessels at non-dedicated facilities
8b	Transfer of substance or preparations from/to vessels at dedicated facilities
9	Transfer of substance or preparations into small containers (dedicated filling lines, including weighing)
14	Production of preparations or articles by tableting, compression, extrusion, pelletisation
15	Use as laboratory agent
22	Potentially closed processing operations with minerals/metals at elevated temperatures (normally industrial setting)
26	Handling of solid inorganic substances at ambient temperature

Environmental release category	Description
8a	Wide dispersive indoor use of processing aids in open systems
8c	Wide dispersive indoor use resulting in inclusion into or onto a matrix
8d	Wide dispersive outdoor use of processing aids in open systems
8e	Wide dispersive outdoor use of reactive substances in open systems
8f	Wide dispersive outdoor use resulting in inclusion into or onto a matrix

Article category	Description
01	Adhesive, sealant and coating
4	Stone, plaster, cement, glass and ceramic articles

9.2.1.1. Description of activities and processes covered in the exposure scenario

The exposure scenario describes the professional use of iron(II) chloride (FeCl_2 , ferrous chloride), iron(III) chloride (FeCl_3 , ferric chloride), iron(II) sulphate (FeSO_4 , ferrous sulphate) and iron(III) sulphate ($\text{Fe}_2(\text{SO}_4)_3$, ferric sulphate) which may be supplied as solids in various hydration states.

The solid substances or solid mixtures containing them may be transferred in enclosed or open dedicated or non-dedicated systems in large or small amounts, be blended and mixed with other substances in enclosed or open vessels and be used for different purposes in closed or open continuous or batch processes.

9.2.1.2. Controlling environmental exposure

9.2.1.2.1. Product characteristics

The present exposure scenario considers powdery iron salt products that are transferred, re-packaged, bagged, delivered to and handled by professional downstream users.

9.2.1.2.2. Amount used

The amount of substance used may vary considerably over the wide range of processes and use sites described in the present scenario and may range from a few grams to dozens of kilograms per day. In the assessment of environmental exposure, a typical use amount of 25 g iron per m^3 waste water and a reasonable highest use amount of 250 g iron per m^3 waste water were considered.

9.2.1.2.3. Frequency and duration of use

The majority of processes described in the present exposure scenario are running on less than 300 days per year. Professional uses will be batch processes in the majority of cases.

9.2.1.2.4. Environmental factors not influenced by risk management measures

The modelling of environmental concentrations was based on the default description of process parameters and landscape in EUSES. A dilution factor of 10 was used for the calculation of PECs in freshwater in the example with the typical use amount of iron salt and a dilution factor of 40 was used in the example with the reasonable highest use amount of iron salt. The corresponding dilution factors for seawater were 100 and 400, respectively. The dilution factor for seawater was 100. The flow rate of the recipient and the dilution factors can be changed by using the appropriate equation for scaling of the risk characterisation ratios (see section 9.4.3.1).

9.2.1.2.5. Other given operational conditions affecting environmental exposure

Some of the processes described in the present exposure scenario may be operated in confined areas.

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

Some of the processes described in section 9.2 are operated in enclosed systems.

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

Sites using solid iron salt products may be equipped with dust abatement techniques to avoid atmospheric emissions, for example bag filters.

The waste water produced in the described processes and containing dissolved iron salts as well as heavy metal impurities is collected and treated, for example by means of precipitation, before released to further waste water treatment or the environment.

9.2.1.2.8. Conditions and measures related to industrial waste water treatment (onsite or external)

The volume of waste water emitted per day was 2000 m³ for the majority of processes as this is the standard condition in EUSES. The volumetric waste water flow can be changed by using the appropriate equation for scaling of the risk characterisation ratios (see section 9.4.3.1).

9.2.1.2.9. Conditions and measures related to external recovery of waste

Frequently, waste water produced at the sites is treated by precipitation to remove iron and heavy metal impurities. The resulting solids, for example hydroxides, are disposed of mainly in landfills in accordance with local environmental regulations.

9.2.1.3. Controlling worker exposure

9.2.1.3.1. Product characteristics

The present exposure scenario considers powdery iron salt products that are transferred, re-packaged, bagged, delivered to and handled by professional downstream users.

9.2.1.3.2. Amount used

The amount of substance used may considerably vary over the wide range of processes and use sites described in the present scenario and may range from a few grams to dozens of kilograms per day.

9.2.1.3.3. Frequency and duration of use

The generic human exposure assessment is based on daily exposure occurring during a full working shift of 8 hours if not otherwise indicated. A worker may be exposed on 220 days per year under normal conditions.

9.2.1.3.4. Human factors not influenced by risk management

The worker under normal conditions has a breathing rate of 10 m³ per 8 hour shift. The exposed skin area per activity was used as defined in the MEASE exposure assessment tool (EBRC Consulting 2010) and as given in Table 160.

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

Some of the processes covered in the present generic exposure scenario are operated in enclosed systems.

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

Sites using solid iron salt products may be equipped with dust abatement techniques to avoid atmospheric emissions as much as possible, for example bag filters.

The facilities where solid iron salt products are directly handled by workers should be equipped with efficient local exhaust ventilation systems.

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

In the absence of local exhaust ventilation workers directly handling solid iron salt products should wear respiratory masks with appropriate dust filters.

Workers directly handling solid iron salt products should wear chemical resistant gloves and safety goggles as well as appropriate working clothes and boots.

9.2.1.4. Controlling consumer exposure

No consumer exposure is anticipated with the industrial activities described in the present exposure scenario.

9.2.1.5. Controlling exposure during the service life of articles

A number of article categories are listed for the present exposure scenario. Since the iron salts will be bound into the solid matrix of articles, no release of iron salts from articles during the service life is anticipated under reasonable use conditions. An assessment of human and environmental exposure to iron salts due to release of substance from articles during the service life is not performed in the present document.

9.2.2. Exposure scenario 6: Professional application of granular solid iron salt products that may lead to moderate dust formation

The exposure scenario covers activities involving the professional use of granular solid iron salts or solid mixtures containing iron salts and that may lead to the formation of moderate amounts of inhalable iron salt dust in the air of workplaces. The present exposure scenario 6 covers the following professional processes performed in a variety of sectors, which are related to a number of environmental release categories and may result in the manufacture of articles.

Sector of use	Description
1	Agriculture, forestry, fishery
10	Formulation
13	Manufacture of non-metallic mineral products (plasters, cement)
19	Building and construction work
24	Scientific research and development

Process category	Activity
1	Use in closed process with no likelihood of exposure
2	Use in closed process with occasional controlled exposure
3	Use in closed batch process (synthesis or formulation)
4	Use in batch and other process (synthesis) where opportunity for exposure arises
5	Mixing or blending in batch processes for formulation of preparations and articles
8a	Transfer of substance or preparations from/to vessels at non-dedicated facilities
8b	Transfer of substance or preparations from/to vessels at dedicated facilities
9	Transfer of substance or preparations into small containers (dedicated filling lines, including weighing)
15	Use as laboratory agent
26	Handling of solid inorganic substances at ambient temperature

Environmental release category	Description
8a	Wide dispersive indoor use of processing aids in open systems
8c	Wide dispersive indoor use resulting in inclusion into or onto a matrix
8d	Wide dispersive outdoor use of processing aids in open systems
8e	Wide dispersive outdoor use of reactive substances in open systems
8f	Wide dispersive outdoor use resulting in inclusion into or onto a matrix

Article category	Description
01	Adhesive, sealant and coating
4	Stone, plaster, cement, glass and ceramic articles

9.2.2.1. Description of activities and processes covered in the exposure scenario

The exposure scenario describes the professional use of iron(II) chloride (FeCl_2 , ferrous chloride), iron(III) chloride (FeCl_3 , ferric chloride), iron(II) sulphate (FeSO_4 , ferrous sulphate) and iron(III) sulphate ($\text{Fe}_2(\text{SO}_4)_3$, ferric sulphate) which may be supplied as solids in various hydration states.

The solid substances or solid mixtures containing them may be transferred in enclosed or open dedicated or non-dedicated systems in large or small amounts, be blended and mixed with other substances in enclosed or open vessels and be used for different purposes in closed or open continuous or batch processes.

9.2.2.2. Controlling environmental exposure

9.2.2.2.1. Product characteristics

The present exposure scenario considers granular iron salt products that are transferred, re-packaged, bagged, delivered to and handled by professional downstream users.

9.2.2.2.2. Amount used

The amount of substance used may vary considerably over the wide range of processes and use sites described in the present scenario and may range from a few grams to dozens of kilograms per day. In the assessment of environmental exposure, a typical use amount of 25 g iron per m^3 waste water and a reasonable highest use amount of 250 g iron per m^3 waste water were considered.

9.2.2.2.3. Frequency and duration of use

The majority of processes described in the present exposure scenario are running on less than 300 days a year. Professional uses will be batch processes in the majority of cases.

9.2.2.2.4. Environmental factors not influenced by risk management measures

The modelling of environmental concentrations was based on the default description of process parameters and landscape in EUSES. A dilution factor of 10 was used for the calculation of PECs in freshwater in the example with the typical use amount of iron salt and a dilution factor of 40 was used in the example with the reasonable highest use amount of iron salt. The corresponding dilution factors for seawater were 100 and 400, respectively. The dilution factor for seawater was 100. The flow rate of the recipient and the dilution factors can be changed by using the appropriate equation for scaling of the risk characterisation ratios (see section 9.4.3.1).

9.2.2.2.5. Other given operational conditions affecting environmental exposure

Some of the processes described in the present exposure scenario may be operated in confined areas.

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

Some of the processes described in section 9.2 may be operated in enclosed systems.

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

Sites using solid iron salt products may be equipped with dust abatement techniques to avoid atmospheric emissions as much as possible, for example bag filters.

The waste water produced in the described processes and containing dissolved iron salts as well as heavy metal impurities is collected and treated, for example by means of precipitation, before released to further waste water treatment or the environment.

9.2.2.2.7. Conditions and measures related to industrial waste water treatment (onsite or external)

The volume of waste water emitted per day was 2000 m³ for the majority of processes as this is the standard condition in EUSES. The volumetric waste water flow can be changed by using the appropriate equation for scaling of the risk characterisation ratios (see section 9.4.3.1).

9.2.2.2.8. Conditions and measures related to external recovery of waste

Frequently, waste water produced at the sites is treated by precipitation to remove iron and heavy metal impurities. The resulting solids, for example hydroxides, are disposed of mainly in landfills in accordance with local environmental regulations.

9.2.2.3. Controlling worker exposure

9.2.2.3.1. Product characteristics

The present exposure scenario considers granular iron salt products that are transferred, re-packaged, bagged, delivered to and handled by professional downstream users.

9.2.2.3.2. Amount used

The amount of substance used may considerably vary over the wide range of processes and use sites described in the present scenario and may range from a few grams to dozens of kilograms per day.

9.2.2.3.3. Frequency and duration of use

The generic human exposure assessment is based on daily exposure occurring during a full working shift of 8 hours if not otherwise indicated. A worker may be exposed on 220 days per year under normal conditions.

9.2.2.3.4. Human factors not influenced by risk management

The worker under normal conditions has a breathing rate of 10 m³ per 8 hour shift. The exposed skin area per activity was used as defined in the MEASE exposure assessment tool (EBRC Consulting 2010) and as given in Table 160.

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

Some of the processes covered in the present generic exposure scenario may be operated in enclosed systems.

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

Sites using solid iron salt products may be equipped with dust abatement techniques to avoid atmospheric emissions as much as possible, for example bag filters.

The facilities where solid iron salt products are directly handled by workers should be equipped with efficient local exhaust ventilation systems.

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

In the absence of local exhaust ventilation workers directly handling solid iron salt products should wear respiratory masks with appropriate dust filters.

Workers directly handling solid iron salt products should wear chemical resistant gloves and safety goggles as well as appropriate working clothes and boots.

9.2.2.4. Controlling consumer exposure

No consumer exposure is anticipated with the industrial activities described in the present exposure scenario.

9.2.2.5. Controlling exposure during the service life of articles

A number of article categories are listed for the present exposure scenario. Since the iron salts will be bound into the solid matrix of articles, no release of iron salts from articles during the service life is anticipated under reasonable use conditions. An assessment of human and environmental exposure to iron salts due to release of substance from articles during the service life is not performed in the present document.

9.2.3. Exposure scenario 7: Professional application of coarse solid iron salt products that may lead to low dust formation

The exposure scenario covers activities involving the professional use of coarse solid iron salts or solid mixtures containing iron salts and that may lead to the formation of low amounts of inhalable iron salt dust in the air of workplaces. The present exposure scenario 7 covers the following professional processes performed in a variety of sectors, which are related to a number of environmental release categories and may result in the manufacture of articles.

Sector of use	Description
1	Agriculture, forestry, fishery
13	Manufacture of non-metallic mineral products (plasters, cement)
19	Building and construction work
24	Scientific research and development

Process category	Activity
1	Use in closed process with no likelihood of exposure
2	Use in closed process with occasional controlled exposure
5	Mixing or blending in batch processes for formulation of preparations and articles
8a	Transfer of substance or preparations from/to vessels at non-dedicated facilities
8b	Transfer of substance or preparations from/to vessels at dedicated facilities
9	Transfer of substance or preparations into small containers (dedicated filling lines, including weighing)
10	Roller application or brushing
15	Use as laboratory agent
26	Handling of solid inorganic substances at ambient temperature

Environmental release category	Description
8a	Wide dispersive indoor use of processing aids in open systems
8c	Wide dispersive indoor use resulting in inclusion into or onto a matrix
8d	Wide dispersive outdoor use of processing aids in open systems
8e	Wide dispersive outdoor use of reactive substances in open systems
8f	Wide dispersive outdoor use resulting in inclusion into or onto a matrix

Article category	Description
01	Adhesive, sealant and coating
4	Stone, plaster, cement, glass and ceramic articles

9.2.3.1. Description of activities and processes covered in the exposure scenario

The exposure scenario describes the professional use of iron(II) chloride (FeCl_2 , ferrous chloride), iron(III) chloride (FeCl_3 , ferric chloride), iron(II) sulphate (FeSO_4 , ferrous sulphate) and iron(III) sulphate ($\text{Fe}_2(\text{SO}_4)_3$, ferric sulphate) which may be supplied as solids in various hydration states.

The solid substances or solid mixtures containing them may be transferred in enclosed or open dedicated or non-dedicated systems in large or small amounts, be blended and mixed with other substances in enclosed or open vessels and be used for different purposes in closed or open continuous or batch processes. Finally, the solid substances or solid and wetted mixtures containing them may be processed by compaction, forming of pellets or tablets, etc.

9.2.3.2. Controlling environmental exposure

9.2.3.2.1. Product characteristics

The present exposure scenario considers coarse iron salt products that are transferred, re-packaged, bagged, delivered to and handled by professional downstream users.

9.2.3.2.2. Amount used

The amount of substance used may vary considerably over the wide range of processes and use sites described in the present scenario and may range from a few grams to dozens of kilograms per day. In the assessment of environmental exposure, a typical use amount of 25 g iron per m³ waste water and a reasonable highest use amount of 250 g iron per m³ waste water were considered.

9.2.3.2.3. Frequency and duration of use

The majority of processes described in the present exposure scenario are running on less than 300 days a year. Professional uses will be batch processes in the majority of cases.

9.2.3.2.4. Environmental factors not influenced by risk management measures

The modelling of environmental concentrations was based on the default description of process parameters and landscape in EUSES. A dilution factor of 10 was used for the calculation of PECs in freshwater in the example with the typical use amount of iron salt and a dilution factor of 40 was used in the example with the reasonable highest use amount of iron salt. The corresponding dilution factors for seawater were 100 and 400, respectively. The dilution factor for seawater was 100. The flow rate of the recipient and the dilution factors can be changed by using the appropriate equation for scaling of the risk characterisation ratios (see section 9.4.3.1).

9.2.3.2.5. Other given operational conditions affecting environmental exposure

Some of the processes described in the present exposure scenario may be operated in confined areas.

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

Some of the processes described in section 9.2 may be operated in enclosed systems.

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

Sites using solid iron salt products may be equipped with dust abatement techniques to avoid atmospheric emissions as much as possible, for example bag filters.

The waste water produced in the described processes and containing dissolved iron salts as well as heavy metal impurities is collected and treated, for example by means of precipitation, before released to further waste water treatment or the environment.

9.2.3.2.8. Conditions and measures related to industrial waste water treatment (onsite or external)

The volume of waste water emitted per day was 2000 m³ for the majority of processes as this is the standard condition in EUSES. The volumetric waste water flow can be changed by using the appropriate equation for scaling of the risk characterisation ratios (see section 9.4.3.1).

9.2.3.2.9. Conditions and measures related to external recovery of waste

Frequently, waste water produced at the sites is treated by precipitation to remove iron and heavy metal impurities. The resulting solids, for example hydroxides, are disposed of mainly in landfills.

9.2.3.3. Controlling worker exposure

9.2.3.3.1. Product characteristics

The present exposure scenario considers coarse iron salt products that are transferred, re-packaged, bagged, delivered to and handled by professional downstream users.

9.2.3.3.2. Amount used

The amount of substance used may considerably vary over the wide range of processes and use sites described in the present scenario and may range from a few grams to dozens of kilograms per day.

9.2.3.3.3. Frequency and duration of use

The generic human exposure assessment is based on daily exposure occurring during a full working shift of 8 hours if not otherwise indicated. A worker may be exposed on 220 days per year under normal conditions.

9.2.3.3.4. Human factors not influenced by risk management

The worker under normal conditions has a breathing rate of 10 m³ per 8 hour shift. The exposed skin area per activity was used as defined in the MEASE exposure assessment tool (EBRC Consulting 2010) and as given in Table 160.

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

Some of the processes covered in the present generic exposure scenario may be operated in enclosed systems.

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

Sites using solid iron salt products may be equipped with dust abatement techniques to avoid atmospheric emissions as much as possible, for example bag filters.

The facilities where solid iron salt products are directly handled by workers should be equipped with efficient local exhaust ventilation systems.

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

In the absence of local exhaust ventilation workers directly handling solid iron salt products should wear respiratory masks with appropriate dust filters.

Workers directly handling solid iron salt products should wear chemical resistant gloves and safety goggles as well as appropriate working clothes and boots.

9.2.3.4. Controlling consumer exposure

No consumer exposure is anticipated with the industrial activities described in the present exposure scenario.

9.2.4. Exposure scenario 8: Professional application of liquid iron salt products

The exposure scenario covers activities involving the professional use of liquid mixtures containing iron salts. The present exposure scenario 8 covers the following professional processes performed in a variety of sectors, which are related to a number of environmental release categories and may result in the manufacture of articles.

Sector of use	Description
1	Agriculture, forestry, fishery
13	Manufacture of non-metallic mineral products (plasters, cement)
19	Building and construction work
24	Scientific research and development

Process category	Activity
1	Use in closed process with no likelihood of exposure
2	Use in closed process with occasional controlled exposure
5	Mixing or blending in batch processes for formulation of preparations and articles
8a	Transfer of substance or preparations from/to vessels at non-dedicated facilities
8b	Transfer of substance or preparations from/to vessels at dedicated facilities
9	Transfer of substance or preparations into small containers (dedicated filling lines, including weighing)
10	Roller application or brushing
11	Non-industrial spraying
13	Treatment of articles by dipping and pouring
15	Use as laboratory agent
19	Hand-mixing with intimate contact and only personal protective equipment

Process category	Activity
	available

Environmental release category	Description
8a	Wide dispersive indoor use of processing aids in open systems
8c	Wide dispersive indoor use resulting in inclusion into or onto a matrix
8d	Wide dispersive outdoor use of processing aids in open systems
8e	Wide dispersive outdoor use of reactive substances in open systems
8f	Wide dispersive outdoor use resulting in inclusion into or onto a matrix

Article category	Description
01	Adhesive, sealant and coating
4	Stone, plaster, cement, glass and ceramic articles

9.2.4.1. Description of activities and processes covered in the exposure scenario

The exposure scenario describes the professional use of iron(II) chloride (FeCl_2 , ferrous chloride), iron(III) chloride (FeCl_3 , ferric chloride), iron(II) sulphate (FeSO_4 , ferrous sulphate), iron(III) sulphate ($\text{Fe}_2(\text{SO}_4)_3$, ferric sulphate) and iron(III) chlorosulphate (FeClSO_4 , ferric chlorosulphate) which may be supplied as aqueous solutions of varying concentrations.

The liquid mixtures containing them may be transferred in enclosed or open dedicated or non-dedicated systems in large or small amounts, be blended and mixed with other substances in enclosed or open vessels and be used for different purposes in closed or open continuous or batch processes.

9.2.4.2. Controlling environmental exposure

9.2.4.2.1. Product characteristics

The present exposure scenario considers liquid mixtures containing iron salts that are transferred, re-packaged, bagged, delivered to and handled by professional downstream users.

9.2.4.2.2. Amount used

The amount of substance used may vary considerably over the wide range of processes and use sites described in the present scenario and may range from a few grams to dozens of kilograms per day. In the assessment of environmental exposure, a typical use amount of 25 g iron per m^3 waste water and a reasonable highest use amount of 250 g iron per m^3 waste water were considered.

9.2.4.2.3. Frequency and duration of use

The majority of processes described in the present exposure scenario may run on less than 300 days a year. Professional uses will be batch processes in the majority of cases.

9.2.4.2.4. Environmental factors not influenced by risk management measures

The modelling of environmental concentrations was based on the default description of process parameters and landscape in EUSES. A dilution factor of 10 was used for the calculation of PECs in freshwater in the example with the typical use amount of iron salt and a dilution factor of 40 was used in the example with the reasonable highest use amount of iron salt. The corresponding dilution factors for seawater were 100 and 400, respectively. The dilution factor for seawater was 100. The flow rate of the recipient and the dilution factors can be changed by using the appropriate equation for scaling of the risk characterisation ratios (see section 9.4.3.1).

9.2.4.2.5. Other given operational conditions affecting environmental exposure

Some of the processes described in the present exposure scenario may be operated in confined areas.

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

Some of the processes described in section 9.2 are operated in enclosed systems.

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

The waste water produced in the described processes and containing dissolved iron salts as well as heavy metal impurities is collected and treated, for example by means of precipitation, before released to further waste water treatment or the environment.

9.2.4.2.8. Conditions and measures related to industrial waste water treatment (onsite or external)

The volume of waste water emitted per day was 2000 m³ for the majority of processes as this is the standard condition in EUSES. The volumetric waste water flow can be changed by using the appropriate equation for scaling of the risk characterisation ratios (see section 9.4.3.1).

9.2.4.2.9. Conditions and measures related to external recovery of waste

Frequently, waste water produced at the sites is treated by precipitation to remove iron and heavy metal impurities. The resulting solids, for example hydroxides, are disposed of mainly in landfills in accordance with local environmental regulations.

9.2.4.3. Controlling worker exposure

9.2.4.3.1. Product characteristics

The present exposure scenarios considers liquid mixtures containing iron salts that are transferred, re-packaged, bagged, delivered to and handled by professional downstream users.

9.2.4.3.2. Amount used

The amount of substance used may considerably vary over the wide range of processes and use sites described in the present scenario and may range from a few grams to dozens of kilograms per day.

9.2.4.3.3. Frequency and duration of use

The generic human exposure assessment is based on daily exposure occurring during a full working shift of 8 hours if not otherwise indicated. A worker may be exposed on 220 days per year under normal conditions.

9.2.4.3.4. Human factors not influenced by risk management

The worker under normal conditions has a breathing rate of 10 m³ per 8 hour shift. The exposed skin area per activity was used as defined in the MEASE exposure assessment tool (EBRC Consulting 2010) and as given in Table 160.

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

Some of the processes covered in the present generic exposure scenario may be operated in enclosed systems, especially those where liquid mixtures are sprayed.

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

The facilities where liquid mixtures are sprayed or vigorously mixed by workers should be equipped with efficient local exhaust ventilation systems.

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

In the absence of local exhaust ventilation workers directly handling liquid mixtures containing iron salts should wear respiratory masks with appropriate filters.

Workers directly handling liquid mixtures containing iron salts should wear chemical resistant gloves and safety goggles as well as appropriate working clothes and boots.

9.2.4.4. Controlling consumer exposure

No consumer exposure is anticipated with the industrial activities described in the present exposure scenario.

9.2.4.5. Controlling exposure during the service life of article

A number of article categories are listed for the present exposure scenario. Since the iron salts will be bound into the solid matrix of articles, no release of iron salts from articles during the service life is anticipated under reasonable use conditions. An assessment of human and environmental exposure to iron salts due to release of substance from articles during the service life is not performed in the present document.

9.3. Generic exposure scenario describing use of iron salts by the general public

The present generic exposure scenario is applicable to a number of representative uses of retail products available to the general public and containing iron salt, which are briefly described in the following. It should be noted that the generic scenario is not restricted to the identified uses described below. It may in fact be applicable also to other uses associated with similar consumer activities.

Use in cements

Iron sulphate is commonly used to reduce the content of hexavalent chromium in cements, which is limited to 2 ppm by European legislation. A concentration of approximately 0.5 % iron salts is mixed into the cement powder, which is delivered to private downstream users in paper bags normally containing between 2.5 and 50 kg. The reaction between iron sulphate and chromium takes place only after wetting of the cement.

Use in agrochemicals

Solid agrochemical products in granular or flake form or ready-to-use aqueous solutions containing iron salts are available to the general public. The solid products may be distributed manually. In most cases, users will transfer the products into a distribution system (bowl, watering can, and sprayer) and may need to dissolve or dilute the products in water before use. The solid or dissolved products are applied to the ground in the garden.

Use for etching metals

Consumers can purchase ferric chloride solution for art work and gravure work, for example to etch copper. Liquid products that are available to the public can contain up to 40 % iron salts and hence are strongly acidic. The solution needs to be diluted with water and needs to be heated to about 50 °C prior to use as an etchant. It is anticipated that these products are used in well-ventilated areas by experienced and trained consumers who will wear at least basic personal protection equipment such as gloves and safety glasses.

9.3.1. Exposure scenario 9: Consumer applications of solid iron salt products that may lead to dust formation

The exposure scenario covers the handling by consumers of solid products containing iron salt products, which often need to be wetted or dissolved prior to use. Consumers may handle solid products containing iron salt during transfer or mixing. Inhalation and dermal exposure to iron salts may arise from transfer or vigorous mixing of solid products containing iron salts, especially if the products are powdery. The types of products and articles used by consumers and potential environmental emissions due to consumer use of products containing iron salts are given in section 9.3.

Consumers may also use a variety of solid articles containing iron salts. No release of iron salts from solid articles is anticipated and potential consumer exposure to iron salts from articles is not considered in the present assessment.

This generic exposure scenario describes the following consumer uses of solid iron salt products:

Product category	Description
1	Adhesives, sealants
9b	Fillers, putties, plasters, modelling clay
12	Fertilisers
14	Metal surface treatment products, including galvanic and electroplating products
27	Plant protection products

Environmental release category	Description
8a	Wide dispersive indoor use of processing aids in open systems
8c	Wide dispersive indoor use resulting in inclusion into or onto a matrix
8d	Wide dispersive outdoor use of processing aids in open systems
8f	Wide dispersive outdoor use resulting in inclusion into or onto a matrix

Article category	Description
01	Adhesive, sealant and coating
4	Stone, plaster, cement, glass and ceramic articles

9.3.1.1. Description of activities covered in the exposure scenario

The exposure scenario describes the consumer use of retail products containing iron(II) chloride (FeCl₂, ferrous chloride), iron(III) chloride (FeCl₃, ferric chloride) and iron(II) sulphate (FeSO₄, ferrous sulphate) which may be supplied as solids in various hydration states. Most solid products containing iron salts will be blended with other mineral materials or dissolved in water prior to use.

The solid products may be used as such or blended with other mineral components prior to use. They may be wetted or dissolved in water. Solid products used by consumers may be transferred, blended, dissolved or distributed by hand.

9.3.1.2. Controlling environmental exposure

9.3.1.2.1. Product characteristics

Solid products containing iron salts may be available as powders, granules or flakes which are distributed in bags containing 1 to 50 kg. The concentration of iron salts in cements is around 0.5 % w/w. The concentration of ferrous sulphate in solid fertiliser or agrochemical products is variable but can be as high as about 80 % w/w.

9.3.1.2.2. Amounts used

Private users may use up to dozens of kilograms of solid products on a single event depending on the type of product and the purpose of its use. Maximum emissions of a few kilograms iron salts per event are anticipated. A reasonable application rate for iron salt fertilisers and agrochemicals is 20 g/m² (e.g. COMPO 2010).

9.3.1.2.3. Frequency and duration of use

The frequency of consumer use of products containing iron salts probably is low for the individual consumer, but daily use is considered for the assessment of environmental concentrations.

9.3.1.2.4. Environmental factors not influenced by risk management

The modelling of environmental concentrations was based on the default description of process parameters and landscape in EUSES. A dilution factor of 10 was used for the calculation of PECs in freshwater in the example with the typical use amount of iron salt and a dilution factor of 40 was used in the example with the reasonable highest use amount of iron salt. The corresponding dilution factors for seawater were 100 and 400, respectively. The dilution factor for seawater was 100. The flow rate of the recipient and the dilution factors can be changed by using the appropriate equation for scaling of the risk characterisation ratios (see section 9.4.3.1).

9.3.1.2.5. Other given operational conditions affecting environmental exposure

Solid products containing iron salts can be used indoors and outdoors and may be directly applied to the soil, such as in the case of fertilisers and agrochemical products.

9.3.1.2.6. Conditions and measures related to municipal sewage treatment plant

Some uses of iron salts will lead to direct release of substance to the environment. The municipal sewage treatment plant considered in the modelling of environmental concentrations by default has a daily capacity of 2000 m³ for those uses leading to release to the public sewerage system.

9.3.1.2.7. Condition and measures related to external treatment of waste for disposal

Small amounts of product may remain in the packages which are disposed of via regular household waste. Solid wastes from private use are expected to be incinerated or disposed of in landfills in accordance with local environmental regulations.

9.3.1.3. Controlling worker exposure

No worker exposure is anticipated with the consumer use of iron salt products.

9.3.1.4. Controlling consumer exposure

9.3.1.4.1. Product characteristics

Solid products containing iron salts may be available as powders, granules or flakes which are distributed in bags containing 1 to 50 kg. The concentration of iron salts in cements is around 0.5 % w/w. The concentration of ferrous sulphate in solid fertiliser or agrochemical products is variable but can be as high as about 80 % w/w.

9.3.1.4.2. Amounts used

Private users may use up to dozens of kilograms of products containing iron salts on a single event depending on the type of product and the purpose of its use.

9.3.1.4.3. Frequency and duration of use/exposure

The frequency of use of products containing iron salts by individual consumers probably is low.

9.3.1.4.4. Human factors not influenced by risk management

A consumer has a breathing rate of 20 m³/day and a body weight of 60 kg by default.

9.3.1.4.5. Other given operational conditions affecting consumer exposure

Products may be used indoors or outdoors. It is recommended that the products are used in well ventilated areas only.

9.3.1.4.6. Conditions and measures related to information and behavioural advice to consumers

Dusty products should be used in well ventilated areas e.g. in the presence of open doors and windows.

9.3.1.4.7. Conditions and measures related to personal protection and hygiene

Usually it is not anticipated that consumers apply personal protection equipment. It is recommended that consumers handling solid products containing iron salts should use gloves and glasses. The use of dust masks is recommended in the case of use of powdery products in confined areas.

9.3.1.5. Controlling exposure during the service life of articles

A number of article categories are listed for the present exposure scenario. Since the iron salts will be bound into the solid matrix of articles, no release of iron salts from articles during the service life is anticipated under reasonable use conditions. An assessment of human and environmental exposure to iron salts due to release of substance from articles during the service life is not performed in the present document.

9.3.2. Exposure scenario 10: Consumer applications of iron salt products involving the use of aqueous solutions and liquid mixtures

Consumers using liquid products containing iron salts may experience mainly dermal exposure to the substances since the iron salts are unlikely to be released from liquid mixtures. Consumers spraying liquid mixtures containing iron salts may also experience inhalation exposure to spray aerosols under certain circumstances. The types of products and articles used by consumers and potential environmental emissions due to consumer use of products containing iron salts are given in section 9.3.

This generic exposure scenario describes the following consumer uses of liquid mixtures containing iron salt products:

Product category	Description
1	Adhesives, sealants
9b	Fillers, putties, plasters, modelling clay
12	Fertilisers
14	Metal surface treatment products, including galvanic and electroplating products
27	Plant protection products

Environmental release category	Description
8a	Wide dispersive indoor use of processing aids in open systems
8c	Wide dispersive indoor use resulting in inclusion into or onto a matrix
8d	Wide dispersive outdoor use of processing aids in open systems
8f	Wide dispersive outdoor use resulting in inclusion into or onto a matrix

Article category	Description
01	Adhesive, sealant and coating
4	Stone, plaster, cement, glass and ceramic articles

9.3.1.1. Description of activities covered in the exposure scenario

The exposure scenario describes the consumer use of retail products containing iron(II) chloride (FeCl_2 , ferrous chloride), iron(III) chloride (FeCl_3 , ferric chloride), iron(II) sulphate (FeSO_4 , ferrous sulphate), iron(III) sulphate ($\text{Fe}_2(\text{SO}_4)_3$, ferric sulphate) and iron(III) chlorosulphate (FeClSO_4 , ferric chlorosulphate) which may be supplied as aqueous solutions of varying concentration.

The liquid products used by consumers may be used as such or in diluted aqueous form and may be poured, mixed, spread on surfaces, brushed or sprayed.

9.3.2.1. Controlling environmental exposure**9.3.2.1.1. Product characteristics**

Liquid products are on the market that may contain iron salts in concentrations up to 20 % w/w. Special liquid products containing up to 40 % w/w iron chloride which are for example used by artists for metal etching are available.

9.3.2.1.2. Amounts used

In the majority of cases consumers will use no more than a few litres of product per event and the amount of iron salts that may be released to the environment hence is also limited to a few kg per event at the most. Liquid fertilisers and agrochemicals are applied in dilute aqueous solution (for example 500 mL liquids in 1.5 L water) by pouring or spraying at a rate of approximately 30 mL product/m².

9.3.2.2.3. Frequency and duration of use

The greatest portion of products containing iron salts that are available to the public are infrequently used by consumers, for example on a monthly basis. Products can be distributed directly on the soil/lawn.

9.3.2.2.4. Environmental factors not influenced by risk management

The modelling of environmental concentrations was based on the default description of process parameters and landscape in EUSES. A dilution factor of 10 was used for the calculation of PECs in freshwater in the example with the typical use amount of iron salt and a dilution factor of 40 was used in the example with the reasonable highest use amount of iron salt. The corresponding dilution factors for seawater were 100 and 400, respectively. The dilution factor for seawater was 100. The flow rate of the recipient and the dilution factors can be changed by using the appropriate equation for scaling of the risk characterisation ratios (see section 9.4.3.1).

9.3.2.2.5. Other given operational conditions affecting environmental exposure

Liquid products containing iron salts can be used indoors and outdoors and may be directly applied to the soil by pouring or spraying, such as in the case of fertilisers and agrochemical products.

9.3.2.2.6. Conditions and measures related to municipal sewage treatment plant

Some uses of iron salts will lead to direct release of substance to the environment. The municipal sewage treatment plant considered in the modelling of environmental concentrations by default has a daily capacity of 2000 m³ for those uses leading to release to the public sewerage system.

9.3.2.2.7. Condition and measures related to external treatment of waste for disposal

Small amounts of products remaining in the packages may be disposed of via the regular household waste. Solid waste is anticipated to be incinerated or disposed of in landfills.

9.3.2.3. Controlling worker exposure

No worker exposure is anticipated with the consumer use of iron salt products.

9.3.2.4. Controlling consumer exposure

9.3.2.4.1. Product characteristics

Liquid products are on the market that may contain iron salts in concentrations up to 20 % w/w. Special liquid products containing up to 40 % w/w iron chloride which are for example used by artists for metal etching are available.

9.3.2.4.2. Amounts used

In the majority of cases consumers will use no more than a few litres of product per event.

9.3.2.4.3. Frequency and duration of use/exposure

The greatest portion of products containing iron salts that are available to the public are infrequently used by consumers, for example on a monthly basis.

9.3.2.4.4. Human factors not influenced by risk management

A consumer has a breathing rate of 20 m³/day and a body weight of 60 kg by default.

9.3.2.4.5. Other given operational conditions affecting consumer exposure

Products may be used indoors or outdoors. It is recommended that the products are used in well ventilated areas only.

9.3.2.4.6. Conditions and measures related to information and behavioural advice to consumers

Liquid products should be used in well ventilated areas e.g. in the presence of open doors and windows.

9.3.2.4.7. Conditions and measures related to personal protection and hygiene

Usually it is not anticipated that consumers apply personal protection equipment. However, in the case of use of concentrated aqueous solutions of iron salt products, for example for metal surface treatment, it is recommended that consumers handling such products should use gloves, glasses and protective equipment since concentrated aqueous solutions of iron salts may have irritating or corrosive properties.

9.3.2.5. Controlling exposure during the service life of articles

A number of article categories are listed for the present exposure scenario. Since the iron salts will be bound into the solid matrix of articles, no release of iron salts from articles during the service life is anticipated under reasonable use conditions. An assessment of human and environmental exposure to iron salts due to release of substance from articles during the service life is not performed in the present document.