9.1. Local scenarios

In table below, the generic exposure scenarios (GES) developed for ZnSO4 are summarised.

Table 1. Generic exposure scenarios for zinc sulphate

Number	Sector	Uses	Code
0	Zinc sulphate production	Manufacture Substance	GES_{ZnSO4} 0
1	Formulation step	Forrmulation general	GES_{ZnSO4} 1
2	First tier applications	Manufacturing of other zinc compounds	GES_{ZnSO4} 2
3		Laboratory reagent	GES_{ZnSO4} 3
4		As component for solid blends & matrices	GES_{ZnSO4} 4
5		As component for production of dispersions, pastes and other viscous matrices	GES_{ZnSO4} 5
6	Second tier applications	DU of ZnSO4-containing solid preparations	GES_{ZnSO4} 6
7		DU of ZnSO4-containing liquid & pasty preparations	GES_{ZnSO4} 7

Numerous uses were identified for ZnSO4. These are listed in table below, with the indication of the Generic Exposure Scenario (GES) that is relevant to these identified uses.

Table 2. Identified uses for ZnSO4 and corresponding Generic Exposure Scenario (GES)

IU number	Identified Use (IU) name	GES code
1	Zinc Sulphate production -Wet	GESZnSO4 0
5	Component for production of inorganic zinc compounds	GESZnSO4 2
6	Electrogalvanizing	GESZnSO4 2
7	Electroplating	GESZnSO4 2
8	Zinc production by electrowinning	GESZnSO4 2
9	Laboratory reagent	GESZnSO4 3
10	Ore dressing (mining metallurgy)	GESZnSO4 0, GESZnSO4 1
11	Zinc production by pyrometallurgy	GESZnSO4 2
12	Component for production of organic zinc compounds	GESZnSO4 2
13	Component for production of Inorganic pigments, i.e. Lithopones	GESZnSO4 1, GESZnSO4 4
14	Component for production of Coatings / paints, inks, enamels, varnishes	GESZnSO4 1, GESZnSO4 4
15	Component for production of surface treatment preparations	GESZnSO4 1, GESZnSO4 4
16	Component for Paper coating	GESZnSO4 1, GESZnSO4 5
17	Use of ZnSO4-containing paper coatings	GESZnSO4 6
18	Component for Textile & leather coating / treatment	GESZnSO4 1, GESZnSO4 5
19	Use of ZnSO4-containing textile & leather coatings	GESZnSO4 6

20	Additive for the production of Lubricants / Grease / Metal working fluids	GESZnSO4 1, GESZnSO4 5
21	Use of ZnSO4-containing Lubricants / Grease / Metal working fluids	Generic consumer/environment*
22	Use of ZnSO4-containing catalysts	GESZnSO4 1, GESZnSO4 5
23	Additive for the formulation of animal feedstuffs, nutrients	GESZnSO4 1, GESZnSO4 4, GESZnSO4 5
24	Additive for the formulation of biocidal products	GESZnSO4 1, GESZnSO4 4, GESZnSO4 5
25	Additive for the formulation of cleaning products	GESZnSO4 1, GESZnSO4 4, GESZnSO4 5
26	Use of ZnSO4-containing cleaning products	GESZnSO4 6, GESZnSO4 7, Generic consumer/environment
27	Additive for the formulation of fertilizers	GESZnSO4 1, GESZnSO4 4, GESZnSO4 5
28	Use of ZnSO4-containing fertilizer's formulations	Generic consumer/environment
29	Additive in the formulation of cosmetics	GESZnSO4 1, GESZnSO4 4, GESZnSO4 5
30	Use of cosmetics	GESZnSO4 6, GESZnSO4 7, Generic consumer/environment
31	Additive in the formulation of pharma / veterinary products	GESZnSO4 1, GESZnSO4 4, GESZnSO4 5
32	Use of Pharma / veterinary products	GESZnSO4 6, GESZnSO4 7, Generic consumer/environment

* corresponds to “GES 8” in IUCLID

9.1.1. GES ZnSO4-0: Industrial use of primary or secondary zinc bearing material in the manufacture of Zn SO4 in several process steps, collection of the substance produced and packaging.

Table 3. GES ZnSO4-0

Exposure Scenario Format (1) addressing uses carried out by workers
9.1.1. Title of Exposure Scenario number GES ZnSO4 - 0: Industrial use of primary or secondary zinc bearing material in the manufacture of ZnSO4 in several process steps, collection of the substance produced and packaging.
List of all use descriptors related to the life cycle stage and all the uses under it; include market sector (by PC), if relevant; SU: 2a, 3, 8, 9, 10 0, (Nace 7.2.9.) PROC: 2, 3, 5, 8b, 9, 22, 26 PC: 19, 20, 21 AC: not applicable ERC: 1
9.1.1. Exposure Scenario
9.1.1.1 Contributing scenario (1) controlling environmental exposure for the Industrial use of primary or secondary zinc bearing material in the manufacture of ZnSO4 in several process steps, collection of the substance produced and packaging.
The manufacturing process includes: • Reception of zinc-bearing materials, (e.g.: the Intermediate Zinc sulphate solution), and transfer to the reaction tank (sulphate media)

- Feeding of the primary materials (e.g. ZnO or Zn(OH)2) into the mixing tank. The leaching reaction with sulphuric acid solutions is kept at the proper pH and temperature.
- Separation of the leach-residue (insoluble sulphates and steriles) occurs in covered settlers; if needed, the leachate may be filtered on adapted filters,
- Purification steps will be applied sequentially:
    - By oxidation (with air or oxygen) of some of the present elements (i.e. Fe) followed by another sedimentation or filtration step, if needed
    - By hydrolysis (with ZnO-rich reagent) of some of the hydrolysable elements (i.e. Fe, Al, …) followed by another sedimentation or filtration step, if needed
    - By cementation (with zinc powder) of some of the present elements (i.e. Cu, Cd, Ni, Co, …) followed by another sedimentation or filtration step, if needed
- Concentration by water evaporation, under exhaust hood.
- Pouring on a cooling belt
- Crystallisation and occasionally drying, in closed reactor.
- Discharge and packaging of produced zinc sulphate crystals. Workers have to place and adjust the bag or drum under the discharge pipe and to set the process in motion. Filled bags or drums are subsequently closed and carried to the storage area.
- Exposure to dust can occur during packing of the powder. Solutions are packed in intermediate bulk containers (ca. 1 m^3 capacity); solids are packed in bags or drums.
- Maintenance activities

Product characteristics

Product related conditions:

- ZnSO4 is produced in minimum 80% purity; higher grades (>95%) are usual.

Amounts used

Daily and annual amount per site:

- maximum 12500 T/y;

Frequency and duration of use

- Continuous production

Environment factors not influenced by risk management

Flow rate of receiving surface water:

- Default is used unless specified otherwise

Other given operational conditions affecting environmental exposure

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

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

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

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

- Process enclosures and closed circuits where relevant and possible.
- Local exhaust ventilation on work areas with potential dust generation, dust capturing and removal techniques
- Containment of liquid volumes in sumps to collect/prevent accidental spillage, acid solutions are treated

with alkali.

- Higher temperatures (~= 100°C) in the surroundings of the drying units are possible.

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

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

- On-site waste water treatment techniques can be applied to prevent releases to water (if applicable) e.g.: chemical precipitation, sedimentation and filtration (efficiency 90-99.98%).
- Careful use of sulphuric acid and (irritating) sulphate solutions
- Containment of liquid volumes in sumps to collect/prevent accidental spillage
- Air emissions are controlled by use of bag-house filters and/or other air emission abatement devices e.g. fabric (or bag) filters (up to 99% efficiency), wet scrubbers (50-99% efficiency). This may create a general negative pressure in the building.

Organizational measures to prevent/limit release from site

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

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

Conditions and measures related to municipal sewage treatment plant

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

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

Conditions and measures related to external treatment of waste for disposal

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

Hazardous wastes from onsite risk management measures and solid or liquid wastes from produc and cleaning processes should be disposed of separately to hazardous waste incineration plants or waste landfills as hazardous waste. Releases to the floor, water and soil are to be prevented. If the zin of the waste is elevated enough, internal or external recovery/recycling might be considered.

Fraction of daily/annual use expected in waste:

zinc producers = 3.1 %

zinc compound producers = 0.056 %

downstream users = 0.30 %

Appropriate waste codes:

02 01 10*, 06 03 13*, 06 03 14, 06 03 15*, 06 04 04*, 06 04 05*, 06 05 02*, 08 01 11*, 10 05 01, 10 10 05 05*, 10 05 06*, 10 05 11, 10 05 99, 10 10 03, 10 10 05*, 10 10 07*, 10 10 09*, 10 10 10, 10 11 01 09*, 11 02 02*, 11 02 03, 11 02 07*, 12 01 03*, 12 01 04, 12 01 12*, 15 01 4*, 15 01 10*, 15

16 01 04*, 16 01 06*, 16 01 18*, 16 06 02*, 16 08 02*, 16 08 03*, 16 11 02, 16 11 03*, 16 11 04, 17 04 07*, 17 04 09*, 17 09 04*, 19 02 05*, 19 10 02*, 19 12 03*

Suitable disposal: Keep separate and dispose of to either

Hazardous waste incineration operated according to Council Directive 2008/98/EC on Directive 2000/76/EC on the incineration of waste and the Reference Document on the Best Techniques for Waste Incineration of August 2006.

Hazardous landfill operated under Directive 1999/31/EC.

A detailed assessment has been performed and is reported in the Waste report (ARCHE, 2012) (See Annex 1)

Conditions and measures related to external recovery of waste

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

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

9.1.1.2 Contributing scenario (2) controlling worker exposure for the industrial use of primary or secondary zinc bearing material in the manufacture of ZnSO4 in several process steps, collection of the substance produced and packaging.

Product characteristic

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

Zinc sulphate is hygroscopic in nature (especially the anhydrous form) and is produced in a dust-free crystalline form.

Approximately 75% of the production of Zinc sulphate is in the form of the crystalline hexa- and hepta-hydrate. A particle size distribution for the heptahydrate shows a very coarse product (mean diameter > 500 µ, 99% > 100 µ), while the monohydrate has a broad particle size distribution with a mean diameter of 170 µ, 14% < 10 µ and 6% < 5 µ (Industry, 1999b).
A study of dustiness, using the modified Heubach method, that includes a multi-stage impactor to separate different aerosol fractions, shows a total dustiness of 26.7 mg/g for monohydrate and 0.25 for hexahydrate. For monohydrate 92.11 % of the generated dust is larger than 8.13 µm and 79.85 % larger than 15.8 µm. For hexahydrate 97.02 % of the generated dust is larger than 8.13 µm and 85.01 % larger than 15.8 µm. For comparison, the total dustiness of zinc oxide is 30 mg/g with 84.53% larger than 8.13 µm and 73.92 % larger than 15.8 µm (Deutsche Montan Technologie GmbH, 2000).

Amounts used

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

Maximum 96 T/day, 32T/shift

Frequency and duration of use/exposure

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

8hrs shift

Human factors not influenced by risk management

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

Uncovered body parts: (potentially) face

Other given operational conditions affecting workers exposure

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

- All processes are carried out indoor in confined areas.

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

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

- Local exhaust ventilation on furnaces and other work areas with potential dust generation, dust capturing and removal techniques
- Process enclosures closed circuits or semi-enclosures where appropriate.
- Careful use of sulphuric acid and (irritating) sulphate solutions
- Containment of liquid volumes in sumps to collect/prevent accidental spillage
- Local exhaust ventilation on furnaces and other work areas with potential dust and fumes generation, dust capturing and removal techniques.

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

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

- Local exhaust ventilation systems (generic LEC (84%) as worst case; higher efficiencies (90-95%) are usual
- Cyclones/filters (for minimizing dust emissions) : efficiency: 70-90% (cyclones), 50-80% (dust filters), 85-95% (double stage, cassette filters)
- Process enclosure, especially in potentially dusty units
- Dust control: dust and Zn in dust needs to be measured in the workplace air (static or individual) according to national regulations.
- Special care for the general establishment and maintenance of a clean working environment by e.g.:
    - Cleaning of process equipment and workshop
- Storage of packaged Zn product in dedicated zones

Organisational measures to prevent /limit releases, dispersion and exposure

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

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

Such management system would include general industrial hygiene practice e.g.:

- information and training of workers on prevention of exposure/accidents,
- procedures for control of personal exposure (hygiene measures)
- regular cleaning of equipment and floors, extended workers instruction-manuals
- procedures for process control and maintenance,...
- personal protection measures (see below)

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

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

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

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

-dust filter-half mask P1 (efficiency 75%)
-dust filter-half mask P2 (efficiency 90%)
-dust filter-half mask P3 (efficiency 95%)
-dust filter-full mask P1 (efficiency 75%)
-dust filter-full mask P2 (efficiency 90 %)
-dust filter-full mask P3 (efficiency 97.5%)

Eyes: safety glasses are optional

9.1.2. GES ZnSO4-1: Industrial use of ZnSO4 in the formulation of preparations by mixing thoroughly, dry or in a solvent, the starting materials with potentially pressing, pelletising, sintering, possibly followed by packing

Table 4. GES ZnSO4-1

Exposure Scenario Format (1) addressing uses carried out by workers
9.1.2. Title of Exposure Scenario number ZnSO4 GES-1: Industrial use of ZnSO4 in the formulation of preparations by mixing thoroughly, dry or in a solvent, the starting materials with potentially pressing, pelletising, sintering, possibly followed by packing .
List of all use descriptors related to the life cycle stage and all the uses under it; include market sector (by PC), if relevant; ***SU: 2a, 3,8, 9, 10, Nace C7.2.9.*** ***PROC: 1,2,3,4,5, 8b,9,13, 14, 15, 22*** ***PC: Not applicable (all)*** ***AC: not applicable*** ***ERC: 1,2***
Further explanations (if needed) ZnSO4 is used in the manufacture of preparations by mixing thoroughly the starting materials, followed by direct use of packaging of the preparation. Many different industrial uses are characterised by this process. Therefore these industrial uses are all covered by this generic exposure scenario.
9.1.2 Exposure Scenario
9.1.2.1 Contributing scenario (1) controlling environmental exposure for the Industrial use of ZnSO4 in the formulation of preparations by mixing thoroughly, dry or in a solvent, the starting materials with potentially pressing, pelletising, sintering, possibly followed by packing .
Further specification: In the described process, the zinc sulphate is: • Removed from the packaging and stored in silos after delivery. • Extracted from the silo, dosed and fed with the other reagents to the mixing tank. Mixing occurs batch-wise or continuously, according the process receipt. The mixing occurs in a closed tank/chamber. • The preparation (dry or wet (solvent/paste) matrix) is further used as such or packed for further treatment/use.
Product characteristics
Product related conditions: ZnSO4 is used in minimum 80% purity; higher grades (>95%) are usual
Amounts used
Daily and annual amount per site: maximum 5000 T/y;
Frequency and duration of use
Continuous production is assumed as a worst case. It is possible that use is not continuous; this has to be considered when estimating exposure.
Environment factors not influenced by risk management
Flow rate of receiving surface water: default for generic scenario: 18,000 m3/d, unless specified otherwise
Other given operational conditions affecting environmental exposure
Other given operational conditions: e.g. technology or process techniques determining the initial release of substance from process (via air and waste water); dry or water based processes; conditions related to temperature and pressure; indoor or outdoor use of products; work in confined area or open air;

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

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

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

- Process enclosures and closed circuits where relevant and possible.
- Dust capturing and removal techniques are applied on local exhaust ventilation on furnaces and other work areas with potential dust generation.
- Containment of liquid volumes in sumps to collect/prevent accidental spillage

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

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

- On-site waste water treatment techniques can be applied to prevent releases to water (if applicable) e.g.: chemical precipitation, sedimentation and filtration (efficiency 90-99.98%).
- Air emissions are controlled by use of bag-house filters and/or other air emission abatement devices e.g. fabric (or bag) filters (up to 99% efficiency), wet scrubbers (50-99% efficiency). This may create a general negative pressure in the building.

Organizational measures to prevent/limit release from site

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

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

Conditions and measures related to municipal sewage treatment plant

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

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

Conditions and measures related to external treatment of waste for disposal

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

Hazardous wastes from onsite risk management measures and solid or liquid wastes from produc and cleaning processes should be disposed of separately to hazardous waste incineration plants or waste landfills as hazardous waste. Releases to the floor, water and soil are to be prevented. If the zin of the waste is elevated enough, internal or external recovery/recycling might be considered.

Fraction of daily/annual use expected in waste:

zinc producers = 3.1 %

zinc compound producers = 0.056 %

downstream users = 0.30 %

Appropriate waste codes:

02 01 10*, 06 03 13*, 06 03 14, 06 03 15*, 06 04 04*, 06 04 05*, 06 05 02*, 08 01 11*, 10 05 01, 10 10 05 05*, 10 05 06*, 10 05 11, 10 05 99, 10 10 03, 10 10 05*, 10 10 07*, 10 10 09*, 10 10 10, 10 11 01 09*, 11 02 02*, 11 02 03, 11 02 07*, 12 01 03*, 12 01 04, 12 01 12*, 15 01 4*, 15 01 10*, 15 16 01 04*, 16 01 06*, 16 01 18*, 16 06 02*, 16 08 02*, 16 08 03*, 16 11 02, 16 11 03*, 16 11 04, 17 04 07*, 17 04 09*, 17 09 04*, 19 02 05*, 19 10 02*, 19 12 03*

Suitable disposal: Keep separate and dispose of to either

Hazardous waste incineration operated according to Council Directive 2008/98/EC on Directive 2000/76/EC on the incineration of waste and the Reference Document on the Best Techniques for Waste Incineration of August 2006.

Hazardous landfill operated under Directive 1999/31/EC.

A detailed assessment has been performed and is reported in the Waste report (ARCHE, 2012) (See Annex 1)

Conditions and measures related to external recovery of waste

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

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

9.1.2.2 Contributing scenario (2) controlling worker exposure for the Industrial use of ZnSO4 in the formulation of preparations by mixing thoroughly, dry or in a solvent, the starting materials with potentially pressing, pelletising, sintering, possibly followed by packing .

Further specification

ZnSO4 is used in the manufacture of preparations by mixing thoroughly the starting materials, followed by direct use of packaging of the preparation. Many different industrial uses are characterised by this process. Therefore these industrial uses are all covered by this generic exposure scenario.

Product characteristic

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

- The concentration of ZnSO4 in the mixtures can cover a broad range (<= 5% up to >25%) depending on the application.
- The preparation can be solid or liquid.
- When the preparation is in solid state, it can be in a) powdery, b) glassy or c) pelletized form. In the powder form, it can be characterised by high dustiness in a worst case situation.

Amounts used

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

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

Frequency and duration of use/exposure

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

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

Human factors not influenced by risk management

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

Uncovered body parts: (potentially) face

Other given operational conditions affecting workers exposure

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

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

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

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

- Process enclosures and closed circuits where relevant and possible.
- Local exhaust ventilation on furnaces and other work areas with potential dust generation, dust capturing and removal techniques.
- Containment of liquid volumes in sumps to collect/prevent accidental spillage

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

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

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

Organisational measures to prevent /limit releases, dispersion and exposure

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

Such management system would include general industrial hygiene practice e.g.:

- information and training of workers on prevention of exposure/accidents,
- procedures for control of personal exposure (hygiene measures)
- regular cleaning of equipment and floors, extended workers instruction-manuals
- procedures for process control and maintenance,...
- personal protection measures (see below)

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

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

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

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

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

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

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

-dust filter-full mask P1 (efficiency 75%)
-dust filter-full mask P2 (efficiency 90 %)
-dust filter-full mask P3 (efficiency 97.5%)

Eyes: safety glasses are optional

9.1.3. GES ZnSO4-2: industrial use of ZnSO4 or ZnSO4-formulations in the manufacturing of other inorganic or organic zinc substances in a solvent-based matrix with potentially filtering and packaging.

Table 5. GES ZnSO4-2

Exposure Scenario Format (1) addressing uses carried out by workers

9.1.3 Title of Exposure Scenario number $ZnSO_4$ GES-2: industrial use of $ZnSO_4$ or $ZnSO_4$-formulations in the manufacturing of other inorganic or organic zinc substances in a solvent-based matrix with potentially drying, filtering and packaging.

List of all use descriptors related to the life cycle stage and all the uses under it; include market sector (by PC), if relevant;

- SU: 3, 8, 9, 10, 14, 15, 17, 0(Nace25.6.1., C24.4.3., E38.3)
- PROC: 1, 2, 3, 4, 8b, 9, 13, 15, 21, 22, 23, 26
- PC : 7, 14, 19, 20, 21, 24, 29, 39
- AC : 2, 7, 12
- ERC : 1, 2, 5, 6a

Further explanations (if needed)

$ZnSO_4$ is used as a starting material for the manufacturing of several other inorganic and organic zinc compounds. All the manufacturing processes are covered by the present scenario.

9.1.3 Exposure Scenario

9.1.3.1 Contributing scenario (1) controlling environmental exposure for the industrial use of $ZnSO_4$ or $ZnSO_4$-formulations in the manufacturing of other inorganic or organic zinc substances in a solvent-based matrix with potentially drying, filtering and packaging.

Further specification

Description of activities/process(es) covered in the Exposure Scenario

- Reception of the $ZnSO_4$ or $ZnSO_4$-containing formulation, or $ZnSO_4$-bearing raw material in the reaction tank
- Sequential addition of reagents for purification steps and filtration on press filter, when needed (ventilation is adapted).
- Concentration by water evaporation, under exhaust hood, is optional.
- Possible pouring on a cooling belt, is optional as well
- Discharge and packaging of produced zinc compounds. Workers have to place and adjust the bag or drum under the discharge pipe and to set the process in motion. Filled bags or drums are subsequently closed and carried to the storage area.
- Exposure to dust can occur during packing of the powder. Solutions are packed in intermediate bulk containers (ca. 1 m^3 capacity), solid products are packed in bags or drums.
- Maintenance activities
- For the specific process of electrogalvanising, which is covered by this scenario, the electrogalvanising bath consists of one or more tanks, usually made of a ceramic material, which contain zinc sulphate in solution. The steel passes through the bath and its surface is coated with zinc/iron-zinc alloys. Because of the speed of the strip (up to 180 m/min) and the short exposure time, the coating consists of a very thin layer.

Product characteristics

Product related conditions, e.g. the concentration of the substance in a mixture; viscosity of product; package design affecting expo-sure

Zn-compounds are produced in their pure form e.g.: >99%, or in solution.

Amounts used

Daily and annual amount per site (for uses in industrial setting) or daily and annual amount for wide disperse uses;

Up to 75 T/d of $ZnSO_4$ is transformed to equivalent Zn compound

Frequency and duration of use

Intermittent (used < 12 times per year for not more than 24 h) or continuous use/release

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

Environment factors not influenced by risk management

Flow rate of receiving surface water (m3/d, usually 18,000 m3/d for the standard town by default; please note*: the default flow rate will be rarely changeable for downstream uses.*

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

Other given operational conditions affecting environmental exposure

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

- Wet processes (leaching, filtering, purification) followed by drying (possible grinding), and packaging;
- All indoor processes, in confined area.

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

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

- Careful use of acids and corrosive solutions, if used
- Sump containment is provided under the tanks and the filters i.o. to collect any accidental spillage
- When applicable, process waters need to be specifically treated before release
- Dosing and packaging operations occur under a special ventilation hood
- Process air is filtered before release outside the building

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

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

- On-site waste water treatment techniques are (if applicable) e.g.: chemical precipitation, sedimentation, filtration (efficiency 90-99.98%).
- Containment of liquid volumes in sumps to collect/prevent accidental spillage
- Air emissions are controlled by use of bag-house filters and/or other air emission abatement devices e.g. fabric (or bag) filters (up to 99% efficiency), wet scrubbers (50-99% efficiency). This may create a general negative pressure in the building. Air emissions are continuously monitored.

Organizational measures to prevent/limit release from site

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

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

Conditions and measures related to municipal sewage treatment plant

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

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

Conditions and measures related to external treatment of waste for disposal

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

Hazardous wastes from onsite risk management measures and solid or liquid wastes from produc and cleaning processes should be disposed of separately to hazardous waste incineration plants or waste landfills as hazardous waste. Releases to the floor, water and soil are to be prevented. If the zin of the waste is elevated enough, internal or external recovery/recycling might be considered.

Fraction of daily/annual use expected in waste:

zinc producers = 3.1 %

zinc compound producers = 0.056 %

downstream users = 0.30 %

Appropriate waste codes:

02 01 10*, 06 03 13*, 06 03 14, 06 03 15*, 06 04 04*, 06 04 05*, 06 05 02*, 08 01 11*, 10 05 01, 10 10 05 05*, 10 05 06*, 10 05 11, 10 05 99, 10 10 03, 10 10 05*, 10 10 07*, 10 10 09*, 10 10 10, 10 11 01 09*, 11 02 02*, 11 02 03, 11 02 07*, 12 01 03*, 12 01 04, 12 01 12*, 15 01 4*, 15 01 10*, 15 16 01 04*, 16 01 06*, 16 01 18*, 16 06 02*, 16 08 02*, 16 08 03*, 16 11 02, 16 11 03*, 16 11 04, 1 17 04 07*, 17 04 09*, 17 09 04*, 19 02 05*, 19 10 02*, 19 12 03*

Suitable disposal: Keep separate and dispose of to either

Hazardous waste incineration operated according to Council Directive 2008/98/EC on Directive 2000/76/EC on the incineration of waste and the Reference Document on the Best Techniques for Waste Incineration of August 2006.

Hazardous landfill operated under Directive 1999/31/EC.

A detailed assessment has been performed and is reported in the Waste report (ARCHE, 2012) (See Annex 1)

Conditions and measures related to external recovery of waste

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

- All residues from the wet process are recycled.
- Users of Zn and Zn-compounds have to favour the recycling channels of the end-of-life products
- Users of Zn and Zn-compounds have to minimize Zn-containing waste, promote recycling routes and, for the remaining, dispose the waste streams according the Waste regulation.

9.1.3.2 Contributing scenario (2) controlling worker exposure for the industrial use of $ZnSO_4$ or $ZnSO_4$-formulations in the manufacturing of other inorganic or organic zinc substances in a solvent-based matrix with potentially drying, filtering and packaging.

Product characteristic

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

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

Amounts used

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

Up to maximum 25T/shift

Frequency and duration of use/exposure

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

8hrs shift (worst case)

Human factors not influenced by risk management

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

Uncovered body parts: (potentially) face

Other given operational conditions affecting workers exposure

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

All processes are carried out indoor in confined areas.

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

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

- Process enclosures or semi-enclosures where appropriate.
- Local exhaust ventilation work areas with potential dust and fumes generation, dust capturing and removal techniques
- Containment of liquid volumes in sumps to collect/prevent accidental spillage

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

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

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

Organisational measures to prevent /limit releases, dispersion and exposure

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

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

Such management system would include general industrial hygiene practice e.g.:

- information and training of workers on prevention of exposure/accidents,
- procedures for control of personal exposure (hygiene measures)
- regular cleaning of equipment and floors, extended workers instruction-manuals
- procedures for process control and maintenance,...
- personal protection measures (see below)

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

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

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

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

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

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

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

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

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

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

Eyes: safety glasses are optional

9.1.4. GES ZnSO4-3: Industrial and professional use of ZnSO4 as active laboratory reagent in aqueous or organic media, for analysis or synthesis.

Table 6. GES- ZnSO4-3

Exposure Scenario Format (1) addressing uses carried out by workers
9.1.4. Title of Exposure Scenario number ZnSO4 GES-3: Industrial and professional use of ZnSO4 as active laboratory reagent in aqeous or organic media, for analysis or synthesis.
List of all use descriptors related to the life cycle stage and all the uses under it; include market sector (by PC), if relevant; ***SU: 3,10, 22, 24*** ***PROC: 1,2,3,4,5, 8a, 8b,9, 10, 15*** ***PC: 19, 21, 28, 39*** ***AC: not applicable*** ***ERC: 1,2, 4, 6a, 6b, 8a, 8b, 8d, 9a***
9.1.4.1. Contributing scenario (1) controlling environmental exposure for the Industrial and professional use of ZnSO4 as active laboratory reagent in aqeous or organic media, for analysis or synthesis.
Further specification: The zinc sulphate is used for • Analysis: sample (solid or liquid) treatment or preparation: the substance is in the sample or in the reagens • or synthesis: manipulations are usually under ventilation (e.g. laminar flow, ventilation hood) • The substance is used o at the industrial scale, in industrial installations for air control and water treatment o at the professional scale by laboratories
Product characteristics
Product related conditions: ZnSO4 is used in minimum 80% purity; higher grades (>95%) are usual
Amounts used
Daily and annual amount per site: maximum 5 T/y (industrial scale) maximum 0.5 T/y (professional scale)
Frequency and duration of use
Use is usually intermittent but continuous use is assumed as a worst case. It is possible that use is not continuous; this has to be considered when estimating exposure.
Environment factors not influenced by risk management
Flow rate of receiving surface water: If applicable: default for generic scenario: 18,000 m3/d, unless specified otherwise
Other given operational conditions affecting environmental exposure
Other given operational conditions: e.g. technology or process techniques determining the initial release of substance from process (via air and waste water); dry or water based processes; conditions related to temperature and pressure; indoor or outdoor use of products; work in confined area or open air; • All processes are performed indoor in a confined area, with dedicated laboratory equipment. All solid residues containing zinc are recovered for recycling.

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

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

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

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

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

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

Organizational measures to prevent/limit release from site

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

- In general emissions are controlled and prevented by implementing an integrated management system e.g. ISO 9000/9001, ISO 1400X series, or alike, and, when applicable, by being IPPC-compliant.
    - Such management system should include general industrial hygiene practice e.g.:
        - information and training of laboratory personel,
        - regular cleaning of equipment and floors,
        - procedures for process control and maintenance,...
- Treatment and monitoring of releases to outside air, and exhaust gas streams according to national regulation.

Conditions and measures related to municipal sewage treatment plant

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

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

Conditions and measures related to external treatment of waste for disposal

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

- At industrial scale:

Hazardous wastes from onsite risk management measures and solid or liquid wastes from produc and cleaning processes should be disposed of separately to hazardous waste incineration plants or waste landfills as hazardous waste. Releases to the floor, water and soil are to be prevented. If the zin of the waste is elevated enough, internal or external recovery/recycling might be considered.

Fraction of daily/annual use expected in waste:

zinc producers = 3.1 %

zinc compound producers = 0.056 %

downstream users = 0.30 %

Appropriate waste codes:

02 01 10*, 06 03 13*, 06 03 14, 06 03 15*, 06 04 04*, 06 04 05*, 06 05 02*, 08 01 11*, 10 05 01, 10
10 05 05*, 10 05 06*, 10 05 11, 10 05 99, 10 10 03, 10 10 05*, 10 10 07*, 10 10 09*, 10 10 10, 10
11 01 09*, 11 02 02*, 11 02 03, 11 02 07*, 12 01 03*, 12 01 04, 12 01 12*, 15 01 4*, 15 01 10*, 15
16 01 04*, 16 01 06*, 16 01 18*, 16 06 02*, 16 08 02*, 16 08 03*, 16 11 02, 16 11 03*, 16 11 04, 1
17 04 07*, 17 04 09*, 17 09 04*, 19 02 05*, 19 10 02*, 19 12 03*

Suitable disposal: Keep separate and dispose of to either

Hazardous waste incineration operated according to Council Directive 2008/98/EC on Directive 2000/76/EC on the incineration of waste and the Reference Document on the Best Techniques for Waste Incineration of August 2006.

Hazardous landfill operated under Directive 1999/31/EC.

A detailed assessment has been performed and is reported in the Waste report (ARCHE, 2012) (See Annex 1)

- At professional scale:

Fraction of daily/annual use expected in waste: 42% of all articles, 58% of the zinc used is recycled.

Appropriate waste codes:
20 01 34, 20 01 40, 20 03 01, 20 03 07

Suitable Disposal:
Waste from end-of-life articles can be disposed of as municipal waste, except when they are separately regulated, like electronic devices, batteries, vehicles, etc.

Disposal of wastes is possible via incineration (operated according to Directive 2000/76/EC on the incineration of waste) or landfilling (operated according to Reference Document on the Best available Techniques for Waste Industries of August 2006 and Council Directive 1999/31/EC and Council Decision 19 December 2002).

A detailed assessment has been performed and is reported in the Waste report (ARCHE, 2012) (See Annex 1)

Conditions and measures related to external recovery of waste

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

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

9.1.4.2. Contributing scenario (2) controlling worker exposure for the Industrial use of ZnSO4 as active laboratory reagent in aqeous or organic media, for analysis or synthesis.

Product characteristic

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

- ZnSO4 is used in minimum 80% purity; higher grades (>95%) are usual
- The sample can be solid or liquid.
- When the preparation is in solid state, it can be in a) powdery, b) glassy or c) pelletized form. In the

powder form, it can be characterised by high dustiness in a worst case situation.

Amounts used

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

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

Frequency and duration of use/exposure

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

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

Human factors not influenced by risk management

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

Uncovered body parts: (potentially) face

Other given operational conditions affecting workers exposure

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

- high temperature steps can occur in protected zones (fume cupboards);
- all indoor processes in confined area, including hazardous substances cabinets.

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

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

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

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

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

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

Organisational measures to prevent /limit releases, dispersion and exposure

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

Such management system would include general industrial hygiene practice e.g.:

- information and training of personel on prevention of exposure/accidents,
- procedures for control of personal exposure (hygiene measures)
- regular cleaning of equipment and floors, extended workers instruction-manuals
- procedures for process control and maintenance,...
- personal protection measures (see below)

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

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

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

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

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

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

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

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

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

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

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

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

9.1.5. GES ZnSO4-4 : Industrial use of ZnSO4 or ZnSO4-formulations as component for the manufacture of solid blends and matrices for further downstream use.

Table 7. GES ZnSO4-4

Exposure Scenario Format (1) addressing uses carried out by workers
9.1.5. Title of Exposure Scenario number GES $ZnSO_4$ - 4 : Industrial use of $ZnSO_4$ or $ZnSO_4$ - formulations as component for the manufacture of solid blends and matrices for further downstream use.
List of all use descriptors related to the life cycle stage and all the uses under it; include market sector (by PC), if relevant; ***SU: 1, 3, 4, 5, 8, 9, 10,11, 12, 13, 14, 20*** ***PROC: 1, 2, 3, 4, 5 ,8b, 9,13, 14, 15, 22*** ***PC: 1,8, 9a,9b,9c, 12, 14,15,18, 20, 21, 26,28, 29, 32, 35, 37, 39*** ***AC: na*** ***ERC: 1, 2, 3, 4, 5, 7, 8a, 8b, 8d, 10a, 10b***
Further explanations (if needed) $ZnSO_4$ or $ZnSO_4$-containing preparations are used in the manufacture of dry preparations by mixing thoroughly the starting materials, possibly followed by pressing or pelletizing, and finally packaging of the preparation.
9.1.5 Exposure Scenario
9.1.5.1 Contributing scenario (1) controlling environmental exposure for the Industrial use of $ZnSO_4$ or $ZnSO_4$ - formulations as component for the manufacture of solid blends and matrices for further downstream use.
Name of contributing scenario
Further specification: In the described process, the $ZnSO_4$ (or Zn compound) containing preparation/mixture is optionally: • Pressed at high temperature (>1000°C), grinded and re-pressed or fritted at high temperature • Molten at high temperature (>500°C) and further cast as glassy material • Pressed and pelletized at low temperature And subsequently packed, or used as such, in further treatment/use
Product characteristics
Product related conditions: $ZnSO_4$ (or Zn compound) in the preparation can be > 25%, usually <5%
Amounts used
Daily and annual amount per site: maximum 5000 T/y;
Frequency and duration of use
Continuous production is assumed as a worst case. It is possible that use is not continuous; this has to be considered when estimating exposure.
Environment factors not influenced by risk management
Flow rate of receiving surface water: default for generic scenario: 18,000 m3/d, unless specified otherwise
Other given operational conditions affecting environmental exposure
Other given operational conditions: e.g. technology or process techniques determining the initial release of substance from process (via air and waste water); dry or water based processes; conditions related to temperature and pressure; indoor or outdoor use of products; work in confined area or open air;

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

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

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

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

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

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

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

Organizational measures to prevent/limit release from site

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

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

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

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

Conditions and measures related to municipal sewage treatment plant

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

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

Conditions and measures related to external treatment of waste for disposal

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

Hazardous wastes from onsite risk management measures and solid or liquid wastes from produc and cleaning processes should be disposed of separately to hazardous waste incineration plants or waste landfills as hazardous waste. Releases to the floor, water and soil are to be prevented. If the zin of the waste is elevated enough, internal or external recovery/recycling might be considered.

Fraction of daily/annual use expected in waste:

zinc producers = 3.1 %

zinc compound producers = 0.056 %

downstream users = 0.30 %

Appropriate waste codes:

02 01 10*, 06 03 13*, 06 03 14, 06 03 15*, 06 04 04*, 06 04 05*, 06 05 02*, 08 01 11*, 10 05 01, 10
10 05 05*, 10 05 06*, 10 05 11, 10 05 99, 10 10 03, 10 10 05*, 10 10 07*, 10 10 09*, 10 10 10, 10
11 01 09*, 11 02 02*, 11 02 03, 11 02 07*, 12 01 03*, 12 01 04, 12 01 12*, 15 01 4*, 15 01 10*, 15
16 01 04*, 16 01 06*, 16 01 18*, 16 06 02*, 16 08 02*, 16 08 03*, 16 11 02, 16 11 03*, 16 11 04, 1
17 04 07*, 17 04 09*, 17 09 04*, 19 02 05*, 19 10 02*, 19 12 03*

Suitable disposal: Keep separate and dispose of to either

Hazardous waste incineration operated according to Council Directive 2008/98/EC on Directive 2000/76/EC on the incineration of waste and the Reference Document on the Best Techniques for Waste Incineration of August 2006.

Hazardous landfill operated under Directive 1999/31/EC.

A detailed assessment has been performed and is reported in the Waste report (ARCHE, 2012) (See Annex 1)

Conditions and measures related to external recovery of waste

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

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

9.1.5.2 Contributing scenario (2) controlling worker exposure for the Industrial use of $ZnSO_4$ or $ZnSO_4$-formulations as component for the manufacture of solid blends and matrices for further downstream use.

Name of contributing scenario 2:

Industrial formulation of dry preparations/mixtures by mixing thoroughly the $ZnSO_4$ (or other zinc compounds) with the other starting materials, with possible pressing, pelletising, sintering and packaging of the preparations/mixtures

Product characteristic

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

- The concentration of $ZnSO_4$ in the mixtures can be up to >25% but is usually of the order of <= 5%, depending on the application.
- A particle size distribution for the $ZnSO_4$ - heptahydrate shows a very coarse product (mean diameter > 500 µ, 99% > 100 µ), while the monohydrate has a broad particle size distribution with a mean diameter of 170 µ, 14% < 10 µ and 6% < 5 µ (RA ZnSO4).
- A study of dustiness, using the modified Heubach method, that includes a multi-stage impactor to separate different aerosol fractions, shows a total dustiness of 26.7 mg/g for monohydrate and 0.25 for hexahydrate. For monohydrate 92.11 % of the generated dust is larger than 8.13 µm and 79.85 % larger than 15.8 µm. For hexahydrate 97.02 % of the generated dust is larger than 8.13 µm and 85.01 % larger than 15.8 µm. For comparison, the total dustiness of zinc oxide is 30 mg/g with 84.53% larger than 8.13 µm and 73.92 % larger than 15.8 µm (Deutsche Montan Technologie GmbH, 2000).
- The preparation is in the solid state, usually with a low level of dustiness; however, powder forms can occur, the high dustiness is therefore applied as a worst case.

Amounts used

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

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

Frequency and duration of use/exposure

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

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

Human factors not influenced by risk management

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

Uncovered body parts: (potentially) face

Other given operational conditions affecting workers exposure

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

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

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

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

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

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

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

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

Organisational measures to prevent /limit releases, dispersion and exposure

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

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

Such management system would include general industrial hygiene practice e.g.:

- information and training of workers on prevention of exposure/accidents,
- procedures for control of personal exposure (hygiene measures)
- regular cleaning of equipment and floors, extended workers instruction-manuals
- procedures for process control and maintenance,...
- personal protection measures (see below)

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

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

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

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

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

-dust filter-half mask P2 (efficiency 90%)
-dust filter-half mask P3 (efficiency 95%)
-dust filter-full mask P1 (efficiency 75%)
-dust filter-full mask P2 (efficiency 90 %)
-dust filter-full mask P3 (efficiency 97.5%)
Eyes: safety glasses are optional

9.1.6. GES ZnSO4-5: Industrial use of ZnSO4 or ZnSO4-formulations as component for the manufacture of dispersions, pastes or other viscous or polymerized matrices.

Table 8. GES ZnSO4-5

Exposure Scenario Format (1) addressing uses carried out by workers
9.1.6 Title of Exposure Scenario number GES $ZnSO_4$ -5 : Industrial use of $ZnSO_4$ or $ZnSO_4$-formulations as component for the manufacture of dispersions, pastes or other viscous or polymerized matrices.
List of all use descriptors related to the life cycle stage and all the uses under it; include market sector (by PC), if relevant; ***SU: 3,4, 5, 6b, 7, 8, 9, 10, 18, 20*** ***PROC: 1, 2,3,4,5,6,8b,9,10, 13, 14,15*** ***PC:, 2, 8, 9a, 9b, 12, 14, 15, 18, 19, 20, 21, 23, 24, 25, 28, 29, 32, 34, 35, 39, 40*** ***AC: 1,2,7*** ***ERC: 1,2,3,4, 5,6a, 6b, 6d, 8a, 8b, 8d, 9a, 9b, 10a, 10b, 11a***
Further explanations (if needed)
9.1.6 Exposure Scenario
9.1.6.1 Contributing scenario (1) controlling environmental exposure for the industrial use of $ZnSO_4$ or $ZnSO_4$-formulations as component for the manufacture of dispersions, pastes or other viscous or polymerized matrices.
Name of contributing scenario
Further specification: In the described process, the zinc sulphate containing preparation/mixture is: • unpacked and stored in silos • Extracted from the silo, dosed and fed with the other reagents and/or solvents to the mixing tank, batch-wise or continuously, according the process receipt. • The resulting zinc salt containing mixture (solution, dispersion, paste) is directly further processed, or packed, for further treatment/use.
Product characteristics
Product related conditions: $ZnSO_4$ in preparation can be > 25%
Amounts used
Daily and annual amount per site: maximum 5000 T/y;
Frequency and duration of use
Continuous production is assumed as a worst case. It is possible that use is not continuous; this has to be considered when estimating exposure.
Environment factors not influenced by risk management
Flow rate of receiving surface water: default for generic scenario: 18,000 m3/d, unless specified otherwise
Other given operational conditions affecting environmental exposure
Other given operational conditions: e.g. technology or process techniques determining the initial release of substance from process (via air and waste water); dry or water based processes; conditions related to temperature and pressure; indoor or outdoor use of products; work in confined area or open air; • In parallel, non-process water can be generated containing zinc (e.g. from cleaning) • All processes are performed indoor in a confined area.

- All residues containing zinc are recycled.

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

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

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

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

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

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

Organizational measures to prevent/limit release from site

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

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

Conditions and measures related to municipal sewage treatment plant

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

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

Conditions and measures related to external treatment of waste for disposal

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

Hazardous wastes from onsite risk management measures and solid or liquid wastes from produc and cleaning processes should be disposed of separately to hazardous waste incineration plants or waste landfills as hazardous waste. Releases to the floor, water and soil are to be prevented. If the zin of the waste is elevated enough, internal or external recovery/recycling might be considered.

Fraction of daily/annual use expected in waste:

zinc producers = 3.1 %

zinc compound producers = 0.056 %

downstream users = 0.30 %

Appropriate waste codes:

02 01 10*, 06 03 13*, 06 03 14, 06 03 15*, 06 04 04*, 06 04 05*, 06 05 02*, 08 01 11*, 10 05 01, 10 10 05 05*, 10 05 06*, 10 05 11, 10 05 99, 10 10 03, 10 10 05*, 10 10 07*, 10 10 09*, 10 10 10, 10 11 01 09*, 11 02 02*, 11 02 03, 11 02 07*, 12 01 03*, 12 01 04, 12 01 12*, 15 01 4*, 15 01 10*, 15 16 01 04*, 16 01 06*, 16 01 18*, 16 06 02*, 16 08 02*, 16 08 03*, 16 11 02, 16 11 03*, 16 11 04, 17 04 07*, 17 04 09*, 17 09 04*, 19 02 05*, 19 10 02*, 19 12 03*

Suitable disposal: Keep separate and dispose of to either

Hazardous waste incineration operated according to Council Directive 2008/98/EC on Directive 2000/76/EC on the incineration of waste and the Reference Document on the Best Techniques for Waste Incineration of August 2006.

Hazardous landfill operated under Directive 1999/31/EC.

A detailed assessment has been performed and is reported in the Waste report (ARCHE, 2012) (See Annex 1)

Conditions and measures related to external recovery of waste

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

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

9.1.6.2 Contributing scenario (2) controlling worker exposure for the industrial use of $ZnSO_4$ or $ZnSO_4$-formulations as component for the manufacture of dispersions, pastes or other viscous or polymerized matrices.

Product characteristic

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

- The concentration of $ZnSO_4$ in the mixtures can be >25%, depending on the application.
- A particle size distribution for the $ZnSO_4$ - heptahydrate shows a very coarse product (mean diameter > 500 µ, 99% > 100 µ), while the monohydrate has a broad particle size distribution with a mean diameter of 170 µ, 14% < 10 µ and 6% < 5 µ (RA ZnSO4).
- A study of dustiness, using the modified Heubach method, that includes a multi-stage impactor to separate different aerosol fractions, shows a total dustiness of 26.7 mg/g for monohydrate and 0.25 for hexahydrate. For monohydrate 92.11 % of the generated dust is larger than 8.13 µm and 79.85 % larger than 15.8 µm. For hexahydrate 97.02 % of the generated dust is larger than 8.13 µm and 85.01 % larger than 15.8 µm. For comparison, the total dustiness of zinc oxide is 30 mg/g with 84.53% larger than 8.13 µm and 73.92 % larger than 15.8 µm (Deutsche Montan Technologie GmbH, 2000)
- The preparation is in the liquid state, as a paste or dispersion or other viscous or polymerized matrix, with a low level of dustiness; however, powder forms can occur, medium dustiness is therefore applied as a worst case

Amounts used

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

Max 5000T/y = 20 T/d = 7 T/shift depending of application.

Frequency and duration of use/exposure

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

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

Human factors not influenced by risk management

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

Uncovered body parts: (potentially) face

Other given operational conditions affecting workers exposure

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

- Wet processes
- All indoor processes in confined area.

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

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

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

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

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

- Local exhaust ventilation systems and process enclosures are generally applied
- Cyclones/filters (for minimizing dust emissions): efficiency 70%-90% (cyclones); dust filters (50-80%)
- LEV in work area: generic LEV (efficiency 84%) is considered worst case; higher efficiencies are usual.

Organisational measures to prevent /limit releases, dispersion and exposure

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

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

Such management system would include general industrial hygiene practice e.g.:

- information and training of workers on prevention of exposure/accidents,
- procedures for control of personal exposure (hygiene measures)
- regular cleaning of equipment and floors, extended workers instruction-manuals
- procedures for process control and maintenance,...
- personal protection measures (see below)

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

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

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

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

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

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

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

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

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

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

9.1.7. GES ZnSO4- 6 : Industrial and professional use of solid substrates containing less than 25%w/w of ZnSO4.

Table 9. GES ZnSO4-6

Exposure Scenario Format (1) addressing uses carried out by workers
9.1.7. Title of Exposure Scenario number GES $ZnSO_4$ - 6 : Industrial and professional use of solid substrates containg less than 25%w/w of $ZnSO_4$.
List of all use descriptors related to the life cycle stage and all the uses under it; include market sector (by PC), if relevant; ***SU: 3, 5, 6b, 9,10, 22*** ***PROC: 4, 5 ,6, 8b, 9,10, 11,13, 19*** ***PC: 1, 8, 9a, 9b, 9c,14,15, 18, 20, 21, 28, 29, 35, 39*** ***AC: 0 (coatings for art and creative items)*** ***ERC: 8a, 8d, 10a, 11a***
9.1.7 Exposure Scenario
9.1.7.1 Contributing scenario (1) controlling environmental exposure for the Industrial and professional use of solid substrates containg less than 25%w/w of $ZnSO_4$.
Further specification: This scenario covers both the industrial scale processes and professional use. In the described process, the $ZnSO_4$ containing preparation/mixture is further processed, involving potentially the following steps: • Reception/unpacking of material • Final application, embedding, or shaping to produce the end product or article.
Product characteristics
Product related conditions: $ZnSO_4$ (or Zn compound) in the article is < 25%
Amounts used
Daily and annual amount per site: • The quantities involved in this scenario are 10-50 times smaller than in blending (GES 4-GES 5); the concentration of the zinc substance is also lower (<25%). • Typical quantities for both Industrial and professional are 50T/y (typical), maximum 500T/y (in industrial setting).
Frequency and duration of use
Continuous production is assumed as a worst case. Usually, use is not continuous; this has to be considered when estimating exposure.
Environment factors not influenced by risk management
Flow rate of receiving surface water: default for generic scenario: 18,000 m3/d, unless specified otherwise
Other given operational conditions affecting environmental exposure
Other given operational conditions: e.g. technology or process techniques determining the initial release of substance from process (via air and waste water); dry or water based processes; conditions related to temperature and pressure; indoor or outdoor use of products; work in confined area or open air; • Solid, so in principle all dry processes throughout, no process waters. Even when no process waters occur (with dry process throughout), some non-process water can be generated containing zinc (e.g. from cleaning) • In industrial and professional setting, all processes are performed indoor in a confined area. All residues containing zinc are recycled.

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

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

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

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

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

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

Organizational measures to prevent/limit release from site

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

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

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

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

Conditions and measures related to municipal sewage treatment plant

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

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

Conditions and measures related to external treatment of waste for disposal

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

- At industrial scale:

Hazardous wastes from onsite risk management measures and solid or liquid wastes from produc and cleaning processes should be disposed of separately to hazardous waste incineration plants or

waste landfills as hazardous waste. Releases to the floor, water and soil are to be prevented. If the zin of the waste is elevated enough, internal or external recovery/recycling might be considered.

Fraction of daily/annual use expected in waste:

zinc producers = 3.1 %

zinc compound producers = 0.056 %

downstream users = 0.30 %

Appropriate waste codes:

02 01 10*, 06 03 13*, 06 03 14, 06 03 15*, 06 04 04*, 06 04 05*, 06 05 02*, 08 01 11*, 10 05 01, 1
10 05 05*, 10 05 06*, 10 05 11, 10 05 99, 10 10 03, 10 10 05*, 10 10 07*, 10 10 09*, 10 10 10, 1
11 01 09*, 11 02 02*, 11 02 03, 11 02 07*, 12 01 03*, 12 01 04, 12 01 12*, 15 01 4*, 15 01 10*, 1
16 01 04*, 16 01 06*, 16 01 18*, 16 06 02*, 16 08 02*, 16 08 03*, 16 11 02, 16 11 03*, 16 11 04, 1
17 04 07*, 17 04 09*, 17 09 04*, 19 02 05*, 19 10 02*, 19 12 03*

Suitable disposal: Keep separate and dispose of to either

Hazardous waste incineration operated according to Council Directive 2008/98/EC on Directive 2000/76/EC on the incineration of waste and the Reference Document on the Best Techniques for Waste Incineration of August 2006.

Hazardous landfill operated under Directive 1999/31/EC.

A detailed assessment has been performed and is reported in the Waste report (ARCHE, 2012) (See Annex 1)

- At professional scale:

Fraction of daily/annual use expected in waste: 42% of all articles, 58% of the zinc used is recycled.

Appropriate waste codes:
20 01 34, 20 01 40, 20 03 01, 20 03 07

Suitable Disposal:
Waste from end-of-life articles can be disposed of as municipal waste, except when they are separately regulated, like electronic devices, batteries, vehicles, etc.

Disposal of wastes is possible via incineration (operated according to Directive 2000/76/EC on the incineration of waste) or landfilling (operated according to Reference Document on the Best available Techniques for Waste Industries of August 2006 and Council Directive 1999/31/EC and Council Decision 19 December 2002).

A detailed assessment has been performed and is reported in the Waste report (ARCHE, 2012) (See Annex 1)

Conditions and measures related to external recovery of waste

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

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

9.1.7.2 Contributing scenario (2) controlling worker exposure for the Industrial and professional use of solid substrates containg less than 25%w/w of $ZnSO_4$.

Product characteristic

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

The concentration of $ZnSO_4$ (or Zn compound) in the mixture is < 25%

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

Amounts used

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

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

Frequency and duration of use/exposure

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

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

Human factors not influenced by risk management

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

Uncovered body parts: (potentially) face

Other given operational conditions affecting workers exposure

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

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

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

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

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

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

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

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

Organisational measures to prevent /limit releases, dispersion and exposure

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

In general, management systems are implemented; They include general industrial hygiene practice e.g.:

- information and training of workers on prevention of exposure/accidents,
- procedures for control of personal exposure (hygiene measures)

- regular cleaning of equipment and floors, extended workers instruction-manuals
- procedures for process control and maintenance,...
- personal protection measures (see below)

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

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

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

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

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

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

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

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

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

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

Eyes: safety glasses are optional

9.1.8. GES ZnSO4-7 : Industrial and professional use of dispersions, pastes and polymerised substrates containing less than 25%w/w of ZnSO4.

Table 10. GES ZnSO4-7

Exposure Scenario Format (1) addressing uses carried out by workers
9.1.8 Title of Exposure Scenario number GES $ZnSO_4$ - 7 : Industrial and professional use of dispersions, pastes and polymerised substrates containing less than 25%w/w of $ZnSO_4$.
List of all use descriptors related to the life cycle stage and all the uses under it; include market sector (by PC), if relevant; ***SU: 9, 20,22*** ***PROC: 8b, 9, 10, 11, 13,*** ***PC: 8, 20, 21,28, 29, 35, 39*** ***AC: na*** ***ERC: 8a***
9.1.8 Exposure Scenario
9.1.8.1 Contributing scenario (1) controlling environmental exposure for the Industrial and professional use of dispersions, pastes and polymerised substrates containing less than 25%w/w of $ZnSO_4$.
Further specification: This scenario covers both the industrial scale processes and professional use. In the described process, the $ZnSO_4$ containing preparation/mixture is further processed, involving potentially the following steps: • Reception/unpacking of material • Final application, spraying, embedding or to produce the end product or article.
Product characteristics
Product related conditions: $ZnSO_4$ (or Zn compound) in the article is < 25%
Amounts used
Daily and annual amount per site: • The quantities involved in this scenario are 10-50 times smaller than in blending (GES 4-GES 5); the concentration of the zinc substance is also lower (<25%). • Typical quantities for both industrial and professional are 50T/y (typical), maximum 500T/y (in industrial setting).
Frequency and duration of use
Continuous production is assumed as a worst case. Usually, use is not continuous; this has to be considered when estimating exposure.
Environment factors not influenced by risk management
Flow rate of receiving surface water: default for generic scenario: 18,000 m3/d, unless specified otherwise
Other given operational conditions affecting environmental exposure
Other given operational conditions: e.g. technology or process techniques determining the initial release of substance from process (via air and waste water); dry or water based processes; conditions related to temperature and pressure; indoor or outdoor use of products; work in confined area or open air; • Wet processes. All process and non-process waters should be recycled internally to a maximal extent. Even when no process waters occur, some non-process water can be generated containing zinc (e.g. from cleaning) • In industrial and professional setting, all processes are performed in a confined area. All residues containing zinc are recycled.

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

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

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

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

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

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

Organizational measures to prevent/limit release from site

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

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

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

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

Conditions and measures related to municipal sewage treatment plant

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

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

Conditions and measures related to external treatment of waste for disposal

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

- At industrial scale:

Hazardous wastes from onsite risk management measures and solid or liquid wastes from produc and cleaning processes should be disposed of separately to hazardous waste incineration plants or waste landfills as hazardous waste. Releases to the floor, water and soil are to be prevented. If the zin of the waste is elevated enough, internal or external recovery/recycling might be considered.

Fraction of daily/annual use expected in waste:

zinc producers = 3.1 %

zinc compound producers = 0.056 %

downstream users = 0.30 %

Appropriate waste codes:

02 01 10*, 06 03 13*, 06 03 14, 06 03 15*, 06 04 04*, 06 04 05*, 06 05 02*, 08 01 11*, 10 05 01, 1
10 05 05*, 10 05 06*, 10 05 11, 10 05 99, 10 10 03, 10 10 05*, 10 10 07*, 10 10 09*, 10 10 10, 1
11 01 09*, 11 02 02*, 11 02 03, 11 02 07*, 12 01 03*, 12 01 04, 12 01 12*, 15 01 4*, 15 01 10*, 15
16 01 04*, 16 01 06*, 16 01 18*, 16 06 02*, 16 08 02*, 16 08 03*, 16 11 02, 16 11 03*, 16 11 04, 1
17 04 07*, 17 04 09*, 17 09 04*, 19 02 05*, 19 10 02*, 19 12 03*

Suitable disposal: Keep separate and dispose of to either

Hazardous waste incineration operated according to Council Directive 2008/98/EC on Directive 2000/76/EC on the incineration of waste and the Reference Document on the Best Techniques for Waste Incineration of August 2006.

Hazardous landfill operated under Directive 1999/31/EC.

A detailed assessment has been performed and is reported in the Waste report (ARCHE, 2012) (See Annex 1)

- At professional scale:

Fraction of daily/annual use expected in waste: 42% of all articles, 58% of the zinc used is recycled.

Appropriate waste codes:
20 01 34, 20 01 40, 20 03 01, 20 03 07

Suitable Disposal:
Waste from end-of-life articles can be disposed of as municipal waste, except when they are separately regulated, like electronic devices, batteries, vehicles, etc.

Disposal of wastes is possible via incineration (operated according to Directive 2000/76/EC on the incineration of waste) or landfilling (operated according to Reference Document on the Best available Techniques for Waste Industries of August 2006 and Council Directive 1999/31/EC and Council Decision 19 December 2002).

A detailed assessment has been performed and is reported in the Waste report (ARCHE, 2012) (See Annex 1)

Conditions and measures related to external recovery of waste

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

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

9.1.8.2 Contributing scenario (2) controlling worker exposure for the Industrial and professional use of dispersions, pastes and polymerised substrates containing less than 25%w/w of $ZnSO_4$.

Product characteristic

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

The concentration of $ZnSO_4$ (or Zn compound) in the mixture is < 25%

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

Amounts used

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

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

Frequency and duration of use/exposure

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

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

Human factors not influenced by risk management

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

Uncovered body parts: (potentially) face

Other given operational conditions affecting workers exposure

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

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

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

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

- Industrial /professional
    - Local exhaust ventilation on work areas with potential dust generation, dust capturing and removal techniques
    - Process enclosures where appropriate
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Technical conditions and measures to control dispersion from source towards the worker

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

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

Organisational measures to prevent /limit releases, dispersion and exposure

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

In general, management systems are implemented; They include general industrial hygiene practice e.g.:

- information and training of workers on prevention of exposure/accidents,
- procedures for control of personal exposure (hygiene measures)
- regular cleaning of equipment and floors, extended workers instruction-manuals
- procedures for process control and maintenance,...
- personal protection measures (see below)

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

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

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

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

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

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

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

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

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

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

Eyes: safety glasses are optional